The Morphosyntactic Parser

Developing and testing a sentence processor that uses underspecified morphosyntactic features

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Contents

0 Introduction

Probably unexpected but—if done well—first year classes bear the potential to spark a student's quiet interest to such an extent that they decide to pursue a presumably insignificant insight from a very early stage of their career and make it the main focus of their PhD dissertation. This is the case for the present thesis despite the fact that its research topic and associated linguistic subfield have filled shelves of literature since first being under investigation decades ago. Yet, however, a specific question remains still unanswered despite this abundance of literature. The following paragraphs will reveal this research gap and set up the present dissertation.

When attending "Introduction into German Linguistics" at the Johannes Gutenberg University Mainz, for the first time a structure like (1) identified itself as having more than one reading. In this example, due to German's morphosyntax, it is either the ambassador who visited the minister or, the other way around, the minister who visited the ambassador.

(1) Die Botschafterin besuchte die Ministerin.
the ambassador visited the minister
"The ambassador/minister visited the minister/ambassador."

It was this revelation that sparked my interest in incremental sentence comprehension. Why did I and my fellow students immediately assume that the first argument, the ambassador, performed the visit? What was it that promoted one reading and inhibited the other respectively? Why did we not think of the other meaning?

However, at that time I figured that there might be more to this. Maybe it was related to the way the language comprehender understood the individual elements that allowed for multiple readings. There had to be substantial properties in one's mind about those elements—or, as it later turned out, rather the precise lack of them—that allowed linguistic elements to be ambiguous. Some semesters later, I attended a class on morphology where the determiner *die* from example (1) and I met again. In this context, I have learned that the phenomenon allowing for the determiner's special characteristics is called "syncretism". Also, I have acquired the tools to capture the theoretical nature of this determiner, namely underspecification. This gave me another insight: The morphosyntactic information that constitutes this very determiner lacks uniqueness. The determiner *die*'s properties allow for insertion into both scenarios of visiting in (1). Conversely, in a hypothetical scenario that avoids the sentence's equivocalness in the first place, the assumption of two phonologically different forms replacing *die* would be necessary.[1] However, German supplies exactly one form that appears to be adequate in

[1]Obviously, these two hypothetical forms would also have to be distinct from the other available

the contexts described for example (1), namely *die*. At the same time of the morphology course, I participated in a psycholinguistics class in which the pieces came together. The language comprehender's interpretation of syncretic elements causes the syntactic undecidability of *die* to be necessarily associated with its equally undecided mental representation. In fact, the inversion of this argument, namely that *die* is never vague but rather always univocal, would entail (1) to be unambiguous or ungrammatical in case of a wrongly chosen *die* alternative. Over the course of my studies, I entertained the idea that the morphology of lexical elements provided properties that intersected with other elements or distinguished them from one another and that this information was used during language processing.

This anecdotal excursion shall be concluded with the prospect that the present thesis seeks to provide different and new answers to the aforementioned questions that occurred in the linguistics class. To do so, I will argue for morphosyntax to effectively provide some kind of fine-grained information and that language comprehenders make use of it. The remainder of the Introduction will state the dissertation's aim and its structure in more detail.

0.1 Aim of the Thesis

To support the claim that morphosyntax is important for language processing, this dissertation seeks to devise a parsing mechanism[2] that incorporates underspecified morphosyntactic features to build up an analysis of structures like example (1). Three issues are being derived over the course of the investigation in the quest to evaluate the explanatory power of the proposed parsing system. Thus, they serve as the thesis' guiding threads.

The first issue is concerned with elements that entail multiple meanings. To be precise, the issue refers to the processes taking place at the transition from one syncretic element to another inflected word. Returning to example (1), it is necessary to describe what happens at the contact point of the determiner *die* and the subsequent noun. Can this transition give insights into why one of the aforementioned multiple readings is favored over another? Is it possible to predict which interpretation is more likely to be supported and which one is rather inhibited?

The insights that are gained by addressing the first issue will be modulated by the tools that allow to describe the aforementioned phenomenon of multiple interpretations of homophonous words. As indicated above, the means of choice to capture this phenomenon is the so-called underspecification. It will be interesting to see whether the

determiners of the respective paradigm.

[2]Note that the use of the term "parser" does not entail the proposed system to be implemented as an algorithm like in a computational or computer-linguistic framework. Chapter 4 will lay out in great detail what the devised system is capable of, what it does and what it does not. Henceforth, the term "parser" will be used to describe the mechanism that incrementally incorporates underspecified morphosyntactic features to build up an analysis. "Parser", "(parsing) system", "(parsing) mechanism" and "(parsing) model" will be used interchangeably.

implications of the insights into the preceding issue are altered by different underspecification approaches. Therefore, the second issue is concerned with whether there are more and less appropriate ways to capture syncretism. Are there approaches that lead to ungrammatical contact points? Do some approaches increase or decrease the number of ambiguity?

The third and final issue concerns the language comprehender's preference that guides the analyses of ambiguous structures. As it was the case before, the assessments of both preceding issues will modulate the insights into the third issue. It has to be investigated whether a processing preference can be implemented into the proposed parsing system and whether doing so provides any further explanatory insights. These three issues can be translated into the following questions:

Question 1: How can word transition be described?

Question 2: Which method to capture syncretism is more appropriate?

Question 3: Should a guiding preference be assumed?

It is essential to raise these questions as their insights directly influence the design of the to be devised parsing mechanism. In turn, the proposed parser shall be able to maneuver through these issues when analyzing a structure, eventually ending up with a grammatical interpretation of a sentence as in (1). If successful, the present dissertation contributes a processing model that relies on morphosyntactic features rather than hierarchical structure building.

0.2 Structure of the Thesis

To achieve this goal, the thesis' theoretical claims have to be experimentally validated. Thus, the present investigation is divided into a Theoretical Part I and an Experimental Part II. The first part's theoretic assumptions about the proposed parsing mechanism is verified or falsified by the second part.

In order to recognize the parallelism between morphosyntactic information and its role in language processing, one has to step back and elaborate on the aforementioned tools to capture inflected elements. Correspondingly, Chapter 1 introduces reason why both *die* determiners in (1) look identical but stand for different morphosyntactic environments. In Sections 1.1.1 and 1.1.2, theories about the inflectional architecture set the stage in order to discuss the phenomenon of collapsing inflectional forms—syncretism—in Section 1.1.3. This phenomenon is accounted for by means of underspecification in Section 1.1.4. The subsequent Section 1.2 details various underspecification approaches on how to describe syncretic inflected elements. Section 1.3 concludes the chapter by hinting at a crucial association between lexical material and its underspecified representation.

The subsequent Chapter 2 provides insights into the question to which extent the theoretic modeling of inflection from the preceding chapter bears any meaning for language processing. A selection of studies is presented that investigate underspecification in the mental lexicon. Two morphological principles seem crucial not only in theoretical descriptions but also in language comprehension: A priming experiment presented in Section 2.1 elaborates on the specificity principle and how it selects lexical forms. In contrast to that, another reaction-time experiment in Section 2.3 investigates the compatibility principle. Both aspects are brought together in an electrophysiological experiment presented in Section 2.4. Along similar studies, the experiments' verdict is that morphosyntactic underspecification is relevant for language processing indeed. The chapter concludes with a brief sketch of a parsing mechanism that makes use of underspecified morphosyntactic features in Section 2.7.

Recall from (1) that the structure allows for two readings. This syntactic ambiguity is crucially associated with the morphology of the two argument determiner phrases (henceforth DP(s)). In particular, it is the syncretism around the *die* determiner that realizes a nominative DP on the one hand but also an accusative DP on the other hand. As it is laid out in Chapter 1, this property can be traced back to underspecification. Consequently, Chapter 3 draws the connection between the assumption that underspecification plays a role in language comprehension and the processing of syntactic ambiguities. Therefore, various empirical investigations are discussed. In Section 3.1, the idea of a preference guiding syntactic analyses is introduced. Apart from that, the studies cited in Sections 3.2 to 3.5 ultimately all neglect the aspect of morphosyntactic underspecification in favor of structural reasons which can account for subject-object ambiguities. In that sense, the notion of minimality in structure-building can be exposed as a common denominator of the presented literature.

Chapter 4 performs the pivotal task of combining the prior chapters: the findings on the processing of morphosyntactic underspecification from Chapter 2 with the insights into structural ambiguity from Chapter 3. The result is a unifying, sophisticated system that incrementally processes morphosyntactic features in order to build up a larger analysis. Section 4.1 defines the foundations of the parser while Section 4.2 meticulously delineates and exemplifies its internal mechanics. Afterwards, the mechanism is provisionally tested against the literature from the preceding two chapters to demonstrate that it can cope with existing claims on underspecification and structural ambiguities.

Eventually, the newly designed parser is fully put to the test in Chapter 5. In this section, the mechanism analyzes subject-object ambiguities under the assumption of differently specified elements. In order to do so, Section 5.1 collects all the feature specifications for the initially introduced underspecification approaches. Subsequently, in Section 5.2, the proposed parser calculates the outcomes of four structural ambiguities for the aforementioned four underspecification models. The resulting outcomes are summarized and compared in Section 5.3.

The system's parsing claims represent the basis for the hypotheses of the Experimental Part II of the present thesis. Three experiments investigate subject-object ambiguities. The parser's and the experiments' outcomes are compared in order to decide whether the mechanism is able to make appropriate predictions. In order to do so, Chapter 7 seeks to investigate ambiguous DPs consisting of two elements (the determiner and the noun; henceforth "two-element DP(s)") in a first electrophysiological experiment. This method is described in Section 7.1. Subsequently, the parser's claims are transformed into concise hypotheses in Section 7.3. The idea is that the first DP-position, that is ambiguous, gets disambiguated by the DP-final second position. This allows for psycholinguistic insights into the contact point of both positions. The subsequent two experiments build upon the gained insights by gradually increasing the complicacy for the newly devised parsing mechanism to calculate hypotheses. Experiment 2 in Chapter 8 deals with DPs consisting of three elements (the determiner, the adjective and the noun; henceforth "three-element DP(s)") while Experiment 3 in Chapter 9 also tests three-element DPs which are on top of that ungrammatical. Sections 8.1 and 9.1 respectively, again, compile appropriate feature specifications for the selection of three-element DPs and ungrammatical DPs. The additional contact point as well as the switch to ungrammaticality allow for further insights into the transition from one DP-position to another. Eventually, the electrophysiological results of the three experiments decide on the proposed parsing mechanism's explanatory adequacy.

Chapter 10 puts the experimental data into perspective. It focusses on the puzzles that emerged from the obtained results. Certain shortcomings of the parsing mechanism are acknowledged Section 10.2. Addressing these issues, in turn, not only allows to point to presumably fruitful future investigations but also to link the proposed ideas of this dissertation to related research in another linguistic field. From thereon, Section 10.4 allows to finally decide on the system's explanatory adequateness. This section highlights the necessity of the ideas entertained in the present thesis by establishing the proposed parsing model as a valid alternative to adjacent processing approaches.

To conclude, Chapter 11 not only recapitulates the findings of this dissertation, but also bridges the gap to this Introduction.

Theoretical Part

1 Syncretism and Underspecification

This chapter's purpose is to establish the existence of a morphosyntactic level of information for lexical entries. These representations are assumed to be underspecified. Hence, the tool to capture syncretism—underspecification—will be introduced. To base these assumptions on theoretical grounds, inflectional models will be contrasted.

1.1 Theories on Morphology and Morphosyntax

Languages that exhibit inflection encode morphosyntactic properties on each inflected word (Stump, 2001, p. I). The association between inflectional elements and morphosyntactic properties has been subject to many theories on inflectional morphology. The subsequent sections, however, will be more concerned with the representational side and seek to briefly address theory-grounded models of how inflected elements can be represented and how morphosyntactic information is organized.

1.1.1 Associative inflectional models

In associative inflectional models, for example, the morphological structure of a particular word is not crucial to its production or perception. A model following this notion is the Satellite Model from Lukatela et al. (1980). According to it, inflected words are uniformly represented in associative, relational networks. By virtue of entrenched inflectional words, the mental lexicon shapes patterns that connect inflected word forms with one another. In this way, decentralized, terminal nodes of morphologically inflected word forms arrange themselves around a central root. This nucleus is labeled as the lexical base. All derivations are equally arranged as satellites around the core (Günther, 1989; Lukatela et al., 1987, 1980). With regard to nouns, nominative singular takes the core position while for verbs it is the non-finite present form. The model's basic architecture is depicted in Figure 1.1a[3] for the adjective *klein* ("small"). Its positive stem occupies the central position whereas other case, number and gender derivations are arranged around the nucleus. According to this model, all entries of a paradigm are represented as full forms. Therefore, the nucleus *klein* in Figure 1.1a inhabits a special status since lexical access should be fast. According to Günther (1989), lexical access to the core can occur directly or via satellites. In the latter case, a verification of the nucleus has

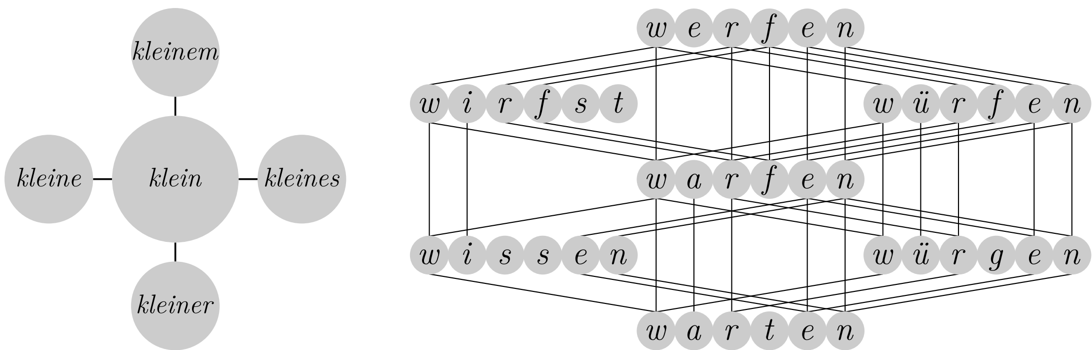
[3]Lukatela et al.'s (1980) Satellite Model (adapted from Clahsen et al., 2001, p. 512). The chosen shapes do not entail a claim about representational properties.

to be carried out. This additional step is—following Lukatela et al. (1980)—responsible for delayed recognition of inflected word forms.

In more recent developments on associative inflectional models, the strict separation of stem and inflectional forms is weakened. Instead, it is assumed that all word forms are stored independently of their morphological structure in networks. These clusters of highly interwoven words emerge due to associative phonological and semantic linking. The strength of individual connections arises from the frequency and similarity of the elements. Accordingly, phonologically related forms of various paradigms are connected and do not differ much morphologically. Therefore, no nucleus or central stem with special characteristics is assumed. As illustrated in Figure 1.1b[4], all inflectional elements have word form properties.

1.1.2 Combinatorial inflectional models

In comparison to associative inflectional models, combinatorial approaches argue for decomposed representations of words. According to this idea, morphologically complex units are separable into stems and affixes. The relations between regular affixes are subject to many morphological theories. Following Corbett and Fraser's (1993) Network Morphology, inflectional affixes or forms are organized in default inheritance trees. The access to one particular form is constrained by the architecture of the tree. An inheritance tree consists of non-terminal and terminal nodes which contain phonological and morphosyntactical information. All nodes are in a dominance relation to one another. Morphosyntactic properties are inherited from one node to another in a top-down fashion. In this way, every daughter node inherits the information of its mother node (Corbett and Fraser, 1993, pp. 119–120). An inheritance tree is built up from a least specified root to highly specific terminal leaves. In Figure 1.2, this position is occupied



(a) Satellite Model. (b) Decentralized word cluster.

Figure 1.1: Architectures of associative inflectional models.

[4]Decentralized word cluster for different forms of *werfen* (*wirfst*, *würfen*, *warfen*, "throw"), *wissen* ("know"), *würgen* ("choke") and *warten* ("wait") (adapted from Clahsen et al., 2001, p. 513). The chosen shapes do not entail a claim about representational properties.

by *die*. This root node contains nothing but its phonological form. As it has no further case, number or gender properties, it cannot pass on any information. However, the non-terminal node for *das* consists of gender and case information which it passes on to the *der* beneath. This *der* can inherit both features. Likewise, the terminal node *den* is then also able to inherit the properties of *das* through *der*. Therefore, the properties of **nonfem**, **nonobl**, **masc** and **acc** culminate in the terminal node *den*.

Contrary to this, Wunderlich's (1996) Minimalist Morphology assumes that the inflectional system is organized in paradigms that lack particular featural distinctions. In that sense, a particular paradigm is viewed as a multidimensional and possibly recursive matrix. Such an array is defined by the categorical morphosyntactic information by words and affixes, consists of slots that can be captured and is hence specified by morphosyntactic features. This setup is depicted in Table 1.1 for the inflectional paradigm of the German strong determiner. In this paradigm, grammatical information is stored in affixes like -$(e)m$ or -$(e)s$ that are suffixed to a stem. Expressing categorical information by means of phonological and thus morphological material is prominently referred to as "exponency" by Matthews (1991). Therefore, this mechanism is not limited to determiners.[5]

1.1.3 Syncretism

The inflectional paradigm in Table 1.1 neatly exhibits what Pott (1833) originally described as distinct forms that have fallen together. The phenomenon reveals "[o]ne of the most persistent and interesting problems at this syntax-morphology interface [...]. [...] [S]yncretism is the situation where the morphology 'lets down' the syntax" (Baerman et al., 2005, p. 1). Slowly returning to the peculiar starting example (1), the structure in (2)[6] (adapted from Schlesewsky et al., 2003b, p. 32) exhibits how German morphology

Table 1.1: Inflectional paradigm of the German strong determiner.

	SG			PL		
	M	N	F	M	N	F
NOM	*der*	*das*	*die*	*die*	*die*	*die*
ACC	*den*	*das*	*die*	*die*	*die*	*die*
DAT	*dem*	*dem*	*der*	*den*	*den*	*den*
GEN	*des*	*des*	*der*	*der*	*der*	*der*

[5]Notation: As the present thesis is neither concerned with the representational status of stems and affixes nor with their relation, the terms "exponent", "marker", "affix" and "form" will be interchangeably used to refer to the element that indicates grammatical categories. For a discussion on the status of exponency see Trommer (2012).

[6]Notation: For glosses and examples, the Leipzig Glossing Rules (Comrie et al., 2015) apply. The DPs' number information will not be glossed since not only do all determiners and nouns appear in singular but also is number information not important in this or following examples. If a recurrence to number becomes relevant, it will be duly noted and appropriately glossed.

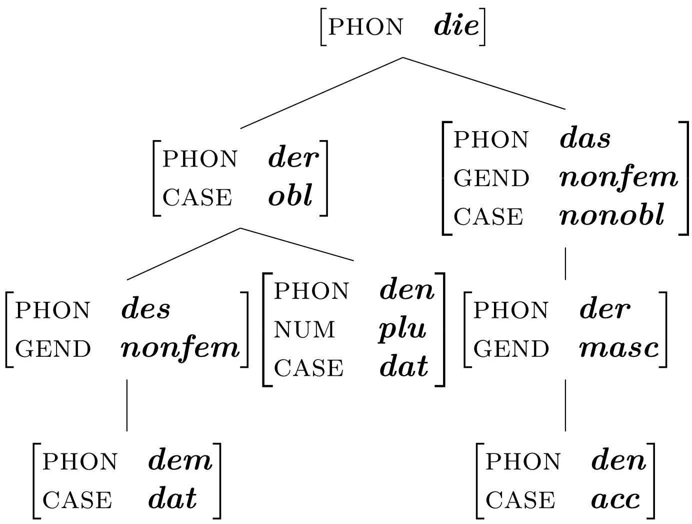


Figure 1.2: Default inheritance tree (Blevins, 1995, p. 145).

often does not let down syntax but satisfies it by "distinguish[ing] subject from object in its syntax" (Baerman et al., 2005, p. 1).

(2) Der Botschafter besuchte den Minister.
the.NOM.M ambassador.NOM.M visited the.ACC.M minister.ACC.M
"The ambassador visited the minister."

As can be seen in Table 1.1, the subject DP1 in (2) is introduced by *der* for nominative, while for the second DP *den* is used in order to realize an object in accusative case. Due to these case marking capabilities, German is not dependent on a strict word order, thus allowing for other, grammatically correct argument sequences. If the order of syntactic roles in (2) is reversed while maintaining the referents' positions, morphology still perfectly satisfies the syntax as (3) illustrates.

(3) Den Botschafter besuchte der Minister.
the.ACC.M ambassador.ACC.M visited the.NOM.M minister.NOM.M
"The minister visited the ambassador."

However, the morphology of German is imperfect insofar as it cannot be entirely mapped onto syntax in a one-to-one relationship. Consider both examples (2) and (3) but with a change of gender from masculine to feminine for their first DPs as in (4a) and (4b) respectively. Furthermore, changing both DPs' genders in either (2) or (3) from masculine to feminine finally results in the Introductions' example (1). This structure is repeated in (4c). The structures in (4) show that, by merely changing the gender of the arguments and therefore the gender of the determiners (see Table 1.1) within the same language and even the same examples, morphology is defective. In all three sentences, the first DP comprises identical elements: In the first two examples, the determiner *die* and the noun *Botschafterin* compose DPs that are either nominative or accusative feminine. Their grammatical function is not disambiguated until the subsequent univocally case-marked DP2. Note, however, that even the putative case unequivocalness of the disambiguating DPs is up to debate in the dissertation at hand. In fact, up to either determiner, all DPs with *der* and *den* are also ambiguous. The remainder of the thesis will give broader insights into this remark. Nevertheless, examples like (4) are commonly used by authors to describe so-called local or global ambiguity in (4a–4b) or (4c) respectively. In case of (4a), the local ambiguity of *die Botschafterin* eventually gets resolved toward an object in accusative, while the same elements make up a subject in nominative in (4b).

(4) a. Die Botschafterin besuchte den Minister.
the.NOM/ACC.F ambassador.NOM/ACC.F visited the.ACC.M minister.ACC.M
"The ambassador visited the minister."

b. Die Botschafterin besuchte der Minister.
the.NOM/ACC.F ambassador.NOM/ACC.F visited the.NOM.M minister.NOM.M
"The minister visited the ambassador."

c. Die Botschafterin besuchte die Ministerin.
the.NOM/ACC.F ambassador.NOM/ACC.F visited the.NOM/ACC.F minister.NOM/ACC.F
"The ambassador/minister visited the minister/ambassador."

Turning to (4c), the situation is more complex. In both consecutive DPs, the determiner *die* and a feminine noun are used, rendering the entire structure globally ambiguous. In this case, morphology indeed lets down syntax as both DPs can either be subject in nominative or object in accusative. The phenomenon that is exploited by these ambiguities and most visible in (4c), is called "syncretism". It is used to describe the instance of one inflectional form neglecting the one-to-one relation between morphology and syntax in morphologically rich languages. Instead, the form in question corresponds to multiple morphosyntactic contexts (Baerman, 2006). The term covers both a diachronic process and a synchronic state. With regard to the former, the distinction of two previously functionally different forms is neutralized insofar as the grammatical meaning, that was originally expressed by two separate forms, is eventually represented by one form only. Also, the term describes the synchronous state, in which one and the same form can express several functions (Luraghi, 2000). The present dissertation focuses on the synchronous state. This very condition can be aptly observed in Table 1.1. The paradigm provides 24 combinations of three grammatical categories: nominative, accusative, dative and genitive case; three genders with masculine, neuter and feminine; and two numbers, namely singular and plural. This yields 24 different syntactic spaces;

16 if gender is collapsed in plural. However, the paradigm's cells are occupied by only six phonologically distinct forms: *der*, *das*, *die*, *den*, *dem* and *des*. Each cell or inventory item corresponds to a combination of case, gender and number information and is filled with one of the aforementioned six forms. This leads to the inventory in Table 1.2.

Table 1.2: Inventory of the German strong determiner paradigm.

determiner		morphosyntactic context	determiner		morphosyntactic context	determiner		morphosyntactic context
der	↔	NOM.M.SG	*das*	↔	NOM.N.SG	*die*	↔	NOM.F.SG
den	↔	ACC.M.SG	*das*	↔	ACC.N.SG	*die*	↔	ACC.F.SG
dem	↔	DAT.M.SG	*dem*	↔	DAT.N.SG	*der*	↔	DAT.F.SG
des	↔	GEN.M.SG	*des*	↔	GEN.N.SG	*der*	↔	GEN.F.SG
die	↔	NOM.M.PL	*die*	↔	NOM.N.PL	*die*	↔	NOM.F.PL
die	↔	ACC.M.PL	*die*	↔	ACC.N.PL	*die*	↔	ACC.F.PL
den	↔	DAT.M.PL	*den*	↔	DAT.N.PL	*den*	↔	DAT.F.PL
der	↔	GEN.M.PL	*der*	↔	GEN.N.PL	*der*	↔	GEN.F.PL

However, this list obscures the probably systematic abundant use of homophonous forms mentioned above. For visualization, Table 1.3 highlights identical forms and reveals the syncretism fields. The form *das* spans over the contexts[7] nominative neuter singular and accusative neuter singular. The contexts nominative feminine singular, accusative feminine singular, nominative masculine plural, nominative neuter plural, nominative feminine plural, accusative masculine plural, accusative neuter plural and accusative feminine plural are represented by *die*. The determiner *der* occupies the cells of dative feminine singular, genitive feminine singular, genitive masculine plural, genitive neuter plural and genitive feminine plural. The contexts of dative masculine plural, dative neuter plural und dative feminine plural are expressed by *den*. Lastly, the determiner *des* is used in the contexts genitive masculine singular and genitive neuter singular. Non-systematically syncretic are the accidentally syncretic *der* in nominative masculine singular and *den* in accusative masculine singular. The paradigm in Table 1.1 shows that there is no one-to-one relation between phonological form and morphosyntactic function. If there were such an equivalence, every cell, hence every morphosynctactic context, would be represented by its own distinct form. In such a scenario, the globally ambiguous structure in (4c) would not exist since globally ambiguous structures would be ruled out. The more distinct an inflectional paradigm is with regard to its functional variance, the more markers exist in this very paradigm. Conversely, this implies that a paradigm affected by syncretism reduces its distinct forms. A logical conclusion is that the mental lexicon would also be able to save memory in case of syncretically stored paradigms:

[7]Notation: Morphosyntactic contexts are written out in continuous text: accusative masculine singular.

> [...] it is unlikely in the extreme that the language user explicitly represents the full inflectional paradigm [...]; it seems more reasonable to assume that [...] inflected forms are computed (deduced) from a single base form (or set of "principal parts" in highly inflected languages where multiple stems are needed to generate the full inflectional paradigm) on an as-needed basis. (Pollard and Sag, 1987, p. 210)

Table 1.3: Strong determiner paradigm.

	SG			PL		
	M	N	F	M	N	F
NOM	*der*	*das*	*die*	*die*	*die*	*die*
ACC	*den*	*das*	*die*	*die*	*die*	*die*
DAT	*dem*	*dem*	*der*	*den*	*den*	*den*
GEN	*des*	*des*	*der*	*der*	*der*	*der*

1.1.4 Underspecification

In this section, the notion of underspecification that is closely related to the term of syncretism shall be addressed. As it turns out, both concepts have their right to exist in associative as well as in combinatorial approaches. According to the former, all inflectional forms are represented in an over-articulated fashion. Therefore, redundant homonymy is a given in this approach. The issue of systematic differences of homonymous and non-homonymous forms is not central to the current question and, thus, shall not be discussed in the study at hand. Foreshadowing the empirical results of the cited literature below, the present thesis will primarily advocate the idea of combinatorial inflectional models. However, Opitz and Pechmann (2016) observed that concepts of syncretism and underspecification may basically be applicable to both associative and combinatorial models. They remarked that a variety of morphosyntactically and psycholinguistically motivated inflectional and derivational models employed categorical features:[8]

> Interestingly, they are all, in principle, compatible with more differentiated feature specifications. All that would be necessary is replacing categorical features by their decomposed (and underspecified) equivalent notations. (Opitz and Pechmann, 2016, p. 218)

Therefore, it is desirable to account for the over-articulated paradigm in Table 1.1 and its inventory in Table 1.2 by systematically capturing their syncretisms. Following

[8]With reference to inflectional paradigms, no case for or against one of the aforementioned approaches shall be made here.

the assumptions of combinatorial models described in Section 1.1.2, a system using unique distinctions only is to be preferred over one that is interspersed with redundant information. The goal then should be—if there are just five or six phonologically distinct forms—to find a system that captures all syntactic contexts by just using these five or six rather than 16 or 24 forms.

Underspecification seems to be an appropriate tool to capture syncretism. The term prominently originated in phonology as it was “adopted as a means of capturing cross-linguistic generalizations about markedness” (Inkelas, 2006, p. 225). With regard to phonology, underspecification “is the partial description of lexical entries, intermediate forms [...] or surface forms. Motivations for underspecification range from language-particular descriptive necessity to the desire to capture universal [...] generalizations” (Inkelas, 2006, p. 224). Since it is desirable to describe lexical items and their distributional properties within a paradigm, the notion of underspecification is also applicable to morphology. Furthermore, the distribution is assumed to be at least partially systematic and non-accidential. Therefore, underspecification is an eligible tool for revealing the morphosyntactic generalizations of syncretisms. These generalizations, hence a particular lexical element across various syntactic contexts, could be “defined by the absence of specification in any given form for features [...]. [U]nderspecification is the situation in which a [lexical entry] lacks a value in underlying or intermediate representation for a feature that it is specified for on the surface” (Inkelas, 2006, p. 224). Most famously, Jakobson (1932, 1936) developed the idea that the phenomenon of syncretism is determined by general principles which “could be used to explore the inner workings of morphosyntactic features” (Baerman, 2006, p. 363). For the Russian verbal and case system, Jakobson (1971) observed the fusion and collapse of forms within nominal paradigms (Jakobson, 1971, p. 69). Underspecification can accordingly be used to capture these fused forms with binary-valued [±FEATURES][9] that individual candidates may lack since a value in question is not necessary for the distinction of at least two homophonic forms. This results in the assumption that the morphosyntactic properties of a lexical element do not need to be fully and explicitly expressed. A marker becomes compatible with multiple morphosyntactic contexts due to its increasingly general morphosyntactic information.

1.2 The Underspecified German Strong Determiner

In this section, five systems shall be introduced that attempted to reduce the over-articulated 24-form inventory in Table 1.2 to merely eight, nine or even less forms by means of underspecification. The approaches were proposed by Bierwisch (1967), Blevins (1995), Wunderlich (1997b), Wiese (1999) and Müller (2002).[10] The last proposal aptly

[9]Notation: Within continuous text, a morphosyntactic feature is written in square brackets containing a binary ±value and the feature itself in SMALL CAPITALS. If one or more of these features attach to a reference word, say a determiner, it is written in *italics* and the feature or set is $_{\text{subscripted}}$, in square brackets and written in small capitals: *den*$_{[+\text{OBJ},\ -\text{OBL},\ +\text{M},\ -\text{F}]}$. This convention is maintained in examples and glosses where necessary.

[10]Notation: Since the thesis at hand will not cite any other publications by these researchers, there will be no confusion of additional references by the same authors. Hence and from hereon, the years

recapped the four other systems. Therefore, the thesis at hand will revert to Müller's individual descriptions when referring to the models of Bierwisch, Blevins, Wunderlich and Wiese. Whenever it seems appropriate, the approaches' portrayals will go beyond Müller's roundup. In addition to that, Müller also introduced his own approach on how to underspecify pronominal inflectional paradigms. It has to be noted that his approach as well as Bierwisch's and Wiese's were concerned with pronominal inflection, being the declensional paradigm of the demonstrative pronoun *dieser* ("this"), while Blevins' and Wunderlich's frameworks covered the paradigm of the German strong determiner. Since the present thesis is concerned with determiner inflection, related paradigms have to be adapted. This is rather unproblematic, since the paradigms of the strong determiner, the demonstrative pronoun and the strong adjective are identical with respect to the distribution of forms as all three of them inflect across the same cases, genders and numbers. Therefore, as the comparison in Table 1.4 shows, the three paradigms can be used interchangeably with regard to the implications of their internal paradigmatic distribution.[11]

Table 1.4: Comparison of the paradigms of the strong determiner, the demonstrative pronoun and the strong adjective *klein* ("small").

	SG			PL
	M	N	F	
NOM	*der* *dieser* *kleiner*	*das* *dieses* *kleines*	*die* *diese* *kleine*	*die* *diese* *kleine*
ACC	*den* *diesen* *kleinen*	*das* *dieses* *kleines*	*die* *diese* *kleine*	*die* *diese* *kleine*
DAT	*dem* *diesem* *kleinem*	*dem* *diesem* *kleinem*	*der* *dieser* *kleiner*	*den* *diesen* *kleinen*
GEN	*des* *dieses* *kleinen*	*des* *dieses* *kleinen*	*der* *dieser* *kleiner*	*der* *dieser* *kleiner*

The three underspecification approaches that dealt with pronominal inflection are Bierwisch, Wiese and Müller. The approaches will be translated into determiner inflection in order to be able to deal with consistent paradigms. The harmonization across

of their publications will be omitted for readability reasons. The mere authors' names will be used interchangeably to either refer to their frameworks or to the publications themselves. "Bierwisch" will then be used instead of "Bierwisch (1967)", "Blevins" instead of "Blevins (1995)", "Wunderlich" instead of "Wunderlich (1997b)", "Wiese" instead of "Wiese (1999)" and "Müller" instead of "Müller (2002)".

[11] The inflectional markers are identical for all cells across the three paradigms except for the strong adjective in genitive masculine singular and genitive neuter singular contexts. However, the mere distribution stays the same.

systems is also concerned with feature naming conventions. Table 1.5 shows the individual feature notations that the authors used in their respective approaches. Obviously, there is no uniform terminology. Bierwisch and Müller used [±Gov] and [±reg] (for *regiert*, "governed") respectively to refer to one of the two case features. Wiese usesd the same written-out distinction to describe the opposition "Objekt" ("object") versus "Nicht-Objekt" ("non-object"). Parallel to that was their use of a feature for oblique cases. Blevins used feature designations akin to Bierwisch's specifications but replaced a negative value with the written-out "*non*" and left a "+" value unexpressed. In addition to that, he also introduced special case features with "*dat*" and "*acc*" while he dispensed with any reference to an objective or governed feature. Nevertheless, his case specification could also be captured with a cross-classification like Bierwisch's, Wiese's or Müller's. Wunderlich adopted another way to decompose case that seems to not be compatible with the other approaches as he used "±hr" for accusative and "±lr" for dative and a combination of "±lr" and "±n" for genitive. Furthermore, Wiese captured [±M] with "Standard" versus "Non-Standard" and [±F] with "Spezial" ("special") versus "Non-Spezial".

Table 1.5: Comparison of different feature notation conventions.

Bierwisch (1967)	Blevins (1995)	Wunderlich (1997)	Wiese (1999)	Müller (2002)
[±Gov]	*acc* *dat*	[±h(igh) r(ole)]	Objekt Nicht-Objekt	[±reg(iert)]
[±Obl]	*obl* *nonobl*	[±l(ow) r(ole)] [±n(ominal)]	Oblique Nicht-Oblique	[±obl]
[±Masc]	*masc* *nonmasc*	[±m]	Standard Non-Standard	[±mask]
[±Fem]	*fem* *nonfem*	[±f]	Spezial Non-Spezial	[±fem]
[±Plur]	*plu* *nonplu*	[±pl]	–	–

Crucially, the distinctions are rather similar across the different approaches but do differ with respect to naming conventions and presence or absence of explicit binary features. In the present investigation, the models' features will be unified notationally for the sake of convenience. When paradigms or their respective inventories are discussed, the individual model's features will be—if necessary—renamed, put into square brackets, extended by ±values and written in small capitals to facilitate readability. Thus, in order to avoid a multitude of varying expressions denoting a particular information unit, the feature designations of [±OBJ], [±OBL], [±M], [±F] and [±PL] will be used across all approaches where possible. These labels are the feature designations of choice as they represent the common denominator in Table 1.5. Furthermore, this set has also been deployed in recent research (e.g., D. Brown et al., 2012; Müller et al., 2004; Opitz and Pechmann, 2014, 2016; Opitz et al., 2013; Penke et al., 2004).[12]

1.2.1 Classic feature decomposition

The first underspecification approach to be introduced is Bierwisch's. His system retained a traditional gender and number feature decomposition. The distinction between singular and plural was achieved by the binary feature of [±PL]. With regard to gender, masculine was specified as [+M, −F], feminine as [−M, +F] and neuter as [−M, −F]. Due to recognizing the gender neutralization in plural, he assumed that any gender feature was incompatible with a plural marking and vice versa. For case, Bierwisch did not suggest privative features but rather introduced a cross-classification of the abstract features [±OBJ] and [±OBL]. In this way, he decomposed nominative into [−OBJ, −OBL], accusative into [+OBJ, −OBL], dative into [+OBJ, +OBL] and genitive into [+OBJ, −OBL]. This allowed for the formation of natural classes across the four grammatical cases. The feature [−OBL] captured the structural cases nominative and accusative while [+OBL] covered the non-structural cases dative and genitive. Accordingly, [+OBJ] separated accusative and dative "which are always governed by verbs or prepositions" from nominative and genitive "which are not necessarily governed in that sense" (Bierwisch, 1967, p. 246). The latter formed a natural class with the feature [−OBJ]. This led Bierwisch to an inventory of inflectional rules for the German determiner declension that reduced the 24 forms from Table 1.2 to the merely eight rules as shown in Table 1.6[13].

These rules were formulated in a general way in order to capture syncretisms. Note that Bierwisch made use of disjunctive feature bundles as in R_2 and in R_3. The disjunctive rule R_2 spans across three syntactic contexts of which two form a natural class:

Table 1.6: Bierwisch's inventory of the strong determiner paradigm (Müller, 2002, p. 332).

determiner		feature specification
R_1 *den*$_{\text{DAT.PL}}$	↔	[+OBJ, +OBL, +PL]
R_2 *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	↔	[+OBL, [+PL ∨ +F]]
R_3 *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	↔	[+PL ∨ +F]
R_4 *dem*$_{\text{DAT.M/N.SG}}$	↔	[+OBJ, +OBL]
R_5 *des*$_{\text{GEN.M/N.SG}}$	↔	[+OBL]
R_6 *den*$_{\text{ACC.M.SG}}$	↔	[+OBJ, +M]
R_7 *der*$_{\text{NOM.M.SG}}$	↔	[+M]
R_8 *das*$_{\text{NOM/ACC.N.SG}}$	↔	[Ø]

[12]Notation: For Blevins, however, his own feature naming style shall be initially maintained when introducing and explaining his model.

[13]Notation: In case the syntactic context attaches to a reference outside of glosses—that is in continuous text or in lists like Table 1.6—the Leipzig Glossing Rules are applied insofar as categories are abbreviated, subscripted and written in small capitals: *den*$_{\text{ACC.M.SG}}$.

dative feminine singular and genitive feminine singular. Since these two are distinct from the third syntactic context—genitive plural—with regard to gender and number, he merged both contexts across natural classes by means of a disjunction: [+OBL, [+PL ∨ +F]]. Due to their underspecified nature, the rules can conflict with each another. Different rules require different inflectional forms for a given specification. These conflicts are solved by ranking the rules. Traditionally, such a ranking translates into an order of rules. The rules in R_{1-8} in Table 1.6 apply from top to bottom as long as no other rule has already assigned an inflectional form to a syntactic context in question (Müller, 2002, p. 332). R_1 precedes all other rules. R_1 fills in den_1 in the dative plural cell in Table 1.7a (Müller, 2002, p. 333). After that, R_2 applies which cannot assign der_2 to the dative plural context since R_1 already assigned den_1 to its paradigm cell. The selected form, hence the rule that actually applies to the morphosyntactic context in question, is underlined in Table 1.7b.

Ultimately after R_8, the whole paradigm can be derived as in Table 1.8. It exhibits the interplay between feature decomposition, underspecified rules and their ranking. For example, R_2 predicts *der* for dative and genitive contexts since both cases are captured by the natural class of [+OBL]. The scope of R_2 is larger due to its underspecified nature. Therefore, R_2 would also assign *der* to the dative plural context. This is annulled by the order of rules since R_1 applies before R_2. In this way, R_2 cannot again be applied to the contexts that were exclusive to R_1. Apart from that, the last rule R_8 is radically underspecified and can be applied to all contexts. This rule applies the unmarked default form *das*. As it turns out, the order of R_8 is rendered irrelevant if the natural class of nominative and accusative would be captured by the feature [−OBL]. Such a specification was not intended by Bierwisch since he was not concerned with negative feature values. Therefore, it is crucial that the rules are ordered since the conflicts could not be resolved otherwise. This order is extrinsically stipulated and not intrinsically motivated. In order to disregard such a stipulation, the rules could be ranked by the principles of specificity and compatibility. According to the former, a more specific rule takes precedence over another less specific one. A rule is more specific if its specification carries more features than the specification of another rule. Among others, this principle is also known as elsewhere principle (e.g., Anderson, 1969, 1992; Kiparsky,

Table 1.7: Rules from Table 1.6 applied to Bierwisch's strong determiner paradigm.

(a) R_1 applied.

	SG			PL
	M	N	F	
NOM				
ACC				
DAT				den_1
GEN				

(b) R_{1-2} applied.

	SG			PL
	M	N	F	
NOM				
ACC				
DAT			der_2	$\underline{den_1}$, der_2
GEN			der_2	der_2

1973), blocking principle (e.g., Anderson, 1986; Aronoff, 1985) or Panini's principle or lexical blocking (e.g., Zwicky, 1986). A comprehensive definition of compatibility came from Opitz et al. (2013, p. 236): "Compatibility can be understood as [...] [a] morphological exponent M [being] compatible with a syntactic context (or paradigm cell) S if M realized a SUBSET of the morphosyntactic feature/value pairs of S."

Table 1.8: R_{1-8} applied to Bierwisch's determiner paradigm (Müller, 2002, p. 333).

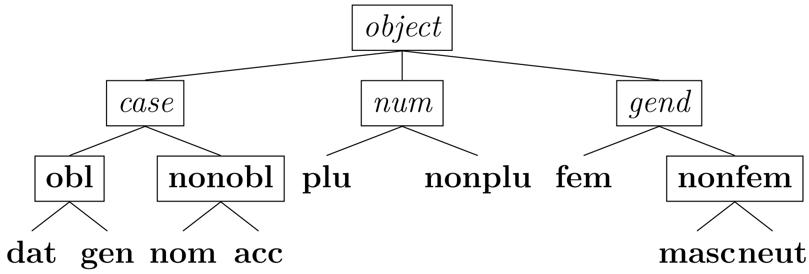
	SG			PL
	M	N	F	
NOM	$\underline{der}_7$, das_8	$\underline{das}_8$	$\underline{die}_3$, das_8	$\underline{die}_3$, das_8
ACC	$\underline{den}_6$, der_7, das_8	$\underline{das}_8$	$\underline{die}_3$, das_8	$\underline{die}_3$, das_8
DAT	$\underline{dem}_4$, des_5, den_6, der_7, das_8	$\underline{dem}_4$, des_5, den_6, das_8	$\underline{der}_2$, die_3, dem_4, des_5, das_8	$\underline{den}_1$, der_2, die_3, dem_4, des_5, das_8
GEN	$\underline{des}_5$, der_7, das_8	$\underline{des}_5$, das_8	$\underline{der}_2$, die_3, des_5, das_8	$\underline{der}_2$, die_3, des_5, das_8

1.2.2 Cross-classification and feature-type geometries

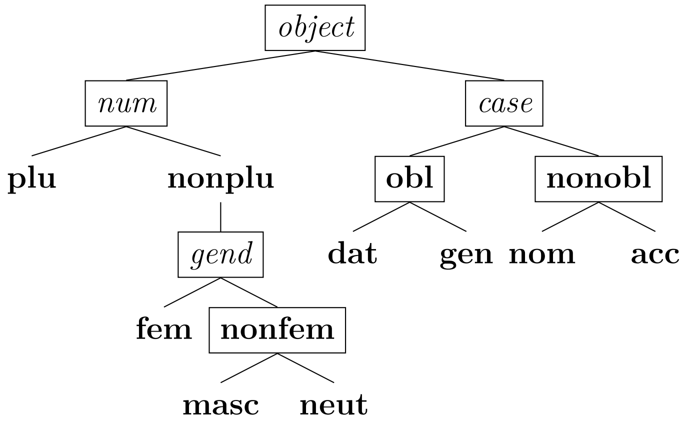
Even though Blevins largely kept Bierwisch's decomposed features for case, number and gender, the two approaches do not resemble each other in any way. Figure 1.3a shows how Blevins (1995, p. 140) motivated partitions of case, number and gender and arranged them in a default inheritance tree.[14] Bold terminal nodes as well as boxed bold partitions represented basic and non-basic features that could be part of feature bundles. Italicized partitions, on the other hand, represented the features' high-level categories (Blevins, 1995, p. 141). Like Bierwisch, Blevins also assumed that any plural marking was incompatible with gender information, "ensuring that no wellformed feature description will contain both **plu** and any of **fem**, **nonfem**, **masc** or **neut**" (Blevins, 1995, p. 142). This allowed him to rearrange the geometry from Figure 1.3a to that in Figure 1.3b. Under the categories of case and number, Blevins subsumed incompatible daughter nodes. Since he assumed that gender information was neutralized in plural contexts, the non-terminal node of **nonplu** dominated the *gend* partition. In this way, every gender specification inherited [−PL].

Conversely, **plu** is incompatible with any gender marking. This allowed Blevins to map the geometry in Figure 1.3b onto the structured sorts geometry of the German strong determiner in Figure 1.4. The nodes of the tree are underspecified with the root representing the radically underspecified default. All daughter nodes inherit every feature from their respective mothers while terminal nodes constitute the most specific elements of the tree.

[14]Recall from above that in order to introduce Blevins' approach, his feature naming conventions shall be used initially.



(a) Original feature geometry.



(b) Rearranged feature geometry.

Figure 1.3: Feature geometries by (Blevins, 1995, pp. 140–141)

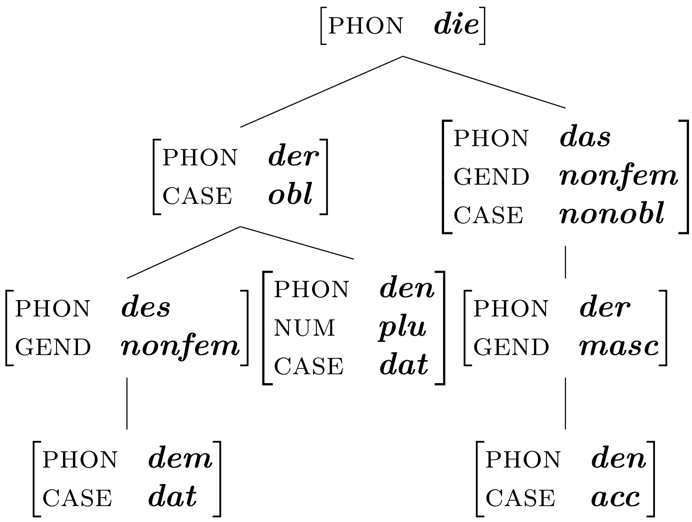


Figure 1.4: Structured sorts geometry of the German strong determiner paradigm (Blevins, 1995, p. 145).

Blevins identified the most frequent form *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ as the featureless elsewhere marker since it neutralized the partitions of case, number and gender. Therefore, *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ dominated all other non-terminal and terminal nodes. Furthermore, he selected *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ as the general **obl** form. Since **obl** subsumes dative and genitive, this node dominates *des*$_{\text{GEN.M.SG/N.SG}}$, *den*$_{\text{DAT.PL}}$ and *dem*$_{\text{DAT.M/N.SG}}$. The determiner *das*$_{\text{NOM/ACC.N.SG}}$ can act as the default **nonobl** form as it neutralizes both structural cases. It is insofar different from *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ as it is neither masculine nor feminine but rather neuter. Due to that, *das*$_{\text{NOM/ACC.N.SG}}$ is also the default **nonfem** form which dominates the terminal **masc** node. In this way, *der*$_{\text{NOM.M.SG}}$ and lastly *den*$_{\text{ACC.M.SG}}$ are subsumed under *das*$_{\text{NOM/ACC.N.SG}}$. This feature geometry can be converted into the set of rules in Table 1.9. This inventory is ordered by specificity as mother nodes are less specific than daughter nodes.

Blevins—other than Bierwisch—dispensed with disjunctive specifications but referred to negative features. In his approach, the radically underspecified default form was not *das* as in Bierwisch's system but rather *die*. Similar to Bierwisch, the generality of the underspecified rules leads to conflicts among their scopes. Applying R_{1-8} yields Table 1.10. However, the order of application of R_{1-8} from Table 1.9 is not the only way to rank the rules. R_{1-4} constitute a block for oblique contexts while R_{5-8} are reserved for non-oblique contexts. Therefore, it would be entirely possible to swap these two blocks and apply R_{5-8} before R_{1-4}. The specificity principle determines which rule has precedence over another. To conclude, Bierwisch and Blevins share the same number of similarly specified rules but are derived based on distinct assumptions about the feature inventory and relations among features.

Table 1.9: Blevins' inventory of the strong determiner paradigm (Müller, 2002, p. 336).

determiner		feature specification
R_1 *den*$_{\text{DAT.PL}}$	↔	[+OBJ, +OBL, +PL]
R_2 *dem*$_{\text{DAT.M/N.SG}}$	↔	[+OBJ, +OBL, −F]
R_3 *des*$_{\text{GEN.M/N.SG}}$	↔	[+OBL, −F]
R_4 *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	↔	[+OBL]
R_5 *den*$_{\text{ACC.M.SG}}$	↔	[+OBJ, −OBL, +M, −F]
R_6 *der*$_{\text{NOM.M.SG}}$	↔	[−OBL, +M, −F]
R_7 *das*$_{\text{NOM/ACC.N.SG}}$	↔	[−OBJ, −F]
R_8 *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	↔	[∅]

1.2.3 Combination of Bierwisch's and Blevins' approaches

Wunderlich, like Blevins, recurred to feature-type architectures in order to capture the paradigm of the German strong determiner. Similar to the two preceding approaches, Wunderlich also kept gender and number features. In this way, he motivated that neuter gender was underspecified in terms of gender features while masculine and feminine gender were specified for [+M] and [+F] respectively. Figure 1.5a depicts the respective inheritance tree. With regard to number, singular was assumed to be featureless while

Table 1.10: R_{1-8} applied to Blevins' strong determiner paradigm (Müller, 2002, p. 336).

	SG			PL
	M	N	F	
NOM	*der*$_6$, *das*$_7$, *die*$_8$	*das*$_7$, *die*$_8$	*die*$_8$	*die*$_8$
ACC	*den*$_5$, *der*$_6$, *das*$_7$, *die*$_8$	*das*$_7$, *die*$_8$	*die*$_8$	*die*$_8$
DAT	*dem*$_2$, *des*$_3$, *der*$_4$, *die*$_8$	*dem*$_2$, *des*$_3$, *der*$_4$, *die*$_8$	*der*$_4$, *die*$_8$	*den*$_1$, *der*$_4$, *die*$_8$
GEN	*des*$_3$, *der*$_4$, *die*$_8$	*des*$_3$, *der*$_4$, *die*$_8$	*der*$_4$, *die*$_8$	*der*$_4$, *die*$_8$

plural is specified for [+PL]. Wunderlich further recognized that the number category ranked above the gender category, resulting in gender neutralization in plural contexts as in Figure 1.5b. Other than Bierwisch or Blevins, he decomposed case features in a different way: "The system consists of two binary features: [±HR] for 'there is a/no higher role' and [±LR] for 'there is a/no lower role.'" (Wunderlich, 1997a, p. 48). Furthermore, there is a [+N] feature for cases with nominal governors. This results in a case geometry in Figure 1.5c in which nominative is radically underspecified, accusative uses just [+HR], dative is specified with [+LR, −HR] and genitive is [+HR, +N]. In line with Bierwisch but other than Blevins, Wunderlich made use of disjunctive specification as can be seen in R_1, R_2 and R_3. Furthermore, he rejected negative features and reserved *das* as the radically underspecified default form. Merging the assumptions about gender, number and case leads to the inheritance tree for the German strong determiner in Figure 1.5d. Wunderlich further assumed that [+LR] in accusative languages and [+N] generally implied the feature [+HR] (Wunderlich, 1997b, p. 51).

Similar to Blevins' inheritance tree, the geometry in Figure 1.5d can also be transformed into the list of ranked rules in Table 1.11. Occurring rule conflicts are resolved as displayed in Table 1.12. In addition to a specificity-motivated rule order, Wunderlich also seems to have assumed that case features ranked higher than gender features. Otherwise, the equally specific rules R_{4-6} could not be ranked without an extrinsically stipulated order.

1.2.4 Phonological properties and feature hierarchies

In contrast to the previous three approaches, Wiese did not only decompose case but also gender and number features. He adopted the case classification from Bierwisch and even further decomposed masculine into [+M, −F], feminine into [−M, +F], neuter into [+M, +F] and plural into [−M, −F]. This is rendered possible—as the plural specification illustrates—because German does not distinguish gender in plural. In this way, nine rules can be formulated that neither use disjunctive nor negative specifications. Similar to Blevins, Wiese's inventory in Table 1.13 also recognized *die* as the radically underspecified default marker.

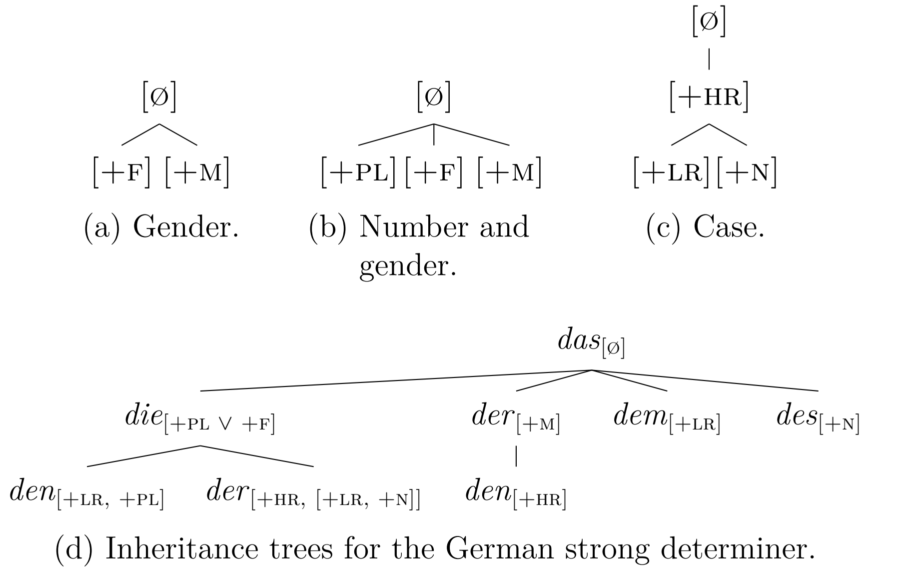


Figure 1.5: Inheritance tree for grammatical categories and the German strong determiner (Wunderlich, 1997b, p. 51).

Table 1.11: Wunderlich's inventory of the strong determiner paradigm (Müller, 2002, p. 338).

determiner		feature specification
R_1 $den_{\text{DAT.PL}}$	$\leftrightarrow$	[+LR, +HR, +PL, [+F $\vee$ +PL]]
R_2 $der_{\text{DAT/GEN.F.SG, GEN.PL}}$	$\leftrightarrow$	[+HR, [+LR $\vee$ +N], [+PL $\vee$ +F]]
R_3 $die_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	$\leftrightarrow$	[+PL $\vee$ +F]
R_4 $dem_{\text{DAT.M/N.SG}}$	$\leftrightarrow$	[+LR, +HR]
R_5 $des_{\text{GEN.M/N.SG}}$	$\leftrightarrow$	[+N, +HR]
R_6 $den_{\text{ACC.M.SG}}$	$\leftrightarrow$	[+HR, +M]
R_7 $der_{\text{NOM.M.SG}}$	$\leftrightarrow$	[+M]
R_8 $das_{\text{NOM/ACC.N.SG}}$	$\leftrightarrow$	[Ø]

R_{1-8} are applied to Wiese's determiner paradigm in Table 1.14. In line with Blevins and Wunderlich, he also assumed that specificity regulated the ranking of the rules. While this explains why R_1 in Table 1.13 must apply before R_2 and all other forms with less than three features, the specificity principle cannot account for equally specific rules. For those rules, the application order cannot be determined on the specificity principle.

Therefore, Wiese based this principle on hierarchically ordered features. He assumed that the features of "Standard and Oblique [...] 'outweigh' [...] Special and Object, and that in both groups the gender feature [...] 'outweigh' the case feature [...]." (Wiese, 1999, p. 14, own translation). This resulted in the following hierarchy: [+M] > [+OBL] > [+F] > [+OBJ] (Müller, 2002, p. 340). Wiese's approach goes beyond the ideas of

Table 1.12: R_{1-8} applied to Wunderlich's strong determiner paradigm (Müller, 2002, p. 338).

	SG			PL
	M	N	F	
NOM	*der*$_7$, *das*$_8$	*das*$_8$	*die*$_3$, *das*$_8$	*die*$_3$, *das*$_8$
ACC	*den*$_6$, *der*$_7$, *das*$_8$	*das*$_8$	*die*$_3$, *das*$_8$	*die*$_3$, *das*$_8$
DAT	*dem*$_4$, *den*$_6$, *der*$_7$, *das*$_8$	*dem*$_4$, *das*$_8$	*der*$_2$, *die*$_3$, *dem*$_4$, *das*$_8$	*den*$_1$, *der*$_2$, *die*$_3$, *dem*$_4$, *das*$_8$
GEN	*des*$_5$, *den*$_6$, *der*$_7$, *das*$_8$	*des*$_5$, *das*$_8$	*der*$_2$, *die*$_3$, *des*$_5$, *das*$_8$	*der*$_2$, *die*$_3$, *des*$_5$, *das*$_8$

Table 1.13: Wiese's inventory of the strong determiner paradigm (Müller, 2002, p. 340).

determiner	weight		feature specification
R_1 *dem*$_{\text{DAT.M/N.SG}}$	heavy	↔	[+OBJ, +OBL, +M]
R_2 *des*$_{\text{GEN.M/N.SG}}$		↔	[+OBL, +M]
R_3 *das*$_{\text{NOM/ACC.N.SG}}$		↔	[+M, −F]
R_4 *den*$_{\text{ACC.M.SG}}$	medium heavy	↔	[+OBJ, +M]
R_5 *der*$_{\text{NOM.M.SG}}$		↔	[+M]
R_6 *der*$_{\text{DAT/GEN.F.SG}}$		↔	[+OBL, +F]
R_7 *den*$_{\text{DAT.PL}}$		↔	[+OBJ, +OBL]
R_8 *der*$_{\text{GEN.PL}}$		↔	[+OBL]
R_9 *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	light	↔	[∅]

Bierwisch, Blevins and Wunderlich in the way that he wanted Table 1.13 not to be understood as a sequence of rules but rather holistically. This means that Wiese divided the rules into three blocks. The first block comprised -*em* and -*es* markers, the second -*en* and -*er* and the third just an -*e* marker. According to Wiese, these blocks referred to phonologically heavy, medium heavy and light markers. In this way, Wiese established a relation between form and function as light markers appear only with unspecific or—in the case of *die*—with radically underspecified feature bundles while medium heavy markers carry medium specific feature bundles. Lastly, heavy markers are the ones with the most features. But Wiese's observations go even further: With the distinction of [±OBJ], he was able to predict the presence or absence of nasal markers. If [+OBJ] is present in either the heavy or medium heavy block, then the nasal is chosen. In this way, every form in the inflectional paradigm can be assigned a unique meaning.

1.2.5 Destructive feature rules

The last approach to be introduced is Müller's. Like Wiese, his system referred to phonological properties of inflectional markers. However, this is the only characteristic Müller

Table 1.14: R_{1-9} applied to Wiese's strong determiner paradigm (Müller, 2002, p. 338).

	SG			PL
	M	N	F	
NOM	$\underline{der}_5$, die_9	$\underline{das}_3$, der_5, die_9	$\underline{die}_9$	$\underline{die}_9$
ACC	$\underline{den}_4$, der_5, die_9	$\underline{das}_3$, den_4, der_5, die_9	$\underline{die}_9$	$\underline{die}_9$
DAT	$\underline{dem}_1$, des_2, den_4, der_5, den_7, der_8, die_9	$\underline{dem}_1$, des_2, das_3, den_4, der_5, der_6, den_7, der_8, die_9	$\underline{der}_6$, den_7, der_8, die_9	$\underline{den}_1$, der_8, die_9
GEN	$\underline{des}_5$, der_5, der_8, die_9	$\underline{des}_5$, das_3, der_5 der_6, der_8, die_9	$\underline{der}_2$, der_8, die_9	$\underline{der}_8$, die_9

shares with Wiese's framework. While the other models assumed discrete inflectional markers based on constructive rules, Müller tackled the problem of underspecification from the opposite direction. Rather than forcing the selection of an exponent by a rule that tells the system *what is*, he used destructive rules that excluded particular inflectional endings by identifying *what is not*. His assumption was that inflectional rules no longer instantiated but prevented a selection of exponents. By applying rule after rule and thus excluding marker after marker, the remaining exponent is the one to be selected. In line with Wiese, Müller used the decomposed features of [±OBJ], [±OBL], [±M] and [±F] to specify the deleted candidates. Unlike the previously discussed models, Müller did not refer to syntactic contexts but to common phonological properties of multiple candidates that needed to be excluded by specific rules. That is why his approach is remotely related to Wiese's framework.

Table 1.15: Müller's inventory of the strong determiner paradigm (Müller, 2002, p. 346).

determiner		feature specification
R_1 ¬[+CORONAL]$_{*den,\ *das/des}$	↔	[+OBJ, +OBL, +M]
R_2 ¬[+DORSAL, +CONSONANT]$_{*der}$	↔	¬[−M, +F] ∧ [+OBJ]
R_3 ¬[−CONSONANT, +SONOR]$_{*die}$	↔	¬[−OBL, −M]
R_4 ¬[+SONOR]$_{*dem,\ *den,\ *der,\ *die}$	↔	¬[−OBL, +M, −F] ∧ ¬[−M]
R_5 ¬[+MIN-SONOR]	↔	[Ø]

R_1 excludes coronal and R_2 dorsal consonants while R_3 rules out sonorous consonants and R_4 vowels. The subscripted determiners are the relevant ones that need to be excluded. The last rule R_5 is not related to a specific candidate but deploys the sonority hierarchy according to which the most sonorous of the remaining candidates has to be chosen. Applying all rules in the order given by the inventory in Table 1.15 reveals their interaction in the paradigm in Table 1.16. To recall the preceding constructive approaches, one has to keep in mind that the determiner which was compatible and the most specific was underlined. This signaled that this very candidate was successfully applied by a particular rule. Contrary to this, in Müller's destructive framework, the rules excluded candidates. Therefore, the rules' application is, in that sense, reversed as they delete determiners. All underlined determiners in Table 1.16 are successfully affected by respective rules. As a result, the determiner that remains unaffected by any rule and is thus not underlined is the one that eventually fills the cell in question.

Table 1.16: R_{1-5} applied to Müller's strong determiner paradigm (Müller, 2002, p. 347).

	SG			PL
	M	N	F	
NOM	$\underline{die}_3$, *der*, $\underline{den}_5$, $\underline{dem}_5$, $\underline{das}/\underline{des}_5$	$\underline{die}_3$, $\underline{der}_4$, $\underline{den}_4$, $\underline{dem}_4$, *das/des*	*die*, $\underline{der}_5$, $\underline{den}_5$, $\underline{dem}_5$, $\underline{das}/\underline{des}_5$	*die*, $\underline{der}_5$, $\underline{den}_5$, $\underline{dem}_5$, $\underline{das}/\underline{des}_5$
ACC	$\underline{die}_3$, $\underline{der}_2$, *den*, $\underline{dem}_5$, $\underline{das}/\underline{des}_5$	$\underline{die}_3$, $\underline{der}_2$, $\underline{den}_4$, $\underline{dem}_4$, *das/des*	*die*, $\underline{der}_5$, $\underline{den}_5$, $\underline{dem}_5$, $\underline{das}/\underline{des}_5$	*die*, $\underline{der}_2$, $\underline{den}_5$, $\underline{dem}_5$, $\underline{das}/\underline{des}_5$
DAT	$\underline{die}_3$, $\underline{der}_2$, $\underline{den}_1$, *dem*, $\underline{das}/\underline{des}_1$	$\underline{die}_3$, $\underline{der}_2$, $\underline{den}_1$, *dem*, $\underline{das}/\underline{des}_1$	$\underline{die}_3$, *der*, $\underline{den}_5$, $\underline{dem}_5$, $\underline{das}/\underline{des}_5$	$\underline{die}_3$, $\underline{der}_2$, *den*, $\underline{dem}_5$, $\underline{das}/\underline{des}_5$
GEN	$\underline{die}_3$, $\underline{der}_4$, $\underline{den}_4$, $\underline{dem}_4$, *das/des*	$\underline{die}_3$, $\underline{der}_4$, $\underline{den}_4$, $\underline{dem}_4$, *das/des*	$\underline{die}_3$, *der*, $\underline{den}_5$, $\underline{dem}_5$, $\underline{das}/\underline{des}_5$	$\underline{die}_3$, *der*, $\underline{den}_5$, $\underline{dem}_5$, $\underline{das}/\underline{des}_5$

1.3 Interim Conclusion: Syncretism through Underspecification

Chapter 1 introduced different theories on the inflectional system. While there are associative models which assume whole word representations, combinatorial models support the idea of individual paradigms for stems and affixes. Both can be brought together by inflectional rules. Inflectional paradigms also neatly reveal the phenomenon of syncretism. In morphology, it manifests itself as coinciding forms across morphosyntactic contexts within an inflectional paradigm. As shown in Tables 1.1 and 1.2, the paradigm and its corresponding inventory offer only few forms for 24 cells. In total, just five or six distinct phonological forms are available to fill all contexts. Since this kind of distribution across paradigms is not accidental, it is theoretically desirable to capture syncretisms in a way that reveals their systematic nature. This can be done by underspecification.

Section 1.2 presented five approaches on how to account for syncretism in inflectional paradigms by means of underspecification. Bierwisch, Blevins, Wunderlich, Wiese and Müller all show different ways of how to capture syncretism in various inflectional paradigms. The first four systems use constructive rules that state how an inflectional marker or exponent has to be specified in order to be selected for a given morphosyntactic context. None of these approaches can fully account for all syncretisms in the determiner paradigm. Only *dem* can be readily derived by Bierwisch, Blevins, Wunderlich or Wiese. The form *die* is also quite unproblematic, especially since it is the unmarked default in

Blevins and Wiese. Nevertheless, it is impossible for these four models to account for all occasions of *der* and *den* as well as for *das/des*. In comparison to that, the fifth approach by Müller formulated destructive rules that exclude exponents for specific phonological properties inside the paradigm. This allows the derivation of just five rules to account for all syncretic forms within a paradigm.

It can be concluded that underspecification is a suitable tool to assign morphosyntactic features to a lexical item. Following Jackendoff's (1975, p. 642) definition of a lexical entry, it is feasible to assess that underspecified morphosyntactic features may very well be added to the phonologic, syntactic and semantic information as listed in Figure 1.6.

$$\begin{bmatrix} \text{entry number} \\ \text{/phonological representation/} \\ \text{morphosyntactic features} \\ \text{syntactic features} \\ \textsc{semantic representation} \end{bmatrix}$$

Figure 1.6: Expanded lexical entry.

Although syncretic inflectional elements may be ambiguous at their surface level, the frameworks introduced in Section 1.2 demonstrated that they definitely differ at a deeper morphosyntactic level. But which one of the underspecification approaches by Bierwisch, Blevins, Wunderlich, Wiese and Müller is explanatorily more adequate? This question entails a more important one: What shall be explained? From a theoretical point of view with the number of rules being the measure, Müller's model would be most appropriate. But this measure may not reflect explanatory adequacy. Naturally, looking into empirical data helps to decide on how good a model is in explaining morphosyntactic underspecification. Therefore, the present thesis will consider the experimental side of the argument in the following Chapter 2.

2 Underspecification in the Mental Lexicon

Given that with Bierwisch at least one of the aforementioned underspecification approaches dates back to the 1960s, it took psycholinguistic research on morphology almost 40 years to slowly shift its fields of interest towards morphosyntactic underspecification. Initially, empirical investigations and psycholinguistic modeling were primarily concerned with the representational status of inflected and derived elements (e.g., Schriefers, 1998). Instead of examining the featural properties of a mental representation itself, it was debated “whether [all words,] morphologically simple or complex, have their own full access representation” or whether this storage method held true for decomposed stems and affixes (Schriefers, 1998, p. 104). The former assumption would favor the associative inflectional models presented in Section 1.1.1. Along these theoretical approaches, Butterworth (1983) proposed the full listing hypothesis which assumed a mental lexicon based on fully assembled words. The latter assumption of morphological decomposition would advocate combinatorial and decompositional theories as introduced in Section 1.1.2. Worth mentioning is Taft and Forster’s (1975) model of morphological parsing. In this framework, words are not stored as a whole but as separate stems and affixes.

Between these two extremes reside the so-called dual route models that try to unify the opposing associative and combinatorial approaches: “These models assume that morphologically complex words can either be recognized via a route using prelexical morphological parsing or via a direct route accessing morphologically complex words as full forms” (Schriefers, 1998, p. 106). These assumptions were corroborated by Caramazza et al. (1988) and more recently by Clahsen et al. (2003). In addition to that, it was also discussed how mental representations of inflected word forms were related to one another. These quasi-controversies led to numerous explanatory approaches like the aforementioned Satellite Model by Lukatela et al. (1980) or various network models e.g. by Andrews (1986) and Schriefers et al. (1992).

The body of research just cited could not decide on the question if and how morphosyntactic underspecification is relevant for the mental representation of a lexical entry. The present thesis is, anyway, less concerned with the theoretical debate on the mental lexicon’s state of matter but focuses rather on finding empirical evidence for morphosyntactic features being associated with a lexical entry as depicted in Figure 1.6. The subsequent sections will provide an overview of this so far sparsely investigated research question.

2.1 Unprimable High Specificity

Clahsen et al. (2001) investigated German adjectival inflection in two behavioral experiments.[15] In the first study, the authors obtained reaction times in a lexical decision task. Participants were asked to evaluate the word/non-word status of single visually presented adjectives that were inflected with -*s* like *kleines* or -*m* like *kleinem* ("small"). The former adjective carried the features [−OBL, −M, −F, −PL] while the latter was specified as [+DAT, +OBL, −F, −PL]. Since the -*m* affix carried two positive features, it was assumed to be more specific than the -*s* marker. Clahsen et al. (2001) predicted that the reaction times would mirror this very difference in specificity. In fact, the authors reported a specificity effect for the inflectional marker with longer reaction times for -*m* in comparison to -*s* and no frequency effect for the entire word form. This result not only supported the notion of combinatorial models but also provided early evidence that the underlying morphosyntactic feature representation may play a role in language processing.

In the second study, a cross-modal priming experiment, subjects heard a single spoken adjective prime that was followed by a contextless visually presented target adjective. Again, response times for the decision on the word/non-word status of the target were recorded. The authors tested the same two adjectival affixes from the first study but in this case with an additional -*e* marker that was assumed to carry a single [−OBL] feature. The three affixes were presented both as auditory primes and as visual targets yielding nine possible combinations: In three pairs, prime and target and thus their feature specifications were identical. In another set of two pairs, -*s* → -*e* and -*e* → -*s*, the affixes shared the [−OBL] feature. In the remaining four prime-target combinations, the pairs mismatched with regard to the [+OBL] and [+DAT] features of -*m* that were neither present on -*e* nor -*s* affixes. Clahsen et al. (2001) predicted that this specificity and feature scale was mirrored in graded priming patterns. In fact, the results showed that reaction times were lowest for the identity conditions. Significantly longer reaction times and thus reduced priming effects were reported for prime-target transitions involving features that were present on the target but not on the prime. Consequently, the prime could not activate the features in question. This was the case for -*e* → -*s* and -*m* → -*s* combinations. In the former, the prime carried a single [−OBL] while the target was more specific, namely specified for gender and number. In the latter case, the -*s* marker carried a [−M] which was not present on the -*m* affix. The longest reaction times and lowest priming effects were produced by -*e* or -*s* primes with an -*m* target. In both cases, -*m* was specified for [+OBL] that mismatched the [−OBL] of -*e* and -*s* affixes.

These findings are only compatible with an underspecified mental lexicon which reduces lexical redundancy and thus the number of syncretic forms. If instead fully specified representations were assumed, all target words would contain unprimable features yielding identical reaction times and reduced priming effects. Therefore, the results cannot be mapped onto associative models since they would predict full form frequency

[15]Note that Clahsen et al. (2001) also conducted an experiment on verbal inflection that supported the notion of combinatorial inflectional models and the assumption that stems and affixes were stored in a decomposed fashion.

effects but not the measured specificity effects. Clahsen et al. (2001) argued for a combinatorial architecture of the mental lexicon in which both stems and affixes were stored separately, each with their respective underspecified features.

2.2 Mentally Represented Underspecified Paradigms

In another study, Janssen and Penke (2002) investigated inflectional markers in subject-verb agreement errors of speech production data from German agrammatic aphasics. While it is largely established that the subject-verb-agreement system of agrammatic aphasics is mainly intact, the small number of substitution errors they make shows just a quantitative but no qualitative difference to healthy participants. Therefore, the use of incorrect inflectional markers should mirror a systematic process that is constrained by the architecture of the mental lexicon and thus would give insights into the unaffected inflectional system. By eliciting speech production data from agrammatic aphasics, the authors tested two combinatorial models, Network Morphology (Corbett and Fraser, 1993) and Minimalist Morphology (Wunderlich and Fabri, 1995). As already discussed in Section 1.1.2, Network Morphology assumes inflectional affixes to be stored in default inheritance trees with their nodes being morphosyntactically underspecified since they inherit information from the mother nodes above. Minimalist Morphology, on the other hand, assumes that the inflectional system is based on underspecified paradigms which have also been introduced already.

Janssen and Penke (2002) evaluated the results with respect to the predictions that both models made for agreement errors. The authors employed six different inflectional affixes that coded person and number on the verb for the agreement process with the subject. Janssen and Penke (2002) hypothesized that the aphasics' substitution errors should either be constrained by the architecture of Network Morphology or Minimalist Morphology. According to the former, agreement errors should be restricted by the design of inheritance trees. This means that substitutions should occur along subsuming nodes and not across different branches. According to the latter, agreement errors should be constrained by the structure of underspecified paradigms. In this case, substitutions should occur horizontally or vertically within one dimension but not across multiple dimensions. Janssen and Penke (2002) tested five Broca's aphasics. In two experiments, the participants produced speech data in which they filled in free or bound morphemes in inflectional contexts. In the first experiment, subjects had to complete a visually presented sentence with a subject pronoun. In the second experiment, participants had to construct sentences according to a verbal action depicted in a photo. Janssen and Penke (2002) reported that the aphasics used a wrong inflectional affix in just seven percent of the trials. Within these seven percent, 55 percent of the errors disconfirmed the architecture of inheritance trees since they occurred across and not along nodes. Instead, the results were compatible with the predictions of underspecified paradigms. According to Minimalist Morphology, substitutions should occur within-dimension. In fact, only three of 47 substitutional errors appeared across dimensions. If substitution errors would have occurred on chance level, nine errors across dimensions should have been made. As this was not the case, Janssen and Penke (2002) concluded that the systematic errors were constrained by the architecture of paradigms in which inflectional affixes were represented in an underspecified fashion.

2.3 Processing Load due to Feature Mismatches

While Clahsen et al. (2001) and Janssen and Penke (2002) experimentally established that inflected items were likely to be associated with morphosyntactic features, Penke et al. (2004) tried to go beyond that. The authors took a first look into the processing of morphosyntactic information by studying the feature specification of German adjectival and determiner inflection within full sentences. Penke et al. (2004) conducted two behavioral sentence matching experiments in which participants had to decide on the identity of two visually presented sentences as fast as possible. In such a reaction time experiment, a so-called ungrammaticality effect emerged for the identification of two identical but ungrammatical sentences. Response times were prolonged in comparison to the detection of two identical grammatical sentences.

In the first experiment on adjective inflection, the authors used prepositional phrases (henceforth PP(s)) within the sentences to span a syntactic context across a strongly inflected adjective. The PP was introduced by a preposition and concluded with a noun. Both elements provided their respective underspecified morphosyntactic features. The idea was that the intermediate adjective's fit was determined by its feature specification in comparison to the one provided by the context. With regard to the features, Penke et al. (2004) seem to have followed Bierwisch's model insofar as they denied negative feature values for inflectional markers. They argued that marked values were only positively specified while negative features were calculated "by their paradigmatic opposition to the positively specified forms" (Penke et al., 2004, p. 425). The authors tested adjectives within PPs that were marked and specified for accusative masculine singular in example (5a), dative feminine singular in (5b), dative plural in (5c) and genitive plural in (5d). Crossing these correctly inflected adjectives with the adjectival affixes -*e* and -*em*, yielded one grammatical and two ungrammatical sentences for each of the four conditions in (5)[16]. While the correct adjective's features within a PP agreed with those from the preceding preposition as well as with the specification of the succeeding noun, the incorrect adjectives of the other two sentences carried mismatching case, number or gender features that opposed either the preposition or the noun. In the ACC.M.SG condition, for example, the PP was introduced by the preposition *für* ("for") that governs accusative case and was then concluded by *Stoff* ("cloth") which is in masculine

[16]Notation: When discussing experimental data, for a condition that tests an accusative masculine singular context for a given structure and if this condition is indeed named after its context, from hereon, the Leipzig Glossing Rules will be applied insofar as the contexts' abbreviations will be used. However, for condition designation, normal instead of small capitals will be used. Accordingly, a condition like that would be named ACC.M.SG.

singular. Therefore, the intermediate adjective was only correct with the inflectional affix -*en* which provides features for accusative masculine singular. All three elements agreed with regard to the feature set of [+obj, −obl, +m, −f, −pl]. Conversely, *karierte*$_{\text{[+pl]}}$ disagreed in number whereas *kariertem*$_{\text{[+obj, +obl]}}$ disagreed with regard to case.

(5) Sentence material from Penke et al. (2004, p. 427):

a. ACC.M.SG:

Du hast eine Vorliebe für$_{\text{[+obj, −obl]}}$ karierten$_{\text{[+obj, −obl, +m, −f, −pl]}}$ /
you have a preference for.ACC plaid.ACC.M.SG /
*karierte$_{\text{[+pl]}}$ / *kariertem$_{\text{[+obj, +obl]}}$ Stoff$_{\text{[+m, −f]}}$.
*plaid.PL / *plaid.DAT cloth.M.SG

"You have a preference for plaid cloth."

b. DAT.F.SG:

Du magst gerne Hühnchen mit$_{\text{[+obj, +obl]}}$ pikanter$_{\text{[+obl, +f, −pl]}}$ /
you like ADV chicken with.DAT spicy.DAT.F.SG /
*pikante$_{\text{[+pl]}}$ / *pikantem$_{\text{[+obj, +obl]}}$ Soße$_{\text{[+f]}}$.
*spicy.PL / *spicy.DAT sauce.F.SG

"You like chicken with spicy sauce."

c. DAT.PL:

Mit$_{\text{[+obj, +obl]}}$ legalen$_{\text{[+obj, +obl, +pl]}}$ / *legale$_{\text{[+pl]}}$ /
with.DAT legal.DAT.PL / *legal.NOM/ACC.PL /
*legalem$_{\text{[+obj, +obl]}}$ Mitteln$_{\text{[+pl]}}$ klappt es nur ganz selten.
*legal.DAT.SG methods.PL works it only seldom

"Legal methods are only rarely helpful."

d. GEN.PL:

Er wohnte inmitten$_{\text{[−obj, +obl]}}$ toleranter$_{\text{[−obj, +obl, +pl]}}$ / *tolerante$_{\text{[+pl]}}$ /
he lived within.GEN tolerant.GEN.PL / *tolerant.PL /
*tolerantem$_{\text{[+obj, +obl]}}$ Nachbarn$_{\text{[+pl]}}$.
*tolerant.DAT neighbors.PL

"He was surrounded by tolerant neighbors."

One would expect that all incorrectly inflected adjectives would elicit identical patterns of ungrammaticality effects. However, on the contrary, Penke et al. (2004) expected a more fine-grained modulation of the ungrammaticality effects. These could then have been traced back to different feature violations on the adjective in comparison to the context in which they appeared, enabling insights into the morphosyntactic characteristics of the inflectional affix. Interestingly, the authors indeed did not report uniform ungrammaticality effects for every incorrectly inflected sentence pair. In fact, both the incorrect adjectives *legale*$_{\text{[+pl]}}$ and *legalem*$_{\text{[+obj, +obl]}}$ in (5c) as well as *tolerante*$_{\text{[+pl]}}$ and *tolerantem*$_{\text{[+obj, +obl]}}$ in (5d) did not evoke significantly longer reaction times in comparison to the correct *legalen*$_{\text{[+obj, +obl, +pl]}}$ and *toleranter*$_{\text{[−obj, +obl, +pl]}}$ respectively. To put it more provocatively, the incorrect adjectives were processed as easily as the correct ones. Penke et al. (2004) attributed the absence of an ungrammaticality effect to the lack of context-opposing features on the adjectives. In comparison to that, adjectives that carried features opposing the ones of the context always elicited longer response times. The clash of a positive feature with the same feature of negative value is called incompatibility. This occurred in (5a) and (5b). In case of (5a), *karierte*$_{[+\text{PL}]}$ and *kariertem*$_{[+\text{OBJ}, +\text{OBL}]}$ evoked an ungrammaticality effect in comparison to the correct *karierten*$_{[+\text{OBJ}, -\text{OBL}, +\text{M}, -\text{F}, -\text{PL}]}$. The context in this condition required a [−PL] and a [−OBL] whereas *karierte* offered an incompatible [+PL] and *kariertem* an opposing [+OBL].

The authors' second experiment confirmed the results of the first for strong determiner inflection. The comparison between features with positive values and the syntactic context turned out to be crucial for the occurrence of an ungrammaticality effect. If incompatible features clashed, longer reaction times entailed. An approach denying underspecification could not explain these results. In a model that advocates fully specified representations all incorrectly inflected adjectives should have produced ungrammaticality effects. Since this was not the case, Penke et al. (2004) argued that the data aptly showed the underspecified nature of lexical representations.

While the empirical evidence strongly corroborated the idea that morphosyntactic underspecification had implications for the architecture of the lexicon, the grounds of this conclusion raise some questions. On a first note, the authors used different ungrammaticality positions within their critical items. As can be seen in (5), the items that induced the ungrammaticality occupied various positions. In addition to that, the correct adjectives of all conditions used different affixes. Therefore, the four conditions by no means form minimal pairs. Obviously, this is due to the asymmetric adjectival declensional system in German.

On another note, it could be argued that this issue is unfounded due to the experimental method in which such an imbalance would not affect the experimental data. However, the authors presented whole sentences which allowed the participants to evaluate the entire item. Therefore, Penke et al. (2004) drew conclusions from a whole-sentence response and not from one that was elicited by word-by-word presentation. This aspect leads to the second issue that is ultimately linked to the first one: Even though the authors only had these whole-sentence responses to work with, their arguments were actually derived from different theoretical fundaments. This renders their methodological reasoning to be too suggestive: Although investing wholly presented PPs (within a sentence), they used a terminology suggesting that the effects were due to an incremental comprehension mechanism.[17] Obviously, presenting sentences as a whole allows

[17]While being well aware that the authors' intentions are hard to detect, one can nevertheless assume that stating that context information "lack[s]" certain features (Penke et al., 2004, p. 432) and that adjective and determiner features are "required by the [grammatical] context" (Penke et al., 2004, pp. 428, 429, 430, 431) are phrasings intended rather for describing the phenomenon of incremental sentence processing. The lack or requirement of features implies a successively operating mechanism that searches for matching counterparts, word by word. Therefore, the ungrammaticality effects the authors detected would be associated with the penalizing outcome of a failing feature retrieval. Conversely, the ungrammaticality effect would not occur in case the system finds its desired counterpart. While

the language user's processing system to evaluate each position's grammatical adequacy depending on its context. Neither methods nor results allow for such a statement about incremental language processing. Therefore, the authors' conclusion regarding a putative step-by-step mechanism has to be considered with caution.

Nevertheless, the presented data by Penke et al. (2004) further strengthened the argument that mental representations seem to be organized in paradigms that are stored with underspecified morphosyntactic features. The subsequent section will evaluate whether the experimental paradigm chosen by Opitz et al. (2013) could address the issues of inflectional asymmetry and incremental processing.

2.4 Neuropsychology of Specificity and Incompatibility

In order to gain even deeper insights into the architecture of the inflectional system and its underlying processes, Opitz et al. (2013, henceforth O13) conducted an experiment in which they recorded event-related brain potentials (henceforth ERP) by means of electroencephalography (henceforth EEG). This method, that shall be briefly described in this section and in more detail in the Experimental Part's Section 7.1, offers a high degree of temporal resolution and is capable of revealing online processing effects of various strengths. O13 modulated the two aforementioned morphological principles, namely compatibility and specificity. This modulation was cast into accusative prepositional phrases that contained a prenominal strong German adjective followed by a noun. Operating within one grammatical case circumvents the problem of an imbalance in the experimental conditions that was mentioned in the previous section for Penke et al. (2004). Crossing the adjectives' genders of masculine, feminine and neuter with the one of the nouns yielded three by three structures. The adjectives were correctly marked in (6a-i–6c-i) for accusative neuter singular, accusative feminine singular, or accusative masculine singular respectively or incorrectly marked in the other examples of (6). The feature transitions depicted different types of compatibility and specificity compliances or violations.

(6) (In)correct adjective inflections from O13 (p. 245):

a. ACC.N.SG:

i. durch$_{[+\text{OBJ}, -\text{OBL}]}$ schlichtes$_{[-\text{F}]}$ Design$_{[-\text{M}, -\text{F}]}$
by.ACC plain.N design.N.SG
→ correct

the experimental paradigm clearly does not allow for such assumptions, the final verdict does indeed suggests them. However, it must be stressed that Penke et al. (2004) did not provide evidence for such a mechanism. This observation leads back to the first issue: The data do not allow for conclusions on incrementality. Thus, Penke et al. (2004) did not really enable the disentangling of the effects of (5b) and (5c) as both contexts allow for a dative adjective. The aforementioned design imbalance that is due to the asymmetric inflectional system would also allow for a concluding masculine noun in (5b) and (5c).

ii. durch$_{[+\text{OBJ}, -\text{OBL}]}$ *schlichte$_{[\varnothing]}$ Design$_{[-\text{M}, -\text{F}]}$
by.ACC *plain.F design.N.SG
→ incorrect due to specificity violation at noun, but compatible

iii. durch$_{[+\text{OBJ}, -\text{OBL}]}$ *schlichten$_{[+\text{OBJ}, -\text{OBL}, +\text{M}, -\text{F}]}$ Design$_{[-\text{M}, -\text{F}]}$
by.ACC *plain.M design.N.SG
→ incorrect due to compatibility violation at noun

b. ACC.F.SG:

i. durch$_{[+\text{OBJ}, -\text{OBL}]}$ schlichte$_{[\varnothing]}$ Struktur$_{[-\text{M}, +\text{F}]}$
by.ACC plain.F structure.F.SG
→ correct

ii. durch$_{[+\text{OBJ}, -\text{OBL}]}$ *schlichten$_{[+\text{OBJ}, -\text{OBL}, +\text{M}, -\text{F}]}$ Struktur$_{[-\text{M}, +\text{F}]}$
by.ACC *plain.M structure.F.SG
→ incorrect due to compatibility violation at noun

iii. durch$_{[+\text{OBJ}, -\text{OBL}]}$ *schlichtes$_{[-\text{F}]}$ Struktur$_{[-\text{M}, +\text{F}]}$
by.ACC *plain.N structure.F.SG
→ incorrect due to compatibility violation at noun

c. ACC.M.SG:

i. durch$_{[+\text{OBJ}, -\text{OBL}]}$ schlichten$_{[+\text{OBJ}, -\text{OBL}, +\text{M}, -\text{F}]}$ Geschmack$_{[+\text{M}, -\text{F}]}$
by.ACC plain.M taste.M.SG
→ correct

ii. durch$_{[+\text{OBJ}, -\text{OBL}]}$ *schlichtes$_{[-\text{F}]}$ Geschmack$_{[+\text{M}, -\text{F}]}$
by.ACC *plain.N taste.M.SG
→ incorrect due to specificity violation at noun, but compatible

iii. durch$_{[+\text{OBJ}, -\text{OBL}]}$ *schlichte$_{[\varnothing]}$ Geschmack$_{[+\text{M}, -\text{F}]}$
by.ACC *plain.F taste.M.SG
→ incorrect due to specificity violation at noun, but compatible

Participants had to give grammaticality judgments on the PPs of (6). While those were visually presented word-by-word, the subjects' brain waves were recorded. Similar to Penke et al. (2004), one could argue that incorrect PPs would elicit uniform results across conditions in comparison to their grammatical counterparts. However, O13 (p. 242-243) predicted that the error detection of the compatibility violation in (6a-iii), (6b-ii) and (6b-iii) was a stronger ungrammaticality cue than the violation of specificity in (6a-ii–6c-iii) in comparison to the grammatical PPs. To put it differently, a PP containing incompatibility would be recognized as being *more* ungrammatical than one with a mere violation of specificity. Conflicting and lacking features in the process of agreement checking were assumed to evoke these graded responses. In the ACC.N.SG condition for example, there is an actual feature mismatch between the [+M] value of the adjective *schlichten* and the [−M] value of the subsequent noun *Design* in (6a-iii). In contrast to that, in (6a-ii) compatibility is maintained by the presented noun but the adjective *schlichte*$_{[\emptyset]}$ is not the most specific alternative since there is one with more features—namely the correctly inflected *schlichtes*$_{[-\text{F}]}$ ("plain"$_{\text{N}}$) in (6a-i). As the detection of the ungrammaticalities involved morphosyntactic violations, the authors predicted a modulated ERP effect mirroring morphosyntactic processing. Violations like this have shown to elicit a language-related ERP component known as a left anterior negativity (henceforth LAN) with a maximum amplitude at around 300 to 500 milliseconds (henceforth ms) after stimulus onset. This LAN is considered to reflect error detection at phrase structure or at morphosyntactic level (e.g., Friederici and Weissenborn, 2007; King and Kutas, 1995; Kluender and Kutas, 1993; Münte et al., 1998). In contrast, a so-called P600 with its positive amplitude between 500 and 900 ms reflects effects of reanalysis and repair of syntactic and semantic-pragmatic anomalies (e.g., Bornkessel-Schlesewsky and Schlesewsky, 2008; Regel et al., 2011; Rossi et al., 2005; Schumacher, 2013, 2014). More detailed introductions of these two ERP effects are given in the Experimental Part's Sections 7.1.1 and 7.1.2 respectively.

According to the effects' functional components, O13 expected strong versus weak LAN modulations on the noun's position for the compatibility versus specificity violations for the ungrammatical structures both followed by P600 effects in comparison to the grammatical conditions. If, in turn, the notion of underspecification was to be denied, fully specified words would render both incorrect conditions to be equally incompatible at the noun position. In this case, there should not occur any difference between (6a-ii) and (6a-iii) since the former would no longer be just less specific but also incompatible: Under the assumption of full specificity, *schlichte* would carry at least a [+F] feature that would oppose *Design*'s [−F]. Because of this, relative to the correct condition, both incorrect forms should exhibit identical brain potentials mirroring an incompatibility effect.

O13 could confirm the underspecification-related predictions: The P600 effect occurred for the structures (6a-ii–6a-iii), (6b-ii–6b-iii) and (6c-ii–6c-iii). Thus, all PPs containing an incorrectly inflected adjective elicited an effect reflecting an independent measure of ungrammaticality for the structures in question. More interestingly though, the researchers measured graded LAN differences with weaker effects for a specificity violation and stronger effects for a compatibility violation compared to the correctly inflected PPs. This outcome is incompatible with full specification. Instead, their ERP results can be perfectly mapped onto the predicted morphosyntactic violation as depicted in (7). Increasing severity of violation and processing load are symbolized by a less-than sign ("<"):

(7) ACC.N.SG:

structure:	(6a-i) correct		(6a-ii) incorrect		(6a-iii) incorrect
violation:	none	<	non-specificity	<	incompatibility
ERP effect:	baseline	<	stronger LAN	<	strongest LAN

O13 argued that these results were only compatible with the predictions of maximal underspecification. Crucially, the authors interpreted the different LAN amplitudes as an indication of processing load when comparing agreement features between the adjective and the subsequent noun. This led O13 to briefly sketching a parsing mechanism.

They proposed that the brain correlates they found depended on the complexity of the feature marking. Critically, the ERP signatures are not only sensitive to morphosyntactic violations per se but also to the degree of the processing load needed for the specificity resolution. To be precise, they assumed that the agreement evaluation of a highly specific marker would lead to enhanced processing load compared to a less specific one. Moreover, the processing of binary agreement features consists of two steps. In a first step, the mechanism checks if the incrementally introduced features are compatible with those already processed. In a second step, missing information needs to be integrated to build up a fully specified morphosyntactic structure.

In order to illustrate these processes, the structures in (6a) shall be investigated in more detail by referring to O13 (pp. 256–258), beginning with (6a-i): The PP's preposition *durch* is the first item that the system encounters with the features [+OBJ] and [−OBL] becoming accessible. Subsequently, the prenominal adjective *schlichtes* has to be analyzed. From its inflectional affix, the gender feature [−F] becomes available. In order to carry out agreement, the adjective's case features, if available, are compared to the preposition's features. If they turn out to be compatible or at least not incompatible with one another, possibly missing features are copied. In (6a), both elements' features are not incompatible since *schlichtes* does not carry case features. This leads to a more complete feature bundle at the position of the adjective: There are case features from the preposition—namely [+OBJ, −OBL]—and, depending on the adjective in question, case, gender and number features—here [−F]. At the adjective's position, this adds up to a feature bundle consisting of [+OBJ, −OBL, −F]. In a final step, the parser encounters the noun *Design* which provides gender and number features but no case features: [−M, −F]. To carry out agreement, the features of the incoming sentence material are compared to those of already processed words, that is the sum of preposition and adjective. This means that missing features are copied from the adjective to the noun. The sum of three morphosyntactic features from both the preposition and the adjective—that is [+OBJ, −OBL, −F]—are compared to the *Design*'s [−M, −F] specification. This leads to the final analyses of [+OBJ, −OBL, −M, −F]. O13's results showed an attenuated LAN effect *on* the noun reflecting the integration of the correct preceding adjective *schlichtes*.

For the structure (6a-ii), the parsing process performs similarly until it reaches the adjective: After the preposition *durch*, the prenominal adjective *schlichte* has to be analyzed. From its inflectional affix, no features become available since it is assumed to be radically underspecified. Therefore, the preposition's and the adjective's features turn out not to be incompatible with one another. The former's specification can be copied onto the latter element, leading to a more complete feature bundle at the position of the adjective: There are case features from the preposition—namely [+OBJ, −OBL]—but none from the adjective: [∅]. At the adjective's position, this adds up to a feature bundle still consisting of [+OBJ, −OBL]. In a final step, the parser encounters the noun *Design* which, again, provides gender and number but no case features: [−M, −F]. To carry out agreement, the features of the incoming sentence material are compared to those of already processed words, that is the sum of preposition and adjective. This means that missing features are copied from the adjective to the noun. The sum of three morphosyntactic features from both the preposition and the adjective—that is [+OBJ, −OBL]—are compared to the *Design*'s [−M, −F] specification. This leads to the final analyses of [+OBJ, −OBL, −M, −F]. According to O13's data, the parsing of the structure (6b) yielded a more pronounced LAN effect in comparison to (6a) on the noun reflecting the integration of the incorrect preceding adjective *schlichte*.

The last PP in (6a-iii) is again similar to the previous parses. The same preposition *durch* is followed by a prenominal adjective, namely *schlichten*. This adjective provides the features [+OBJ, −OBL, +M, −F] that become available to the system. In order to carry out agreement, the adjective's case features, if available, are compared to the preposition's features. If they turn out to be compatible or at least not incompatible with one another, possibly missing features are copied. In (6c), both elements' features are compatible since *schlichten* carries the exact same features as *durch*. This leads to a more complete feature bundle at the position of the adjective: There are case features from the preposition—namely [+OBJ, −OBL]—and, depending on the adjective in question, case, gender and number features—here [+OBJ, −OBL, +M, −F]. At the adjective's position, this adds up to a feature bundle consisting of [+OBJ, −OBL, +M, −F]. In a final step, the parser once more encounters the noun *Design*, which provides gender and number features but no case features: [−M, −F]. To carry out agreement, the features of the incoming sentence material are compared to those of already processed words, that is the sum of preposition and adjective. This means that missing features are copied from the adjective to the noun. This time around, agreement cannot be carried out by means of feature copying since the current position's [+OBJ, −OBL, +M, −F] specification is incompatible with the noun's [−M, −F]. It is the [±M] feature that is conflicting. The adjective's [+M] opposes the [−F] that is provided by the noun. ERP data shows the most pronounced LAN effect *on* the noun reflecting the integration of the incorrect preceding adjective *schlichten*.

Besides comparing the incorrect specificity and compatibility violating conditions, the authors also contrasted the nouns' ERP responses of all three genders in the correct conditions. They found the strongest negativities on masculine nouns in the ACC.M.SG (6a-i) in comparison to weaker LAN effects on neuter and feminine nouns in ACC.N.SG and ACC.F.SG conditions in (6a-ii) and (6a-iii) respectively. Interestingly, the amplitude for the masculine noun overlapped with the incorrect incompatible condition. O13 attributed the higher processing load on well-formed masculine PPs to the additional features that had to be compared. The authors analogously concluded that the inflectional system attempted to keep the number of stored markers as well as their individual processing minimal by employing morphosyntactic underspecification. Evidently, a parsing behavior like this suggests that the language processing system makes use of a morphosyntactically underspecified architecture. This particular finding will be re-addressed in Section 2.6.

The reasoning behind this conclusion, though, is questionable. As mentioned above, the authors associated the different LAN amplitudes with the processing load when comparing agreement features *between* the adjective and the subsequent noun. However, the LAN effects were obtained *on* the noun's position. No effects were reported for the adjective *on* the adjective's position. It could be objected that measuring position Y reveals the system's response to this very position Y in relation to its preceding position X. What the obtained data of position Y does not transparently reveal, is the system's response to the prior position X. Nevertheless, O13 tried to draw conclusions *about* the adjective's adhering to or violating of specificity and compatibility by interpreting the ERP effects measured *on* the subsequent noun. But what the authors rather did was making statements on the position they measured, namely the noun. This is not intuitive. It would be more reasonable to draw conclusions about online processing at the word that is checked for its featural setup. What happens on the adjective, should primarily be measured on the adjective, and what happens on the noun, should primarily be measured on the noun. Only if the two adjacent positions provided ERP responses, they could have been compared and assumptions could have been made about what happens between them. It shall be further noted that the authors used a seemingly unusual presentation method. While they showed the PP word-by-word with a stimulus presentation time of 400 ms, they deployed a very long inter-stimulus-interval of 300 ms. This can lead to a very slow and unnatural reading experience and may additionally reinforce the issue of real-time measurements.

Despite these issues, it still can be concluded that O13 provided strong evidence that "an inflectional system that consists of a set of underspecified markers can arguably be viewed as OPTIMAL from an optimal design perspective on language" (O13, p. 259). The authors attributed these data to the numbers of features which had to be compared. These results are only compatible with an underspecification account.

2.5 Processing Load due to Specifications' Complexities

Further evidence for morphosyntactic underspecification came from Leminen and Clahsen (2014). Like the already cited literature, they also investigated German strong adjective inflection. The authors conducted two cross-modal ERP priming experiments of which the first is not relevant for morphosyntactic underspecification. In the second experiment, similar to Clahsen et al. (2001), they tested adjectives like *kleine*, *kleines* and *kleinem* and constructed prime-target pairs with -*s*/-*e* and -*m*/-*e* affixes in comparison to an identity condition. Leminen and Clahsen (2014) predicted a more pronounced LAN for -*m* relative to -*s* affixed primes in comparison to the identity pair. This effect should have occurred since—according to the authors—the *m* exponent is specified for [+DAT] that can neither be primed by -*s* or -*e* markers or any other affix. The "unprimability" of [+DAT] is depicted in Table 2.1.

The main result of the second experiment was that the highly specific -*m* affixes produced an unexpected positive effect at around 300 ms after the onset relative to the -*s* and -*e* markers. While the status of this so-called P300 is highly debated (e.g., S. B. R. E. Brown et al., 2015; Donchin, 1981; Nieuwenhuis, 2011; Nieuwenhuis et al., 2005; Polich, 2007; Verleger et al., 2005) and will not be discussed here, a general consensus may be that it reflects, as Leminen and Clahsen (2014, p. 229) carefully put

Table 2.1: Specifications for -*e*, -*s* and -*m* markers (Leminen and Clahsen, 2014, p. 231).

-*e*	-*s*	-*m*
–	[−PL]	[−PL]
–	[−F]	[−F]
–	[−M]	–
[−OBL]	[−OBL]	[+OBL]
–	–	[+DAT]

it, "processes involved in stimulus evaluation and categorization". However, the authors simply "interpret[ed] the reduced P300 for the -*s* prime condition as an indication of facilitated processing demands (relative to -*m* primes), due to shared morpho-syntactic features in the prime and the target" (Leminen and Clahsen, 2014, p. 230). McDowell et al. (2003) argued that the P300 modulation mirrored cognitive workload. It was the [−OBL] feature that is shared between -*s* and -*e* but not between -*m* and -*e* that facilitated processing in the former and obstructed it in the latter case. To make things even more complex, the -*m* also carries [+DAT] which is not part of the specification of -*e*.

If, however, fully specified -*e*, -*s* and -*m* exponents are assumed, then there would *always* be at least one feature that was not part of the specification of another marker. Table 2.2 depicts the nominative feminine singular, nominative neuter singular and dative masculine singular for the -*e*, -*s* and -*m* exponents respectively. Therefore, no facilitating feature overlap would be possible. The effects Leminen and Clahsen (2014) measured could not have occurred. The findings—even though revealed by an unusual ERP effect—are only compatible with an underspecification account.

Table 2.2: Fully specified feature bundles for -*e*, -*s* and -*m* markers.

-*e*	-*s*	-*m*
[−PL]	[−PL]	[−PL]
[+F]	[−F]	[−F]
[−M]	[−M]	[+M]
[−OBL]	[−OBL]	[+OBL]
[−DAT]	[−DAT]	[+DAT]

2.6 Descending Specificity of Masculine, Neuter and Feminine Nouns

In a working paper, Opitz and Pechmann (2014, henceforth O14) further investigated gender feature specification of German nouns. In three reaction time experiments, they examined whether processing differences could be found for masculine, neuter and feminine nouns. They reported that bare nouns seemed to be morphosyntactically underspecified. In this way, they strengthened the argument of underspecification as a global property of the mental lexicon. The authors dealt with the possible objection to O13 being that the different LAN effects for different genders were due to underlying characteristics of the nouns. Therefore, O14 sought to untangle these properties from incremental, syntactic feature-related processes that were subject of O13. In the first experiment, participants had to give grammaticality judgments on the exact same PPs as in O13. The results showed that masculine nouns were judged less accurate and slower than neuter and feminine nouns. In the second experiment, subjects had to perform a lexical decision task on bare nouns. Masculine nouns produced the longest reaction times in comparison to neuter and feminine nouns (in accordance with O13). The last experiment investigated how gender was assigned. The results showed that participants took longer to assign masculine gender than other genders. In conclusion, O14 reported that masculine nouns were judged slower and less accurate while feminine nouns were judged with the shortest reaction time and highest accuracy. The authors concluded that masculine nouns evoked higher processing load in comparison to feminine nouns.

Due to this, they argued that it was not feasible to assume all features—[±M] and [±F]—for all genders in nominal inflection. According to their results, they proposed that masculine nouns should carry more features than neuter and feminine nouns. O14 even argued that neither [−M] nor [+F] may be necessary features of the specifications of nouns. Therefore, they suggested the following feature specifications for nouns in which feminine nouns may be radically underspecified carrying no features at all:

(8) Gender specification of nouns according to O14 (p. 256):
masculine nouns: [+M, −F]
neuter nouns: [−F]
feminine nouns: [Ø]

These findings further showed that underspecification was not limited to the inflectional system. O14 supported the idea that underspecification played a fundamental role in the lexical representation of nouns. The evidence that has been compiled here suggests that capturing redundancy is not limited to the inflectional system. Along O13, O14 concluded that underspecification is a global property of the mental lexicon. Underspecification also seems to be highly relevant in how lexical representations of nouns are stored and processed as it allows the human language system to reduce storage demands. To a certain degree, O14 corroborated O13's proposal even though the original parsing mechanism had to be modified. The newly suggested specification for neuter nouns in (8) forced the authors to revise the parser's operation outlined above due to the structure in (6a-iii). Previously, it was assumed by O13 that the neuter noun *Design* carried a [−M] feature. In this way, the feature incompatibility in (9c) was viewed as the source for the detected ERP effect. But in O14, with the lack of the [−M] feature, there was no longer a clash of these two opposing features:

(9) (In)correct adjective inflections in the ACC.N.SG condition from O13 (p. 245) and O14 (p. 239):

a.	durch$_{[+\text{OBJ},\ -\text{OBL}]}$	schlichtes$_{[-\text{F}]}$	Design$_{[-\text{F}]}$
	by.ACC	plain.N	design.N.SG

→ correct

b.	durch$_{[+\text{OBJ},\ -\text{OBL}]}$	*schlichte$_{[\emptyset]}$	Design$_{[-\text{F}]}$
	by.ACC	*plain.F	design.N.SG

→ incorrect, previously due to specificity violation at noun, but compatible

c.	durch$_{[+\text{OBJ},\ -\text{OBL}]}$	*schlichten$_{[+\text{OBJ},\ -\text{OBL},\ +\text{M},\ -\text{F}]}$	Design$_{[-\text{F}]}$
	by.ACC	*plain.M	design.N.SG

→ incorrect but no longer due to compatibility violation at noun

O13's measured negative ERP effect in (9b) could no longer be attributed to feature incompatibility since the noun turned out to be compatible with its preceding adjective. O14 had to adjust the parsing mechanism insofar as to relocate the source of the stronger ERP negativity away from the incompatibility argument to sub-processes of the feature comparison. They assumed that their processing model worked in bidirectional ways. Depending on which direction the parser measured, compared and copied features, the processing load varied. A search for missing features in forward direction, that is from the features of already processed sentence material to newly incoming sentence material, led to higher processing load and therefore to a more pronounced LAN effect. In the PP **durch schlichten*$_{[+\text{OBJ},\ -\text{OBL},\ +\text{M},\ -\text{F}]}$ *Design*$_{[-\text{F}]}$ from (6a-iii), the parser expected a [+M] feature from the already processed material to be present in the newly incoming noun too. This feature was missing and had to be copied from the already processed items to the newly incoming item. A failing search process in the other direction was less severe as shown in **durch schlichte*$_{[\emptyset]}$ *Design*$_{[-\text{F}]}$ from (9b). In this structure, *Design*'s [−F] could not be found on the preceding *schlichte*. This yielded a minor violation in the search, compare and copy mechanism. Therefore, the LAN was less pronounced. With regard to processing load, the modulation from (7) can be adjusted as in (10):

(10) ACC.N.SG:

structure:	(9a) correct		(9b) incorrect		(9c) incorrect
retrieval failure:	none	<	1 backward	<	1 forward
ERP effect:	baseline	<	stronger LAN	<	strongest LAN

The authors claimed that their new explanation was also compatible with the surprising effect in the correct ACC.M.SG condition. Recall that these structures elicited the most pronounced LAN in comparison to the neuter and feminine condition, matching incorrect PPs. O13 originally explained that effect with the sheer number of feature comparisons in the masculine condition. A high number of feature checks would increase processing load insofar that it matched the effects of compatibility violations. Two qualitatively distinct processes elicited the same effect on two qualitatively different conditions. Unfortunately, O14 retained O13's argument with regard to high number of feature comparisons. The problem with this is that, within that argument, a single mechanism leads to the same effect under two qualitatively different conditions. Not only failing retrievals will lead to processing load but also successful searches if they are numerous.

This is not the only issue that O14's new parsing mechanism exhibited. Note that O14 explained their revised parsing mechanism only based on O13's ACC.N.SG condition since, suddenly, their new findings did not match the old ERP results. For these correct and incorrect structures, their overhauled parsing mechanism perfectly predicted the obtained ERP data from O13 and the behavioral results from O14. Not addressing the other conditions suggests that either the old or the new explanations holds true for the ERP data. But transferring O14's revised argument for the ACC.N.SG condition in (9) to O13's remaining conditions ACC.F.SG in (11a) and ACC.M.SG in (11b) respectively, entailed substantially different predictions than the ones O13 derived, tested and confirmed. In order to demonstrate the actually deviant outcomes, the nouns' features of (6) have to be adjusted to the new specification of (8). Thus, the feminine noun *Struktur* in (11a) is now featureless while the masculine *Geschmack* in (11b) retains its two features. In both incorrect cases, the backward-looking feature search is to no avail since *Geschmack* is featureless. However, the incorrect ACC.F.SG condition in (11a-ii) reveals that in the PP *durch schlichten Geschmack*, the adjective cannot find its [+M, −F] features on the subsequent radically underspecified noun.[18] Thus, two feature retrievals fail. Turning to the other incorrect ACC.F.SG in condition (11a-iii), only one feature search fails, namely *schlichte*'s [−F] cannot be found on *Geschmack*. This means that there is an asymmetry between the two incorrect conditions.

(11) (In)correct adjective inflections from O13 (p. 245):

a. ACC.F.SG:

i.	durch$_{[+\text{OBJ}, -\text{OBL}]}$	schlichte$_{[\emptyset]}$	Struktur$_{[\emptyset]}$
	by.ACC	plain.F	structure.F.SG
ii.	durch$_{[+\text{OBJ}, -\text{OBL}]}$	*schlichten$_{[+\text{OBJ}, -\text{OBL}, +\text{M}, -\text{F}]}$	Struktur$_{[\emptyset]}$
	by.ACC	*plain.M	structure.F.SG
iii.	durch$_{[+\text{OBJ}, -\text{OBL}]}$	*schlichtes$_{[-\text{F}]}$	Struktur$_{[\emptyset]}$
	by.ACC	*plain.N	structure.F.SG

b. ACC.M.SG:

i.	durch$_{[+\text{OBJ}, -\text{OBL}]}$	schlichten$_{[+\text{OBJ}, -\text{OBL}, +\text{M}, -\text{F}]}$	Geschmack$_{[+\text{M}, -\text{F}]}$
	by.ACC	plain.M	taste.M.SG
ii.	durch$_{[+\text{OBJ}, -\text{OBL}]}$	*schlichtes$_{[-\text{F}]}$	Geschmack$_{[+\text{M}, -\text{F}]}$
	by.ACC	*plain.N	taste.M.SG
iii.	durch$_{[+\text{OBJ}, -\text{OBL}]}$	*schlichte$_{[\emptyset]}$	Geschmack$_{[+\text{M}, -\text{F}]}$
	by.ACC	*plain.F	taste.M.SG

Following O14's argument, their parsing system would predict a stronger ERP effect for the incorrect (11a-ii) than for the incorrect (11a-iii) in comparison to the correct

[18] Note that as in O14, here, the view is also limited to gender features since they are the only ones that differ from adjective to adjective. Identical case features—namely [+OBJ, −OBL]—are unitarily provided by the preposition *durch*.

(11a-i). However, O13 predicted and detected uniform ERP effects for the two incorrect PPs in the ACC.F.SG condition. The elicited negativities did not differ significantly. In this respect, O14's revised parsing mechanism cannot account for O13's previous ERP data as their gradations in (12) mismatch.

(12) ACC.F.SG:

structure:	(11a-i) correct		(11a-ii) incorrect		(11a-iii) incorrect
retrieval failure:	none	<	2 forward	>	1 forward
ERP effect:	baseline	<	stronger LAN	=	strongest LAN

The picture becomes even more obscure when looking at the ACC.M.SG condition in (11b-ii). Again, when applying the same argument that worked for the ACC.N.SG condition, an asymmetry occurs between the two incorrect conditions (11b-ii) and (11b-iii). It is not possible to disentangle (11b-ii) from (11b-iii) with regard to the forward-looking search. For both conditions, the forward-looking search from *schlichtes*' [−F] in (11b-ii) and *schlichte*'s empty feature set in (11b-iii) to the subsequent noun at least entails no failed retrieval. But the following questions are obvious: Is a lack of features like in (11b-iii) advantageous for processing? Or is rather the feature identity between *schlichtes*' and *Geschmack*'s [−F] felicitous? For the time being, this shall not be answered but be viewed in a conservative way and treated as it would elicit no different ERP results. What will ultimately be decisive for processing load, is the backward-looking feature retrieval even if it may be viewed as being less severe if failed. In the incorrect PP in (11b-ii), only one feature of the masculine noun cannot be found on the preceding adjective *schlichtes*, namely *Geschmack*'s [+M]. In comparison to that, in the other incorrect PP in (11b-iii), there are two features of the masculine noun that cannot be retrieved on the preceding radically underspecified adjective *schlichte*, namely [+M, −F]. While O13 neither predicted nor recorded significant differences between the two incorrect ACC.M.SG conditions as both should only violate specificity, the new parser by O14 made the assumption that (11b-iii) should be harder to process than (11b-ii). Similarly to the ACC.F.SG condition, O13's ERP data cannot be mapped onto O14's new assumptions as depicted in (13).

(13) ACC.M.SG:

structure:	(11b-i) correct		(11b-ii) incorrect		(11b-iii) incorrect
retrieval failure:	none	<	1 backwards	<	2 backwards
ERP effect:	(strong) LAN	=	(strong) LAN	=	(strong) LAN

To conclude, O14 did not present uniform data and results. Nevertheless, they were still able to advocate underspecification as a systemwide characteristic of the human language system since one conclusion can be retained: Graded ERP or behavioral results should not have occurred if underspecification was to be denied. If, instead, a full specification account would be pursued, either incompatibility (O13's account) or numerous failing feature retrievals in both directions (O14's explanation) should have arisen. Morphosyntactic underspecification thus is still an adequate explanation. The positive side effect that comes with it is that it allows for reducing storage demands and processing efforts by "keeping the number of required sub-processes, i.e. search operations, to a minimum" (O14, pp. 258-259). Opitz and Pechmann (2016), seemingly a slight revision of the O14 working paper, also endorsed the idea of morphosyntactic underspecification in the mental lexicon by retaining O14's experimental results and conclusion about the new specification of nouns from (8). However, they did not only drop the argument about feature checking entirely but also neglected the drastic implications of the new noun specifications on the parses in (11). In doing so, they failed to revise O13's parsing mechanism which is necessary as laid out above. One can only speculate about the reasons why Opitz and Pechmann (2016) dropped the parser from O14. The fact that their system predicted effects that would greatly depart from the predictions and findings of O13 may be one of them.

2.7 Interim Conclusion: Parsing with Features

In Chapter 2, it was established that underspecified morphosyntactic features may not only be a part of theoretical lexical entries as in Figure 1.6 but that they seem to have an equivalent in the mental representation of inflected items as depicted in Table 2.3. Sections 2.1 and 2.2 suggested that inflectional paradigms comprised morphosyntactically underspecified lexical entries.

Table 2.3: Correspondence between theory-based lexical entry and its mental representation.

theory	↔	mental representation
[entry number /phonological representation/ morphosyntactic features syntactic features SEMANTIC REPRESENTATION]	↔	[entry number morphosyntactic features]

In addition to that, the presented data of Sections 2.3 to 2.6 corroborated the idea that underspecified morphosyntactic features also played a significant role in language processing and architecture of the mental lexicon. This assumption comes with a positive side effect: Employing underspecified entries reduces memory load in the mental lexicon. Compared to an account proposing maximal specification, underspecification allows the language system to thrive towards a parsimonious and optimal architecture by reducing the number of stored elements as well as their individual constituting features.

Nevertheless, various issues came to light. Section 2.3 revealed that Penke et al. (2004) may have over-interpreted their results with regard to incrementality. The authors presented full sentences and measured the participants' response time determining the sentences' identity. The researchers phrased their results in a way that suggested an incremental parsing mechanism being at work as they attributed the reaction time differences to the quality and quantity of failed and successful feature checks. O13, on the other hand, conducted an ERP study and deployed a presentation technique that indeed allowed for conclusions with regard to incrementality. They sought to investigate the language processing system's behavior at the transition from one word to another. They controlled this point of contact by manipulating the inflectional status of the adjective. Unfortunately, O13 drew conclusions on the preceding word but obtained ERP responses on the subsequent position. This method may not provide reliable data to draw conclusions about the morphosyntactic transition from one word to another. Nevertheless, the authors provided a briefly sketched parsing mechanism that operated at word transition.

O14 offered additional insight into the inflectional system by studying the morphosyntax of nouns. Due to their experimental results that were revealed to be partially incompatible with O14's ERP data, a revision of the parser sketched in O13 became necessary. Surprisingly, O14 got re-released as Opitz and Pechmann (2016) in which the authors tacitly dropped the entire parsing argument altogether. In doing so, the authors retroactively also abandoned the original but defective idea from O13. Reasons for that may be a non-stringent complication of the mechanism: For the new version of their parsing system, they deprived the original mechanism of specificity and compatibility as principles of feature checking in favor of explaining the mode of operation solely by means of forward and backward-looking feature retrievals. However, they revised it only to the extent that it accounted for one condition of O13. O14 missed the fact that their new system would make different predictions for two of the other conditions that were originally tested in O13. Nevertheless, the authors basically sticked to the transition that was originally outlined by O13.

Figure 2.1 envisions this transition. The illustration does not show unanalyzed linguistic material. Rather, the rounded squares represent lexical entries or some version of them with which a language processing system could operate. In accordance to O13's PPs, the first rounded square is a placeholder for a preposition, the second for an adjective and the subsequent and third for a following noun. Following the insight from Table 2.3, the top half would be associated with phonological or graphemic properties—depending on the input modality—physically identifying the lexical item, while the bottom half would contain the respective morphosyntactic information. Delineated extensively in Chapter 4, it is this contact point of morphosyntactic features that will be cast into a comprehensive parsing mechanism and empirically investigated in the present dissertation.

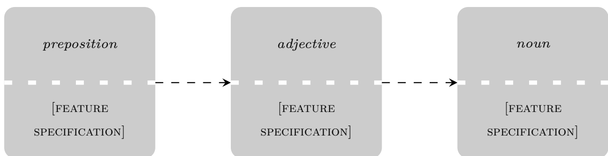


Figure 2.1: Illustration of O13's contemplated transition from an adjective to a noun.

3 Subject-Object Ambiguities

If morphosyntactic underspecification is really that important for the architecture of the inflectional system, the following question is obvious: Does the human language comprehension system make use of this kind of information in sentence processing as claimed in the preceding section? A secondary question is how a potential usage of morphosyntactic underspecified features could be investigated in online sentence comprehension. Therefore, adequate sentence material has to be found to test a theoretical processing mechanism. Crucially, such a parsing mechanism has to be formulated beforehand. This parser would allow to make clear-cut position-dependent predictions about the incremental buildup process of a particular structure. But how could such a structure look like?

A counterargument for such an undertaking would be that O13 clearly already tested such a hypothesis as described in Section 2.4. But it has to be kept in mind that O13 only tested prepositional phrases that were restricted to one syntactic context. The German inflectional system is much more elaborate than what accusative singular PPs have to offer. It is necessary to test more syntactic contexts in order to establish the claim that the theoretical construct of morphosyntactic underspecification has a neurocognitive counterpart. Ideally, the contemplated sentence material would have to cover various grammatical cases, numbers and genders. Thinking of such sentence material, one particular phenomenon of German, that has generated an abundance of theoretical and empirical literature, comes to mind: subject-object ambiguities as in the starting example (1) or (4). The link should be self-evident: What makes these ambiguities actually possible, is nothing but syncretic case marking that has been discussed extensively in Chapter 1. In the examples (4a–4c), the first DP is ambiguous because of the syncretic nature of the determiner *die* for both nominative and accusative. The corresponding paradigm in Table 1.1 does not distinguish between the two cases via two separate exponents but with only one homophonous marker that collapses both cases across feminine singular and plural forms. The claim that is made here offers a new interface between subject-object asymmetries in German and the processing load generally associated with these structures. This interface is morphosyntax, syncretism to be precise.

Therefore, the present investigation goes farther than O13's and O14's studies as it extends beyond accusative masculine singular structures. In Chapter 4, eventually, a system that is designed to build up predictions and analyses from underspecified morphosyntactic features shall be introduced. Its goal is to provide an alternative view on argument interpretation aside from common structural reasoning. In order to do so, literature on the processing of subject-object ambiguities in German will be discussed firstly. As already shown in (4), German exhibits the phenomenon of ambiguous noun phrases. These ambiguities can be locally unassigned with regard to their grammatical functions of subject and object. Verbs, however, assign nominative case to subjects and accusative case to direct objects (Gorrell, 2000). Ultimately, the system's inability to distinguish syntactic functions may give rise for processing load at a point in time when a structure requires a specific analysis to turn out grammatical. Understanding the processing of such ambiguities has been subject to an abundance of psycholinguistic literature.

3.1 Subject Preference

Hemforth (1993), for instance, investigated the online processing of case-ambiguous DPs as in (14), a repetition of (4), in eye tracking studies. She reported slower reading times for the second argument DP being marked for nominative rather than accusative. Hemforth (1993) concluded that sentence-initial DPs which were ambiguous between nominative and accusative were integrated preferably as subjects in nominative case.

The ambiguity of the first DP can be resolved by the overt case marking of the second DP or by the number agreement information of the verb. In (14), the DP *die Botschafterin* ("the ambassador") is case-ambiguous and therefore not uniquely assignable to a particular syntactic function. The DP can either be a subject in nominative or a direct object in accusative case. However, the second DPs *den Minister* and *der Minister* in (14a) and (14b) respectively are not ambiguous since case is not neutralized for the masculine strong determiners. Therefore, the second DPs are unequivocally marked for accusative realizing a direct object in (14a) and for nominative realizing a subject in (14b) due to the verb's subcategorization. Conversely, (14a) and (14b) are locally ambiguous up to the disambiguating case marking of the second DP. For these structures, Hemforth (1993) showed that (14b) was "harder to process" (Bader et al., 2000, p. 35). The increased reading times were attributed to a reanalysis of the structure. This kind of ambiguities are known for their garden path effects. In Hemforth (1993), participants took significantly longer to read the unexpected object-before-subject order. These prolonged reading times were due to a reanalysis of the structure in question.

(14) a. Die Botschafterin besuchte den Minister.
the.NOM/ACC.F ambassador.NOM/ACC.F visited the.ACC.M minister.ACC.M
"The ambassador visited the minister."

b. Die Botschafterin besuchte der Minister.
the.NOM/ACC.F ambassador.NOM/ACC.F visited the.NOM.M minister.NOM.M
"The minister visited the ambassador."

c. Die Botschafterin besuchte die
the.NOM/ACC.F ambassador.NOM/ACC.F visited the.NOM/ACC.F

Ministerin.
minister.NOM/ACC.F

"The ambassador/minister visited the minister/ambassador."

In comparison to (14a) and (14b), the structure (14c) is globally ambiguous since the second DP *die Ministerin* does not provide disambiguating, overt case marking. The DPs are unascertained with regard to their case and grammatical function. Various structure-based proposals have been made to account for this well documented phenomenon. Considering the movement-based Active Filler Hypothesis (e.g., Clifton and Frazier, 1989; Frazier, 1987), an encountered filler has to be assigned to a gap as soon as possible. To achieve this, the word order of a main declarative clause is derived by two movements. Both the finite verb and the argument DP are moved from their base-generated SOV locations to the CP's head and specifier position respectively as illustrated in Figure 3.1. For (14), this means that, as soon as the parser encounters the finite verb *besuchte*, it can predict a gap in the subject position which can be filled ultimately with the clause-initial DP. This holds true for both structures in (14a) and (14b). Therefore, the next DP must not be nominative-marked. While this prediction is fulfilled in (14a), the second argument in (14b) is marked for nominative which will cause processing difficulty. This structural explanation is the manifestation of the phenomenon referred to as "subject preference" (henceforth SP). This SP is structurally predicted irrespective of construction frequency (Levy, 2008). In comparison to that, (14c) is processed like (14a).

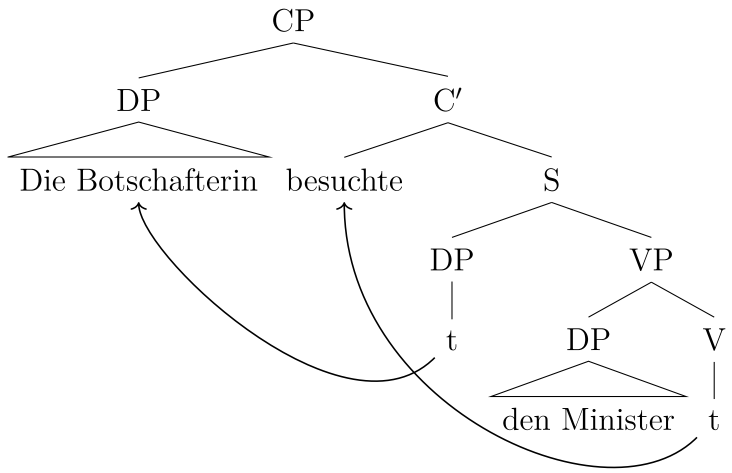


Figure 3.1: Structure of sentence (14c).

3.2 Processing Load due to Non-Canonical Structures

Like O13, Rösler et al. (1998) also conducted an ERP experiment expecting a LAN elicited by a morphosyntactic manipulation. This manipulation concerned ditransitive constructions. As already mentioned in Section 1.1.3, German allows to freely change the order of syntactic arguments due to its case marking capabilities. The examples in (15)[19] show three out of six possible word order permutations (Rösler et al., 1998, p. 153). Consider the first syntactic role: The initial DP can either be marked as a subject in nominative in (15a), as an object in dative in (15b) or as an object in accusative in (15c):

(15) a. Dann hat der Vater dem Sohn den Schnuller gegeben.
then has [the father].NOM.M [the son].DAT.M [the pacifier].ACC.M given
"Then the father gave the pacifier to the son."

b. Dann hat dem Sohn der Vater den Schnuller gegeben.
then has [the son].DAT.M [the father].NOM.M [the pacifier].ACC.M given
"Then the father gave the pacifier to the son."

c. Dann hat den Schnuller der Vater dem Sohn gegeben.
then has [the pacifier].ACC.M [the father].NOM.M [the son].DAT.M given
"Then the father gave the pacifier to the son."

In fact, rearranging the sentence arguments even further yields three additional permutations. However, according to linear precedence principles by Uszkoreit (1986), not all six argument configurations are equally acceptable for native German speakers. A subject should precede both an object in accusative and dative while dative should precede accusative. Rösler et al. (1998) argued that the participants' brain responses mirrored the amount of processing load induced by the number of violated linear precedence principles. Consequently, for the first syntactic argument of structures like (15), they expected a more pronounced LAN effect for (15b) in comparison to (15a) since *der*—according to the authors—was able to introduce the expected subject in nominative. Furthermore, they hypothesized a stronger LAN for (15c) in comparison to (15b). Participants had to read visually presented ditransitive structures like (15) word-by-word after which they had to answer a comprehension question. During the trials, their brain responses were recorded. While behavioral results showed that indeed the preferred sequence of syntactic roles was the canonical order of subject before indirect object before direct object, the ERP data revealed a more detailed picture. For the first DP, the authors could report a more pronounced LAN for the determiners introducing objects in comparison to the *der* that introduced the subject in nominative. Furthermore, the initial *dem* evoked a stronger LAN effect than the corresponding *den*. This effect was reversed for the second argument position for subject-initial structures: The non-canonical *den* evoked stronger effects in comparison to *dem*. Rösler et al. (1998) discussed this second finding in light

[19] Notation: Other than in the previous examples (2)–(14), agreeing determiners and nouns will not be glossed individually but as combined DPs with square brackets. Footnote 6 still applies.

of the expected canonicity effect predicted by the linear precedence principles. In line with that were the results for the first DP insofar as indirect and direct object determiners significantly differed from the *der* DP. However, the authors did not discuss the difference between the stronger indirect object's *dem* and the direct object's *den* that elicited a weaker effect.

3.3 Structural Simplicity Entails Facilitated Processing

Similar to Rösler et al. (1998), Matzke et al. (2002) tested canonical subject-first sentences like in (16a) and (16c) and non-canonical object-first sentences as in (16b) and (16d) in an ERP study. The authors' basic claim was that (16b), displayed in Figure 3.2b, entailed a more complex syntactic structure than (16a), depicted in Figure 3.2a. Experimental items also contained additional prepositional phrases after the verb and preceding the second DP. ERPs were recorded for each word.

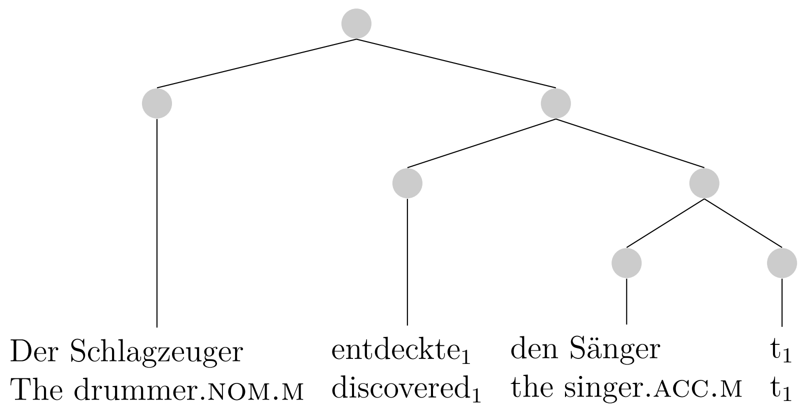
(16) a. Der begabte Sänger entdeckte den talentierten
[the gifted singer].NOM.M discovered [the talented
Gitarristen.
guitar player].ACC.M
"The gifted singer discovered the talented guitar player."

b. Den begabten Sänger entdeckte der talentierte
[the gifted singer].ACC.M discovered [the talented
Gitarrist.
guitar player].NOM.M
"The talented guitar player discovered the gifted singer."

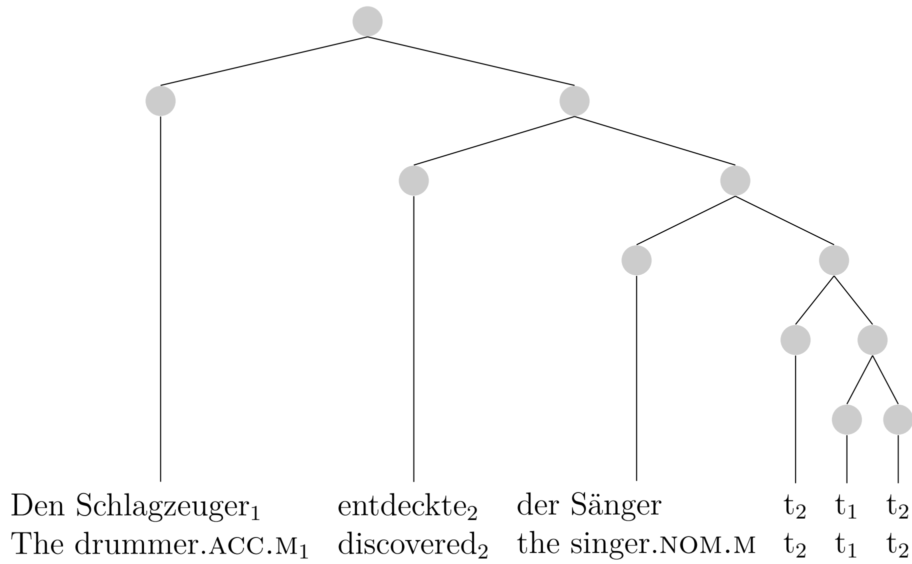
c. Die begabte Sängerin entdeckte den talentierten
[the gifted singer].NOM/ACC.F discovered [the talented
Gitarristen.
guitar player].ACC.M
"The gifted singer discovered the talented guitar player."

d. Die begabte Sängerin entdeckte der talentierte
[the gifted singer].NOM/ACC.F discovered [the talented
Gitarrist.
guitar player].NOM.M
"The talented guitar player discovered the gifted singer."

For the determiner position of the first DP, the authors could not find a difference between *die* from (16c) in the canonical and *die* from (16d) in the non-canonical order. This was to be expected since both determiners were ambiguous between a canonical word order with an initial subject in nominative case and a non-canonical word order with an initial object in accusative case. The parser had no additional input to assume a structure different from a subject-first analysis. The fact that the parser followed a subject-before-object analysis was corroborated by the results of the second DP for both conditions (16c) and (16d). At this position, Matzke et al. (2002) reported a negativity as well as a P600 for the non-canonical condition (16d) in comparison to the canonical sentence (16c). Turning to the masculine conditions, the non-canonical *den* in (16b) elicited a negativity in comparison to the canonical structure in (16a). As foreshadowed by the authors, the results showed "that a 'subject-first' reading will be preferred" since it "is a useful heuristic" (Matzke et al., 2002, p. 845).



(a) Simple tree structure.



(b) More complex tree structure.

Figure 3.2: Syntactic tree structures of the sentences sentence (16a) and (16b) from Matzke et al. (2002, p. 845).

3.4 Special Status of Nominative Case

In Schlesewsky and Frisch (2003), the authors argued that accusative and dative case differed from nominative insofar that the latter held a special status being a default case. According to their reasoning, this peculiar property allowed the left-dislocated DP in (17) to "be realized with either dative or nominative case marking, but not with accusative" (Schlesewsky and Frisch, 2003, p. 64). They argued that nominative could be used as a default case even though a different grammatical case marking would be necessary (Schlesewsky and Frisch, 2003, p. 64). The authors stated that for ungrammatical subject-initial structures like in (18), the error detection rate was higher for (18a) than for (18b) (Schlesewsky and Frisch, 2003, p. 62).

(17) Dem Pfarrer / der Pfarrer / *den Pfarrer, dem helfen wir alle.
[the priest].DAT / [the priest].NOM / [the priest].ACC the help we all
"The priest, we all help him."

(18) a. * ..., welcher Politiker die Minister getroffen haben.
[which politician].NOM.M.SG [the minister].NOM/ACC.PL met have.PL
"... which politician the ministers have met."

b. * Welcher Politiker, glaubst du, traf der Minister?
[which politician].NOM.M think you met [the minister].NOM.M
"Which politician, do you think, met the minister?"

In (18a), the ungrammaticality is induced by the number disagreement at the sentence final auxiliary. In comparison to that, in (18b) the ungrammaticality is due to the second DP which is also, like the sentence initial DP, marked for nominative case. The authors claimed that there was a fundamental difference in discovering a mismatch in number or case. In order to corroborate their claim, Schlesewsky and Frisch (2003) conducted a speeded-acceptability judgment experiment. Participants had to judge the acceptability of transitive grammatical structures as well as ungrammatical double case-marked sentences like (18b) as fast as possible. These structures were double-marked for either nominative, accusative or dative. Examples (19a–19c) illustrate this illicit case marking (Schlesewsky and Frisch, 2003, pp. 65–66):

(19) a. * Welcher Kommissar aus der Vorstadt lobte der Detektiv?
[which inspector].NOM.M from the suburbs commended [the detective].NOM.M

b. * Welchen Kommissar aus der Vorstadt lobte den Detektiv?
[which inspector].ACC.M from the suburbs commended [the detective].ACC.M

c. * Welchem Kommissar aus der Vorstadt half dem
[which inspector].DAT.M from the suburbs helped [the
Detektiv?
detective].DAT.M

The authors found a grammaticality effect for correct versus incorrect sentences. For the latter, they also reported significantly less reliable judgments for double nominative-marked structures. This means that more responses were given judging incorrect double nominative structures as grammatical in comparison to the equally ungrammatical accusative and dative counterparts. For the latter two, the authors could not find a significant difference in accuracy or latency. Schlesewsky and Frisch (2003) claimed that existing explanations could not cover the results as nominative and accusative should have behaved identically since they were both structural cases. To conclude, the researchers argued for a special status necessary to describe nominative's unique properties within the case hierarchy.

3.5 Subject Preference due to Structural Simplicity

Bornkessel et al. (2004) also examined subject-object ambiguities. Embedded clauses in the experimental sentences consisted of a first and a second argument followed by a verb. The arguments' order was either canonical (nominative followed by accusative) or non-canonical (accusative followed by nominative). The second argument evoked an N400 effect in the canonical but not in the non-canonical order. The authors interpreted this result as the parser's preference to integrate the first encounterable DP as an argument of an intransitive sentence. In contrast to that, the initial accusative triggered the parser to immediately abandon the assumption of an intransitive structure. The system unambiguously expected a second argument marked for nominative. Conversely, in the canonical order, the parser encountered the accusative-marked second argument with its preference for the intransitive structure. Therefore, the second, nominative-marked argument in the non-canonical order could be integrated more easily than the second, accusative-marked argument in the canonical order. Accordingly, Bornkessel et al. (2004) viewed these results as an argument for an SP. In line with this reasoning was the effect of a so-called scrambling negativity which was elicited in an object-before-subject order for an initial accusative-marked object (e.g., Bornkessel et al., 2002, 2003b; Rösler et al., 1998; Schlesewsky et al., 2003b).

3.6 Interim Conclusion: Minimality

As it turns out, the research discussed above as well as other studies have at least one of the following three things in common: Firstly, Bornkessel et al. (2004, 2002, 2003b), Hemforth (1993), and Schlesewsky et al. (2003a) among other studies from above investigated full phrases. This hinders the authors to make clear-cut predictions at the transition from one word to another.

Notably, this leads to the second common denominator: By looking at entire phrases, Bornkessel et al. (2004, 2002, 2003b), Hemforth (1993), Matzke et al. (2002), Rösler et al. (1998), and Schlesewsky et al. (2003a,b) among others neglected the syncretic nature of the tested determiners. None of the researchers acknowledged the fact that—as already discussed in Chapter 1—*der* is not exclusively reserved for nominative masculine singular but also appears in oblique cases across gender and number. Similarly, *den* does not solely occur in accusative masculine singular but also in dative plural. By disregarding these differences, the researchers restrained their explanatory power for the phenomenon they sought to investigate. The present thesis, in contrast, will cover these issues in order to establish a more thorough, yet also more fine-grained picture.

However, along the studies introduced above and an abundance of further literature on argument processing in German (e.g., Bader and Meng, 1999; Hopf et al., 1998; Meng and Bader, 2000), a third common denominator can be isolated. The general gist of the literature is that structure-building is enabled by simplicity. Generally speaking, the explanations of this phenomenon may be viewed as an amalgamation of strategies that favor the "advantage for less complex representations and dependencies" over more complex ones or the "preference for smaller structures" (Bornkessel-Schlesewsky and Schlesewsky, 2009a, p. 1541) over larger ones. This understanding of minimality can be traced back for example to Frazier and Fodor (1978), Inoue and Fodor (1995) and Fodor (1998). The latter described the system's "general laziness" even as its "way of life" (Fodor, 1998, p. 292). However, the principle is by no means limited to syntax. Burkhardt and Domahs (2009) dedicated an entire Special Issue in *Lingua* to the notion of minimality in linguistics. The researchers that contributed to this Special Issue unearthed empirical evidence that minimality played a role at the interfaces of phonology (Buchwald, 2009; Knaus and Domahs, 2009), morphology (Roehm and Haider, 2009; Scharinger, 2009), syntax and semantics (Bornkessel-Schlesewsky and Schlesewsky, 2009a; Häussler and Bader, 2009). Even more generally, minimality seems to even be relevant to the neurobiology of language processing (Friederici, 1999, 2002). These findings led Bornkessel (2002) to formulating a holistic, cross-linguistically and neurobiologically plausible account towards argument processing in language (see also Bornkessel and Schlesewsky, 2006; Bornkessel-Schlesewsky and Schlesewsky, 2009c, 2016): the Extended Argument Dependency Model (eADM).

Bornkessel and Schlesewsky (2006, p. 790) understood Inoue and Fodor's (1995, p. 35) notion of "Minimal Everything" as an "overarching least-effort principle" of the human language comprehension system. Its goal was to "assign[...] minimal structures [...] in the absence of explicit evidence to the contrary" (Bornkessel and Schlesewsky, 2006, p. 790). The idea of minimality will also be important for the remainder of the study at hand. The subsequent Chapter 4 will raise awareness for an obvious connection to a similar term.

4 The Morphosyntactic Parser

Chapter 2 demonstrated that the available research on the inflectional system is defined by the goal to capture a form of efficiency that seems to be inherent in its architecture. The literature on the processing part of inflection refers to this kind of economy with the term of "optimality". Comparably, Chapter 3 showed that investigations on argument interpretation and syntactic parsing are essentially driven by the idea that structural simplicity may guide linguistic processing. Researchers use the term "minimality" to describe this notion of thriftiness. Obviously, both fields share a similar understanding of how to motivate these seemingly unrelated phenomena: parsimony. However, a pivotal insight can be obtained from bringing together both research areas: In German, syncretism is the key phenomenon that enables subject-object ambiguities. It is this observation that, crucially, not only justifies bringing together the two research areas but also emphasizes the necessity of the present dissertation. However, it is also the overlap in the aforementioned spirit with regard to parsimony that further licenses crossing both fields. Their fusion will culminate in the formulation of *The Morphosyntactic Parser* (henceforth TMP) in the coming sections.

This chapter's structure is threefold: Section 4.1 sets the stage for the later in-detail explanation of TMP's mode of operation. In particular, the model's status compared to existing processing literature will be examined, while it is also necessary to define its sphere of influence. The outcome of this is a short summary on TMP's theoretical and practical boundaries. After that, and most importantly, TMP's inner workings will be explained in Section 4.2. This section will motivate the above-mentioned fusion. It will establish TMP's inner workings and give reasons why its internal mechanism reflects the aforementioned notion of parsimony. Therefore, the model's individual steps and sub-processes will be meticulously delineated and eventually exemplified. Section 4.3 will conclude the chapter with two short test runs that will deal with structures from Chapters 2 and 3.

4.1 The System's Environment

In order to have a starting point from which claims can be derived, TMP has to be located in relevant theory and practically confined within a field of operation. Section 4.1.1 will argue that TMP can find its place in the aforementioned eADM. Consequently, this proposal sets the radius in which TMP will eventually operate. Therefore, Section 4.1.2 defines the model's area of operation and determines the kind of sentences it will have to process. This will result in tight descriptive limitations in Section 4.1.3.

4.1.1 Relation to existing theory

With regard to TMP's theoretical place in relevant argument processing literature, the aforementioned eADM by Bornkessel and Schlesewsky (2006) has to be taken into account. Their model describes the linking of semantic to syntactic roles by means of a three-phase cascading processing architecture. While the first phase provides basic syntactic templates for predicating and non-predicating elements like verbs and nouns, Phase 2 is primarily concerned with thematic roles. Bornkessel and Schlesewsky (2006) followed Primus (1999) by breaking the notion of multiple thematic predicates down to two generalized semantic roles: actor and undergoer. They can be distinguished based on "their dependency relative to each other" (Primus, 1999, p. 52). The authors assumed "that the language processing system endeavors to identify the participant primarily responsible for the state of affairs (the actor) as quickly and unambiguously as possible" (Bornkessel-Schlesewsky and Schlesewsky, 2016, p. 358). In order to interpret "whether it is the actor or the undergoer of the event being described" (Bornkessel and Schlesewsky, 2006, p. 789), various information sources such as prominence hierarchies for nouns or logical structure and voice for verbs were considered. Phase 3 eventually maps predicating and non-predicating elements with extra-core information like world knowledge, frequency information and plausibility.

The proposal put forward here should not be understood as a competing model or as just another one in a long line of theoretical approaches but rather as complementing eADM. TMP may fit nicely into the eADM as the former can be viewed as zooming in to one particular aspect of the latter. The model's Phase 2b, a subdivision of the second phase, is relevant for argument encoding and interpretation and therefore of particular interest for the phenomenon of the SP: In absence of any relational information, Bornkessel and Schlesewsky's (2006) notion of an SP can be considered insofar as the system needs to extract the number information from the initial argument and wait for compatible or incompatible features. Whereas, within the eADM, the determination of whether or not the [±AGRT] feature is met, does not rely on meticulous feature specification, the approach put forward here solely refers to the morphosyntactic features that are provided by the input elements. Accordingly, the assignment of [±AGRT] from Bornkessel and Schlesewsky (2006) will be modeled in terms of satisfying the more fine-grained feature principles that will be defined in the following line of argumentation. In other words, setting [±AGRT] will be further decomposed. As [±AGRT] is set whenever these feature-related processes can retrieve necessary information at the current item, the proposal at hand will—like the eADM—also dispose of any hierarchical phrase structures. Instead, the approach put forward here investigates the transition from one element to another in a completely flat manner in terms of structure. On these grounds, the claim will be made that, if the language processing system indeed relies on morphosyntactic features, and if this approach is to be modeled inside the eADM, its locus would have to be implemented wherever ASSIGN [±AGRT] is involved in its Phase 2.

However, this kind of operation not only applies to the transition from one word to another but is also concerned with preference-guided processing. Bornkessel and Schlesewsky (2006) basically modeled their idea of an SP by assigning the agreement feature [+AGRT] to the first argument. Without prior prominence information from Phase 2a, information flows based on the crucial minimality principle directly from positional information to "assign agreement" in Phase 2b. The first argument which was previously encoded is assumed to be assigned [+AGRT]. This is an effective way to interpret an initial argument in absence of any relational information. Since in German the subject agrees with the finite verb, this initial argument needs to be nominative-marked. This strategy can be viewed as a source of the SP. As long as the subsequent arguments' and verb's agreement properties are compatible with the preceding input, this analysis can be upheld. In contrast to that, if agreement is not met, this will lead to increased processing costs because, in order to resolve this agreement error, the [±AGRT] feature has to be re-indexed relatively to another argument. In other words, the measurable neurocognitive effect of reanalysis of a grammatical function is not due to adopting a deviant phrase structure but rather to a reassignment of the agreement feature [±AGRT]. Therefore, neither abstract and empty categories nor different phrase structures for grammatical function alternations have to be assumed.

Consequently, this is the very interface where a possible SP in the understanding of the present investigation has to be instantiated. On the one hand, the SP can quite literally be described as an overarching umbrella carrying discrete features. The preference can be derived from the parser's expectation to encounter an argument DP which is compatible with a subject in nominative case. Within the frameworks of Bierwisch, Blevins, Wunderlich and Wiese,[20] the SP can be described in detail as a feature-related phenomenon: Recall from the underspecification frameworks from Section 1.1.2 that nominative case can be decomposed into two binary features. Thus, an SP could be specified per approach as depicted in (20). Self-evidently, these SP features cannot be part of the linguistic material. Rather, the SP's nature as an overarching umbrella manifests itself as a system-entailed preference preceding any lexical input in order to affect the subsequent elements. Therefore, the SP will be treated like a placeholder for the approach-specific features of (20) similar to the placeholder of a mental representation of an overtly present preposition in Figure 2.1. In this way, the specification would set the syntactic context for the next element as the prepositions did for the subsequent adjective in Penke et al. (2004) and O13. Insofar, the SP's precursory specification would then "ascribe" nominative case to subsequent words' analyses. As a result, also following Figure 2.1, Bierwisch's SP features from (20) would be implemented as in Figure 4.1. By these means, the SP—or more specifically an SP_{NOM}—and its features could be part of any feature-related processing when encountering subsequent linguistic material. A particular parsing operation—Step 1 in Section 4.2.3—will go into detail on how this "ascription" functions.

(20) SP_{NOM} specification for a subject DP:
Bierwisch: [−OBJ, −OBL]
Blevins: [−OBJ, −OBL]
Wunderlich: [−HR, −LR]
Wiese: [−OBJ, −OBL]

[20] Appendix B.1.5 explains why Müller's approach has to be excluded from this assumption.

However, this is not the only conceivable way to instantiate the preference. Another possible implementation of an SP$_{\text{NOM}}$ is, in fact, not as hard-coded as the first solution in the sense of an overtly specified umbrella. Recall from Section 1.2 that only Blevins actually assumed negative features. Wunderlich and Wiese explicitly described nominative as radically underspecified and thus featureless. The underspecification approaches exhibit the tendency against negative specifications. Therefore, apart from modeling the SP$_{\text{NOM}}$ with an overt specification like in (20), it might also be feasible to implement the SP$_{\text{NOM}}$'s implications without explicit features. The SP$_{\text{NOM}}$ would then perform as a parser-inherent mechanism. This argument will be prominently revisited in Section 4.2.3 when the parser's inner workings will be described.

4.1.2 Space of hypotheses

As the previous section placed TMP virtually within the eADM, this location has immediate consequences for the system's domain and scope. Its space of hypotheses or field of operations is defined by the area in which the model will operate. This will also affect the sentences TMP eventually has to deal with. Section 4.1.2.1 will briefly explain why TMP is limited to morphosyntactic features only. The subsequent Section 4.1.2.2 will discuss the structure and the content of the targeted sentence material and how both will shape TMP.

4.1.2.1 Area of operation

Since the current proposal is envisioned as a complement to the eADM's process of ASSIGNing [±AGRT], its descriptions are viewed as a magnification down to the microscopic level of nothing but morphosyntactic features. By virtue of that, relational or any extra-morphosyntactic information, that is crucial in the global eADM, is cut out from the present assumptions. Consequently, it has to be stressed that TMP cannot and does not make assertions outside of its deliberate and inevitable narrowness. It shall neither be claimed that morphosyntactic features are the sole information source available to the system nor that non-morphosyntactic, relational cues are irrelevant. To the contrary, zooming out and away from the magnified, morphosyntax-related processes may reveal that TMP-like mechanisms compute a wide range of information consisting of semantic, pragmatic, frequency and structural cues at various processing stages within the eADM or other computational models. For these reasons, as a starting point for the proposed system, the thesis at hand reverts to morphosyntactic features only. These features must be provided in a way so that TMP's predictions can be experimentally

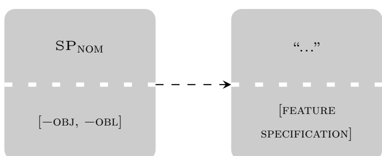


Figure 4.1: Implementation of the SP$_{\text{NOM}}$ with Bierwisch's features from (20).

investigated. This requirement makes the system not only prone to circularity but, in turn, also heavily influences its design.

4.1.2.2 Sentence properties

As indicated above, the structure and the way the sentence material will provide morphosyntactic features will inevitably determine TMP's inner workings as described in Section 4.2. Thus, it is necessary to define the sentences that will be fed into TMP with regard to their structures and their contents. The sentences have to be constructed so that they can be tested by TMP as well as in subsequent ERP experiments. Therefore, structures that are the same for both testing grounds are desired. Identical sentences allow to derive hypotheses from TMP's parsing operations and draw conclusions from the experiments. This is the only way to assess whether or not TMP's parsings can predict position-dependent processing load.

The sentence material's structure itself is determined by the above-mentioned crucial observation that syncretism enables subject-object ambiguities. Therefore, this kind of argument relations shall serve as TMP's field of work. The structures resemble Schlesewsky et al.'s (2003b, p. 32) declarative sentences that were cited in (14). However, they have to be adjusted as follows: The thesis at hand seeks to investigate the presence or absence of an SP_{NOM} that may or may not loom above the integration of linguistic material. Section 4.2.3 will discuss different manifestations of the SP_{NOM}. The system should be allowed a clean "start-up phase" in order for a possible SP_{NOM} to fully unfold nevertheless. Therefore, and also due to later experimental reasons, the structures will begin with an adverbial phrase like *gestern* ("yesterday") in the prefield.[21] A critical requirement for the lexical material demanded the preclusion of any non-morphosyntactic information. This will be pursued in two ways: Firstly, the thematic role information carried by the verb should become available as late as possible. In comparison to Schlesewsky et al.'s (2003b, p. 32) structures, the main verb will thus be located in the right sentence bracket at the end of the sentence, while the left bracket will be occupied by a finite auxiliary verb. Secondly, to further eliminate possible relational, positional or structural cues, TMP should decide on the status of an ambiguity and disambiguation as early as possible. This requirement is also met by sentences in (14) as their first DP was ambiguous. Similarly, the first of two subsequent DPs—that reside in the middle field—is the one on which TMP will encounter a local ambiguity. Both argument DPs will consist of a strong determiner and a subsequent noun.

However, Section 3.6 argued that the researchers failed to consider the syncretic nature of some of the determiners they tested, like *der* and *den*. The inflectional paradigm in Table 1.1 showed that the former is ambiguous between $der_{NOM.M.SG}$ and $der_{DAT.F.SG}$ and the latter between $den_{ACC.M.SG}$ and $den_{DAT.PL}$ respectively. The sentences that TMP has to deal with deploy the determiners *der* and *den* for the first DP and utilize their eventual disambiguation by the subsequent noun, yielding four different structures. Consequently, the sentence-final verbs have to be transitive and govern either accusative or dative case

[21] The terminology describing the German topological fields from Eisenberg (2013, pp. 372–379) will be used to capture the positions of relevant constituents.

for one of its two argument DPs in order to devise grammatical sentences. Those DPs need to contain proper actors in order to ensure further the absence of any relational information to which the argument interpretation may be altered before the eADM's ASSIGN [±AGRT] step. Therefore, all DPs will comprise human referents. For reasons of experimental logistics, the DPs' nouns shall be as short as possible which is why they will be only bisyllabic. Also, for reasons of a later balanced experimental design, the nouns that will follow *der* and *den* are chosen from a declensional class which exhibits no overt plural marking in nominative, accusative and genitive compared to their singular counterparts (Sternefeld, 2006, p. 54). A noun like *Bäcker* meets this requirement. This noun can be grammatically combined with *der* in order to realize a subject in nominative masculine singular or with *den* to realize a direct object in accusative masculine singular. To realize a dative plural DP with *den*, an *-n* suffix will be adjoint to *Bäcker*. Since *der* can also be disambiguated towards a dative feminine singular context, *der* can also be combined grammatically with feminine nouns. For these nouns, monosyllabic masculine nouns like *Kunde* will be adjoined with the derivational suffix *-in* to mark them as feminine. Since feminine nouns shall appear only in one syntactic context—that is singular—other bisyllabic nouns like *Diva*, *Mutter* ("mother") or *Tante* ("aunt") are eligible to comprise a DP in dative feminine singular. All these considerations yield the four structures in Table 4.1.

Table 4.1: Overview of the structures with the syncretic and thus ambiguous determiners and their subsequent disambiguating nouns.

	prefield	left bracket	middle field				right bracket
			det. pos.	noun pos.	det. pos.	noun pos.	
a.	Gestern	hat	der	Bäcker	den	Konditor	gesehen.
	Yesterday	has.SG	the.NOM.M, DAT.F	baker.NOM.M	the	confectioner	seen
	"Yesterday, the baker saw the confectioner."						
b.	Gestern	hat	der	Kundin	der	Konditor	geholfen.
	Yesterday	has.SG	the.NOM.M, DAT.F	costumer.DAT.F	the	confectioner	helped
	"Yesterday, the confectioner helped the costumer."						
c.	Gestern	hat	den	Bäcker	der	Konditor	gesehen.
	Yesterday	has.SG	the.ACC.M, DAT.PL	baker.ACC.M	the	confectioner	seen
	"Yesterday, the confectioner saw the baker."						
d.	Gestern	hat	den	Bäckern	der	Konditor	geholfen.
	Yesterday	has.SG	the.ACC.M, DAT.PL	bakers.DAT.PL	the	confectioner	helped
	"Yesterday, the confectioners helped the bakers."						

This overview, however, somewhat obscures the fact that, up to the determiner, all four structures are actually identical and thus appear to be just one sentence. Therefore, Figure 4.2 seeks to visualize the unanalyzed sentences insofar as a single superficial structure splits into the ambiguous determiners *der* and *den* basically making it two structures. Both determiners fork again into two subsequently disambiguating nouns each, eventually resulting in four structures. Thus, TMP's way of handling ambiguous and disambiguating lexical material will be decided upon the first DP. For this reason, only the first DP is of interest for the investigation. Consequently, the adverbial phrase and the auxiliary noun are considered non-crucial for the encounter and the resolution of the ambiguity. Therefore, the present dissertation will focus on TMP's processing of first clause-medial DP only, conveniently summarized in the trimmed-down examples of (21).

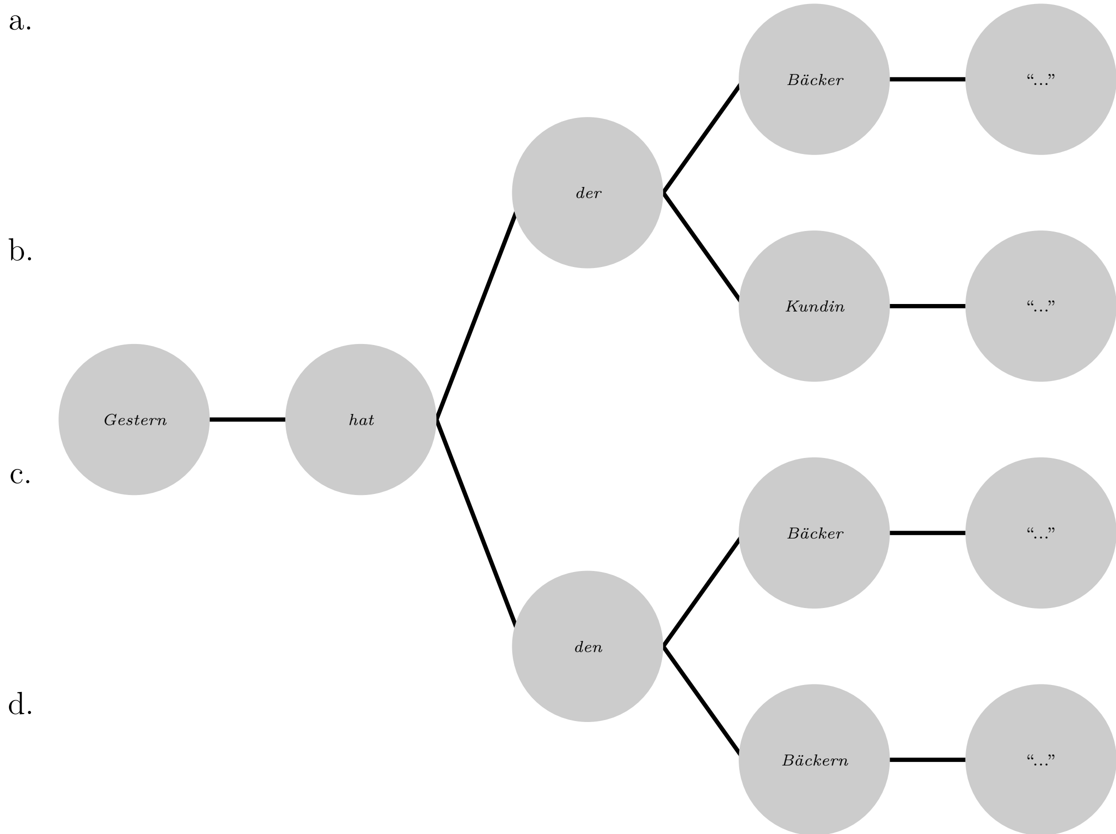


Figure 4.2: Visualization of Table 4.1's structures.

(21)	a.	der the.NOM.M, DAT.F	Bäcker baker.NOM.M
	b.	der the.NOM.M, DAT.F	Kundin customer.DAT.F
	c.	den the.ACC.M, DAT.PL	Bäcker baker.ACC.M
	d.	den the.ACC.M, DAT.PL	Bäckern bakers.DAT.PL

To summarize TMP's basic operational framework, it shall be developed in the most conservative and plain way possible. It was argued that its operations may fit into and can complement eADM's agreement processes. Therefore, the model will dispense with all semantic, pragmatic, frequency and structural information and revert to morphosyntactic features only. This limitation, in turn, also has an impact on the structure and content of the sentences TMP will have to handle. Consequently, it was acknowledged that this constriction defines TMP's design. Its area of operation is limited to the disambiguation of a locally ambiguous DP. This DP consists of a strong determiner and a subsequent noun. Even though it is possible to continue the determiner with a sequence of adjectives or relative clauses, it cannot be stressed enough that, for the moment, TMP's space of hypotheses is limited to two-element DPs for which the phrases in (21) are the target structures.

4.1.3 Boundaries of the system

Overall, it must be noted that the system that will be explained in the following sections is nothing but an approximation of reality, until the experimental data from Part II are available. Until then, TMP will provide exemplary insights into the procedure of predicting and integrating linguistic input. Self-explanatorily, these processes can only be inferred from the external responses to linguistic stimuli. For this reason, it is eminent to separate the processes of TMP as a mechanism from what happens cognitively in actual human language processing. Only after TMP has been delineated and put up against experimental data, it is allowed to map the empirical results of the experiments onto the theoretical claims of the mechanism. In order to do so, for the Experimental Part II, it will be assumed that TMP's analyses can be mapped onto a real-world human language processor. Until then, no statements about processing load, processing effort, processing difficulty or processing cost shall be made in connection with TMP. Instead, "calculating" will be used to solely describe the system's mechanics. TMP's calculatory work will be characterized as *simple* or *complex*. Later descriptions will also refer to TMP's work with calculatory *simplicity* or *complexity*.[22] This will be done to avoid confusion with psycholinguist terms like "easy" or "low" and "hard" or "high" processing load. Although this nomenclature might suggest an approach within computational linguistics, it has to be stressed that the present dissertation does not claim that TMP could be transformed into an algorithm.

4.2 Inner Workings

The goal of the present dissertation is to devise a mechanism that establishes an analysis by incorporating morphosyntactic features. Following the literature from Chapter 2, this operation is assumed to be carried out incrementally at the contact point between one and its subsequent word. The idea that parsing may operate in this way was already vaguely assumed by O13 and O14 and illustrated in Figure 2.1. Recall that the rounded squares mirror the language processing system's representations of a sequential input of

[22]Notation: These labels will be applied in *slanted* (not *italicized*) font to facilitate visual discernibility.

an adjective and a subsequent noun, both associated with their respective morphosyntactic features. Since an analysis may add up lexical items other than prepositions, adjectives and nouns, the one position shall be called more generally ***current material*** and the other sequentially second position ***incoming material*** as illustrated in Figure 4.3. For the development of TMP, it is necessary that the model can access morphosyntactic features. For the present argument, it is not relevant *how* TMP accesses morphosyntactic features or in which modality they are available. Furthermore, it shall not be discussed whether TMP is (in)compatible with associative or combinatorial inflectional models. No additional mechanism of affix stripping shall be assumed. Insofar, it shall be stipulated that morphosyntactic information is readily available for TMP to not only transition from current to incoming material but also from and to their respective feature specifications.

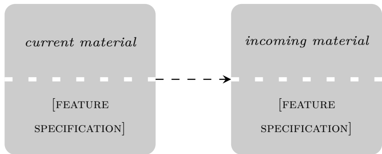


Figure 4.3: Transition from current to incoming material with respective features.

Regarding the four structures in (21), this transition creates several different featural contact points since the DP's elements—determiners and nouns—are all associated with various specifications. Therefore, it will be interesting to see how TMP behaves at the two incremental DP positions. This circumstance can be conveyed onto the first of the three crucial questions concerning the assessment of TMP's inner workings that were foreshadowed in the thesis' Introduction:

> Question 1: How do the parses differ between the elements of the subject-object ambiguities?

However, recall from Section 1.2 that Bierwisch, Blevins, Wunderlich, Wiese and Müller introduced five different approaches on how to underspecify inflected elements. Therefore, not only the determiner position provides different morphosyntactic features in comparison to the subsequent noun but also the five underspecification approaches vary with regard to quality and quantity of the features they assume for individual DP elements. Consequently, if a determiner is involved in the transition depicted in Figure 4.3, Bierwisch, Blevins, Wunderlich, Wiese and Müller offer five different options to associate a feature bundle with the determiner in question. Different feature specifications for the same element result in different transitional contact points when proceeding to the subsequent element. Therefore, the investigation of TMP's prediction and buildup processes may give insights into the concluding remark of Section 1.3 on whether one of the underspecification approaches is explanatorily adequate. As indicated in the Introduction, this issue can also be (re-)phrased as the second question that will guide the remainder of the thesis:

> Question 2: Which one of the underspecification approaches by Bierwisch, Blevins, Wunderlich, Wiese and Müller is explanatorily more adequate?

4.2.1 Feature identity as the path of least resistance

But how does TMP exactly deal with the transition from the current to the incoming material? To answer this fundamental question, the model's mode of operation has to be laid out in this section. The following descriptions will provide reasons for the aforementioned fusion of characteristics of syncretism and subject-object ambiguities taking place at this exact position. For that purpose, TMP will draw from two inspirational sources.

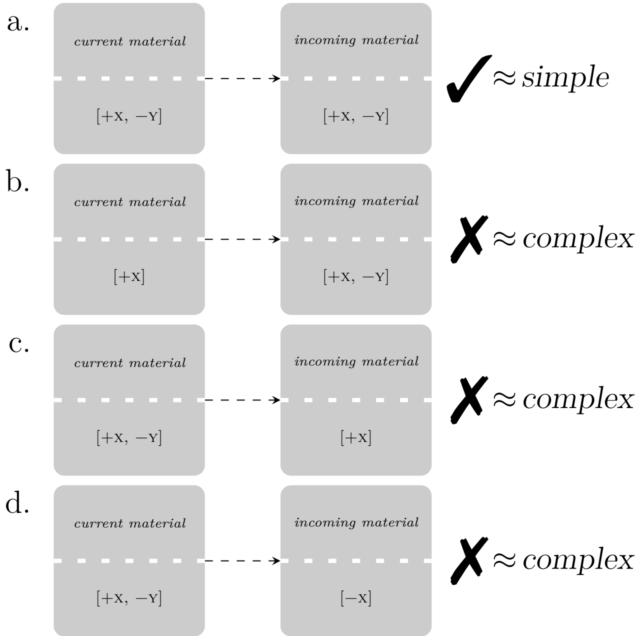
With regard to the first source of inspiration, O13 and O14 cannot be ignored. Due to the fact that Opitz and Pechmann (2016) dropped the whole parsing idea from O14, a parsing mechanism shall be proposed employing characteristics from both O14's and O13's versions while using their compelling advantages but avoiding their shortcomings. The starting point, though, will be the very iteration of the parser that Opitz and Pechmann (2016) decided to not pursue any more: O14. In this section, the technical and theoretical aspects of both approaches—O13 and O14—shall be revisited briefly. Most crucially, TMP's behavior at the transition from one word to another will be discussed in detail in Section 4.2.3. Even though O14—and due to that also O13—is the first of two inspirational sources, TMP is by no means a copy of their parser. For TMP, a straight mode of operation will be defined from which exact predictions can be derived. O14, in comparison, lacked a clear-cut formulation of how their forward- and backward-directed feature comparisons actually worked:

> There are in principle at least two ways in order to achieve the observed asymmetry between the two violation conditions. It could either be that a) these two sub-processes operate consecutively and thus the failure of the first search is a more immediate disturbance of the parsing process, or b) both searches may operate simultaneously but a violation of the search from the already parsed structure to the incoming material is regarded as more severe than a violation of the search in the opposite direction for independent reasons. (O14, p. 253)

In fact, O14 even complicated their parser insofar as they assumed another layer of feature checking. Recall that masculine nouns in the correct PPs elicited the same ERP effect as the two incorrect conditions. O14 explained this outcome with the increased number of features that had to be checked at the PP final masculine noun in comparison to neuter and feminine nouns. Therefore, O14's parser consisted of two mechanisms that lead to the same results but in grammatically different scenarios. It is not clear if and how these at least two layers interact or which has precedence over the other. Contrary to this, and foreshadowing TMP's architecture (see Step 2), its subprocesses will be ranked and their order will be motivated. For the time being, though, the ingredient that O13 and O14 contribute to TMP's formulation is the idea of a strictly incremental and absolutely flat transition from one word to another.

However, TMP goes beyond O13's or O14's model concerning feature agreement between the current and the newly incoming material. Its mode of operation is envisioned to perform in the most parsimonious way possible. This leads to the second and most important source of inspiration that makes up TMP: minimality. TMP will incorporate Fodor's (1998, p. 292) assumption about the parser's "lazy way of life" that was discussed in Section 3.6. In line with this is also O13's and O14's understanding of optimality. Both ideas of parsimony are interpreted, understood and used in the following way: The deviance of features, that the parser encounters on the subsequent incoming material in comparison to the previously already integrated material, should be minimal. This assumption can be cast into a bias: a bias for feature identity. But why is this striving for minimal feature deviance desirable? If the features of the incoming material mirror or overlap with the already processed items, the system can follow the path of least resistance. Although this bias towards minimal feature deviance can also be expressed as TMP's expectation of feature specifications that mirror the current specification's features, it has to be noted that this description does not entail a statement about prediction. It must be emphasized that feature identity is understood as a bias, an ambition, a preference or, most generally, as a principle and not a hypothesis of upcoming input. However, the described bias allows the system to derive predictions for the upcoming input that succumb said ambition. In a scenario in which the incoming material obeys the model's ambition in the aforementioned fashion, it has no need to motivate the input of deviant features. Instead, feature differences are most likely to always emerge. They can occur in two ways: Firstly, the input can overbid a previous integration. This means that the newly incoming material includes different features or introduces more features than those that have already been integrated. Secondly, the input can underbid a previous integration. This means that the newly incoming material lacks features that have already been integrated. (22) illustrates both feature identity as well as exemplary feature deviances. In (22a), complete feature identity is given. This situation is viewed to be the computationally *simplest*, since current and incoming information do not need to be synchronized in a particular way as they already overlap completely. In comparison to that, (22b) does not adhere to minimality. Here, the incoming item introduces an additional feature—namely [−Y]—that is not part of the current analysis which consists only of [+X]. Therefore, detecting this mismatch and synchronizing, hence copying, the missing [−Y] from the new word with the previous specification is understood to be computationally *complex*. Turning to (22c), the opposite situation is at hand. In this case, the transition from the current word to the new item does not adhere to minimality. The current material's specification provides a feature—namely [−Y]—that is lacking in the incoming material's feature set. Again, detecting this mismatch and synchronizing, hence copying, the missing [−Y] from the current specification onto the new word should be *complex*. Lastly, (22d) shows both the lack of a feature on the incoming item—namely [−Y]—as well as a compatibility violation. Even though the system can find the [X] feature on the incoming material, it carries an opposing value compared to the current material's specification. This compatibility mismatch should also be *complex*. Eventually, the goal of the present thesis will be to map TMP's *simple* and *complex* featural transitions onto experimental evidence about smaller and higher processing difficulties.

(22) Featural deviances between current and incoming material's specification:



While (22) shows the four main cases of feature checking—identity in (22a), introduction of more features in (22b), lack of features in (22c) and incompatibility in (22d)—one can easily think of permutations of these instances with different numbers of features and values. For example, both a current analysis as well as a newly incoming word could be featureless. In this case, feature identity would also be given like in (22a) since no information has to be searched, missed or synchronized. This scenario should also represent a *simple* integration. It is equally conceivable that in (22b) and (22c) introducing more as well as lacking previous features occurs at the same time. That all features of the newly incoming word would carry features that oppose the ones of the current analysis, is also a possible setting. This thorough incompatibility should be *complex*.

The bias for feature identity or minimal feature deviance is envisioned as an overarching least-expense principle that does not apply to one particular feature-related process but rather determines the overall behavior of TMP. The subsequent sections will further explain the mechanisms and sub-mechanisms.

4.2.2 Current material, predictions and incoming material

The aforementioned architectural assumptions have direct implications for TMP's design and for how the integration of an upcoming word is envisioned. This process is viewed to conform to TMP's bias for minimal feature deviance described in the previous section. Until this point, however, one specific term has been deliberately avoided. TMP's previous outline lacked a critical element between the two positions of current and incoming material: prediction. Before TMP's notion of prediction(s) will be thoroughly laid out below, it must be noted that this term is by no means the innovation of the present thesis. It turns out that part of the literature on processing cited in Chapter 3 already mentioned the term in one form or another. In cases in which they did not explicitly use the term, they at least implied it by referring to the sentence processor's expectancy for upcoming input (Bornkessel et al., 2004; Bornkessel and Schlesewsky, 2006; Bornkessel-Schlesewsky and Schlesewsky, 2009a, 2016; Fodor, 1998; Frazier and Fodor, 1978; Matzke et al., 2002; Rösler et al., 1998). However, the cited literature struggled to come up with a uniform clear-cut definition of what prediction actually is. An exuberant amount of research dedicated to this subject reported on numerous priming, eye tracking and ERP experiments (e.g., Federmeier, 2007; Huettig, 2015; Kutas et al., 2011; Van Petten and Luka, 2012). Still, the research only partially coped with the aforementioned issue. Generally, the literature has the idea in common that the language processor pre-activated linguistic information at its disposal at a current processing state. This pre-activated information is part of the upcoming material. What has been unanswered so far is the question how this pre-activation comes about. What is the driving force behind it? Taken as a given, however, is the division between a current state of processing and upcoming material (Ferreira and Chantavarin, 2018). As already pointed out, this separation is pursued in the present thesis too. The current material allows for ***predictions*** for the upcoming material. Dell and Chang (2014, p. 2) understand prediction as the generation of expectations about upcoming material. Similarly, Friston (2012, p. 248) views the "brain as a constructive or predictive organ that actively generates predictions of its sensory inputs using an internal or generative model." Both, Dell and Chang (2014, p. 2) and Friston (2012, p. 248) consider the driving force behind optimizing predictions the "attempt to minimize future error" (Dell and Chang, 2014, p. 4) or rather the minimization of prediction error. How this driving force is understood in the current approach will be addressed in Section 4.2.3.1. Nonetheless, not only two but three steps are sequentially involved when feature agreement between the current and incoming material is checked: current material, predictions and incoming material. These positions are incrementally arranged along a linear and sequential procedural direction for the following reasons: Predictions are only possible after the current specification has been processed. Therefore, the predictions are chronologically subsequent to the current material. Accordingly, the incoming material becomes available after the current material has been processed and after predictions have been derived. Thus, the incoming material is chronologically placed after the current material and the predictions. Logically, predictions are possible after the current material and are derived before the incoming material enters the system. As established already, current material and incoming material can be viewed as placeholders for lexical material. Similarly, predictions also serve as a wild card but not as in current and incoming material for physical lexical material but for what the space of hypotheses provides. Accordingly, predictions can contain numerous possible candidates. The current material can be larger in lexical size since it is assumed to contain all the elements that have already been processed up until this step. In comparison to that, multiple predictions can be broken down to word level status as they are the individually generated alternatives for the upcoming material.[23] The incoming material is then the targeted incoming input which could possibly be limited to just a single word. Recall from Section 2.7 and Figure 4.3 that the lexical material is associated with morphosyntactic features. Therefore, at all three positions, the words' respective feature specifications are present as depicted in Figure 4.4. The division allows the system to encounter syncretic incoming material. This will become clear when TMP's parsing mode at word transition will be explained in the following section.

4.2.3 Calculating with features

As indicated above, current material, predictions and incoming material are understood as parsing steps. However, those steps are rather non-discrete in the following sense: The transitions illustrated in Figure 4.4 have to be extended so that the connective left-to-right arrows adequately reflect feature-related processes that are based on TMP's bias for minimal feature deviance. Foreshadowing their descriptions below, current material, predictions and incoming material have to be partially interconnected in the following way: As stated in the previous section, the current material allows for predictions. To be precise, in the proposed system, it is the feature specification of the current material that enables these predictions by means of TMP's bias to maintain feature identity. Therefore, an arrow originating from the current material's specification leads to the predictions. This process shall be named **Prediction** and be subsumed under the description of parsing Step 1. Now, TMP's description runs into the problem of two similar designations. In order to avoid any possible confusion and to keep the process of Prediction descriptively separate from its result, the placeholder of "predictions", that would basically contain predicted candidates, shall be renamed to simply *candidates*. The process of deriving candidates will be illustrated in parsing Step 2. The delineations of the parsing Steps 1 and 2 will also clarify why it is necessary to separate Prediction as a process from predicted candidates as a result of this very process. Ideally, after candidates have been derived, the incoming material enters the system. Candidates and incoming material will thus also be linked by a unidirectional process of **Synchronization** that will be laid out in parsing Step 3. Lastly, the incoming material has to be combined with the current material via a bidirectional **Integration** process in order to continue to the next parsing stage. This operation will be also subsumed under Step 3's descriptions. A sequence consisting of current material, Prediction process, candidates, Synchronization

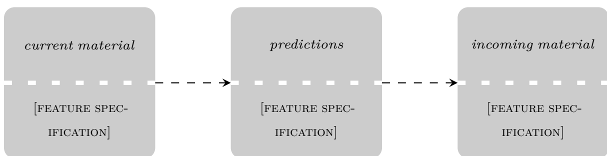


Figure 4.4: Transition from current to incoming material with intermediate predictions.

[23]But obviously, predictions may rely on phrase- or clause-level structures. For instance, after processing an auxiliary the parser expects to encounter a DP.

process, incoming material and Integration process represents one calculation stage as depicted in Figure 4.5. Primarily, this very stage is concerned with what kind of lexical material will be inserted into the slot of the incoming material. Consequently, the head of the solid black arrow after Step 3 depicts the possible and probable continuation of the parse into a subsequent calculation stage in which a noun may have to be integrated.

In the following, the reasons for this particular layout shall be explained for the Steps 1, 2 and 3 of this very Stage 1. The subsequent descriptions will clarify why the processes of Prediction, Synchronization and Integration connect current material, candidates and incoming material. In order to demonstrate the calculations of each step, three important preconditions have to be met. These requirements are essential in order to calculate and analyze parses at all. Parsing Prerequisite I is less concerned with the mechanics of the parsing model itself but rather with the space of hypotheses and thus with the lexical material that will be introduced to TMP. The interface between the lexical material and parsing mechanism is the former's morphosyntactic features. Parsing Prerequisite II ensures that the relevant features are associated with the lexical material. Finally, the lexical items have to be fed into a particular system. This is guaranteed by Parsing Prerequisite III.

Parsing Prerequisite I: lexical material

Parsing Prerequisite II: features

Parsing Prerequisite III: mechanism

Concerning Parsing Prerequisite I, the description of both the three steps and the partially interconnecting subprocesses will be demonstrated by analyzing the DP from (21a). Consequently, as previously addressed in Section 4.1.2, TMP's space of hypotheses will be limited to the sequence of determiner and noun, for which (21a)'s *der Bäcker* is the target structure. However, for the sake of brevity, the exemplification will end after the integration of the DP's determiner.[24] In (21a), the determiner under investigation is *der*, targeted in nominative masculine singular. This alternative is also ambiguous with *der*$_{\text{DAT.F.SG}}$ in (21b). The ambiguity is resolved by the subsequent noun that—as already mentioned—will be omitted in the present demonstration. Nevertheless, there are enough (lexical) elements and positions that precede the determiner allowing TMP

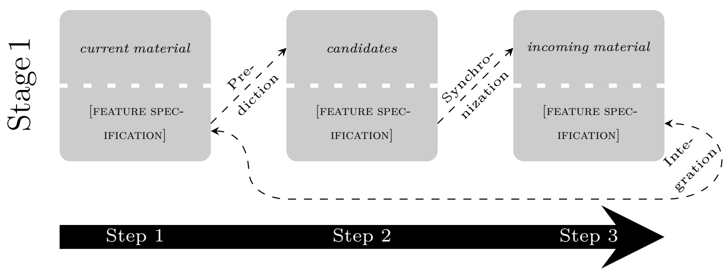


Figure 4.5: TMP's parsing subprocesses.

[24]The full analysis of the DP can be found in Section 5.2.1.1.

to unfold its mode of operation. Recall from Table 4.1 that *der* in (a) is targeted as *der*$_{\text{NOM.M.SG}}$ in the sentence *Gestern hat der Bäcker den Konditor gesehen.* The preceding auxiliary verb *hat* appears in singular number. The sentence-initial adverbial phrase *Gestern* is assumed to not be crucially relevant for morphosyntax-related processes as it neither carries inflectional properties, and thus no morphosyntactic features, nor is it part of any agreement relation. Apart from that, the exemplification of TMP will revert to the aforementioned assumption that a prevalent SP$_{\text{NOM}}$ comes into effect. As established in Section 4.1.1, the SP$_{\text{NOM}}$ is not part of the sentence or DP material itself but assumed as an overarching umbrella. Therefore, the SP$_{\text{NOM}}$ as depicted in Figure 4.1 precedes any lexical material.

Complying with Parsing Prerequisite II, the underspecification approaches by Bierwisch, Blevins, Wunderlich, Wiese and Müller offer a wide variety of features that can be tested with the determiner *der*. However, the present description will be based on Bierwisch's features for now.[25] Therefore, his determiner inventory from Table 1.6 is of relevance as it will provide the feature specification for *der*$_{\text{NOM.M.SG}}$: [+M]. For the singular auxiliary verb, it is assumed that it contributes [−PL]. As already mentioned, the adverbial phrase *Gestern* is viewed to be morphosyntactically irrelevant for the current investigation. Thus, it is assumed to provide no features. Finally, the SP$_{\text{NOM}}$ will be specified according to (20) as [−OBJ, −OBL] in order to integrate the first detectable DP in nominative case.

Unsurprisingly, with regard to Parsing Prerequisite III, TMP in the depiction of Figure 4.5 will serve as the appropriate parsing mechanism. The mechanism has been envisioned as an incrementally operating system that incorporates the morphosyntactic features of lexical items on the bases of minimal feature deviance relative to the current material.

4.2.3.1 Step 1: From current material to predicted candidates

Since the exemplification will be concerned with the integration of the determiner only, TMP's calculations will begin with this input. This means that the preceding material is assumed to have been parsed already. That includes the SP$_{\text{NOM}}$ that provides [−OBJ, −OBL], the adverbial phrase *Gestern* that is assumed to be featureless and the auxiliary verb *hat* which contributes [−PL]. This feature bundle will be concentrated into [−OBJ, −OBL, −PL]. It represents the system's current state of processing. Therefore, this feature bundle is associated with TMP's current material slot and its specification respectively as depicted in Figure 4.6. The Prediction process originates unidirectionally from the current material's specification as these features set the context for the subsequent processes. Apart from the sequential reasoning above, the arrow is unidirectional since the existence of predicted candidates can only be motivated if the driving force behind them originates from a prior step. A "look back" from predictions to the current material seems to be not plausible. The unidirectionality is motivated by TMP's minimality-driven bias to maintain feature identity. Even if the process would look back

[25]TMP's parses for the remaining underspecification approaches by Blevins, Wunderlich and Wiese can be found in Appendix B.

to the current material, maybe in order to evaluate the predicted candidates, the ambition to eventually revise them would still originate from the previous step. Due to these considerations, the process is envisioned to be unidirectional.

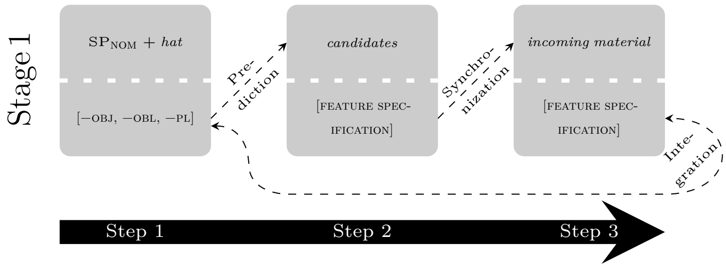


Figure 4.6: an SP$_{\text{NOM}}$ is assumed as current material and associated with its specification.

Coming back to the question on the driving force behind prediction from Section 4.2.2, the current investigation shall elaborate on its understanding of this process. Unsurprisingly, the Prediction is thoroughly determined by TMP's bias for minimal feature deviance. Nothing is more parsimonious for the processing system than to expect every upcoming input to conform to the already processed information. Therefore, the Prediction process in this case *is* TMP's bias to maintain features. In this way, no extra-systemic necessity for prediction making has to be stipulated. Transitioning to Step 2 via the Prediction process, TMP's bias manifests itself in the sense that the feature specification of the current material from Step 1 eventually serves as a guideline to which a possible continuation will ideally obey. This guideline is understood as a filter for upcoming material. However, it has to be stressed that it would absolutely be plausible to realize the dependent variable, to which the derivation and selection of determiners conforms differently. Crucially, the setup put forward must not claim to exist as a neurocognitively grounded equivalent to TMP yet. However, in a processing system which tries to approximate reality, the current material's features eventually regulate the subsequent predicted candidates in one way or another. The current mode of visualization is simply chosen for logistical reasons. In the implementation at hand, the current material's features *become* the filter specification by means of the feature maintaining. This configuration is illustrated in Figure 4.7.

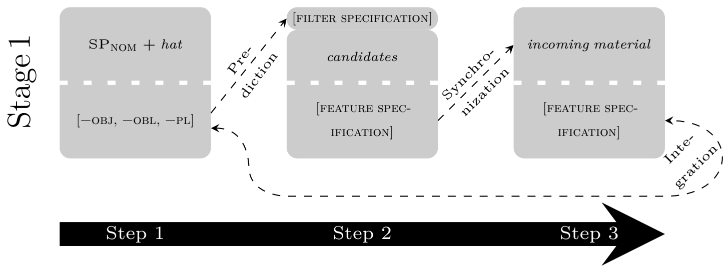


Figure 4.7: The current material's specification serves as a filter specification for the predicted candidates.

Because the bias to maintain the current material's specification is intrinsic to TMP's minimality assumption, no statement can be made regarding calculatory load yet. In the case at hand, [−OBJ, −OBL, −PL] was the current material's specification and is maintained in the filter specification. This is depicted in Figure 4.8.

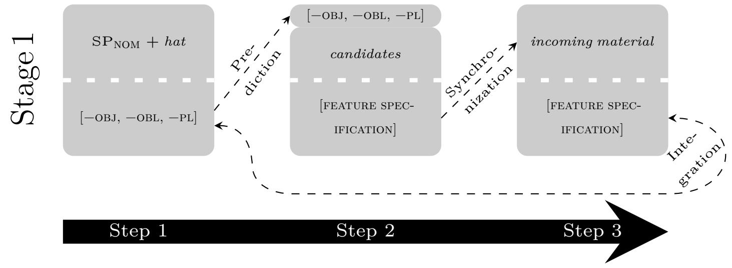


Figure 4.8: TMP's minimality bias predicts the continuation of the current material's specification from Step 1 at the feature specification at Step 2.

4.2.3.2 Step 2: Deriving predicted candidates

At Step 2, predicted candidates are derived. As already pointed out in Section 4.2.2, this is a placeholder not for one element but for a multitude of candidates that are confined by TMP's space of hypotheses. Logically, not all alternatives are predicted equally. If this were the case, then the term prediction would come to nothing. Therefore, one candidate has to be selected over others. A meaningful solution for that could be the application of an order. Thus, it shall be assumed that predicted candidates are subject to ranking. Their placeholder will be renamed in Figure 4.9 accordingly.

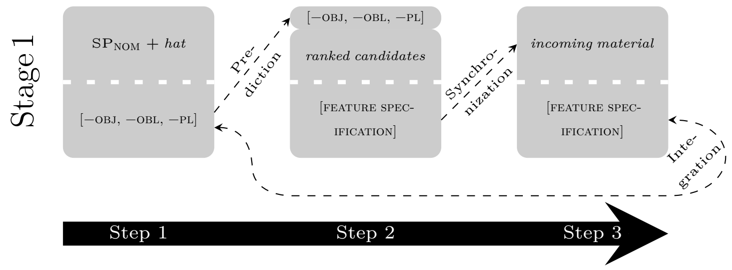


Figure 4.9: Predictions are ranked.

But how does this ranking come about? How does TMP derive an order of ranked predicted candidates? This process is envisioned to adhere to the principle of minimal feature deviance. Deriving predictions means that feature bundles, and by virtue of that lexical elements, that fit these requirements more adequately than others, are the ones that are preferably predicted as their anticipated integration would tend more towards the calculatory *simplicity*. Consequently, lexical elements that match the predicted feature set of the filter specification more aptly rank over those that have less in common with the filter specification. The former are candidates that are rather in line with the scenario (22a) while the latter candidates depart from that setting and are more in line with the scenarios (22b–22d).

Like in optimality theory, three criteria determine the ranking of predictions in Table 4.2. These constraints are also ordered and applied to the candidates relative to the filter specification: incompatibility > non-retrievability > retrievability. Incompatibility is the most significant constraint. Unlike O14, TMP will not neglect a check for compatibility. Clahsen et al. (2001), Penke et al. (2004), Leminen and Clahsen (2014) and even O13 itself presented important data that strongly suggested an opposing feature value to be a severe processing violation yielding a pronounced ungrammaticality cue. It is feasible to assume that a negative response to a positive query is the more explicit violation in comparison to a mere lack of a query. Therefore, incompatibility outranks the other two constraints. More incompatible features are thus more disadvantageous. Conversely, a lower number is better in order for a candidate to rank higher.

The second constraint is non-retrievability which is also disadvantageous. This constraint is split into two searches. Features may be checked in a forward fashion originating from the filter specification heading to the candidate's specification or, in the opposite way, in a backward fashion originating from the candidate's specification heading to the filter specification. Following O14, a failing forward retrieval is more severe than a failing backward retrieval. As TMP—like any other possible human's sentence processor—is anchored in time, it is the input to the system that primarily decides on its processing behavior. It is thus plausible to assume that the parser prospectively and expectantly *looks* from the already processed material to the incoming material. As this view happens prior to the actual input, a failing forward-looking feature retrieval is envisioned to be fatal. In comparison to that, the backward looking retrieval cannot be an expectancy as it is only possible if material has already entered the system. In this case it has to deal with it either way. Thus, a failing forward search outranks a failing backward search in severity. Candidates with more non-retrievable features rank lower than those with no non-retrievable features. Therefore, a lower number is better in order for a candidate to rank higher. High values of incompatibility and non-retrievability determine high feature deviance of the candidates in question. Consequently, these values shall be low in order to mirror TMP's minimality bias for establishing maximal feature identity as depicted in (22a).

The third constraint—retrievability—is, on the other hand, a measure to maintain feature identity. Analogously, its value can be high in order to establish maximal feature identity. Obviously, retrievability and non-retrievability must be checked separately since the feature specification of one item may share features of another but they may differ in their specification. Therefore, retrievability values cannot be translated into non-retrievability values or vice versa. Also, compatibility does not need to be evaluated independently since this check is logically inherent to retrievability. However, in order to keep the system as conservative as possible, the current argument will refrain from TMP using positive retrievability as a measure to decide on a candidates rank. At most, it will resolve equally ranked candidates.

These ordered sub-mechanisms allow to derive ranked candidates by adhering to or violating the constraints in accordance to the filter specification. The perfect ranked candidate would therefore provide full compatibility, only retrievable features and no non-retrievable features. If these requirements for full feature identity were met, the top-ranked candidate's feature specification would be identical to the filter specification.

With all these assumptions in place, predicted ranked candidates can now be derived. But predicted candidates of what? What are the candidates? Recall from above that the determiner from (21a)'s *der Bäcker* shall be analyzed. Thus, TMP's space of hypotheses is confined to determiner continuations with $der_{\text{NOM.M.SG}}$ as the targeted alternative that should preferably be the incoming material. Since the analysis is typified based on Bierwisch's approach, all eight of his underspecified determiners from Table 1.6 are competing to be the best fit for the context that is specified by the current material's features. Table 4.2 lists the ranked candidates at Step 2 using Bierwisch's features. However, it must be stressed again that the choice for the layout put forward here is generated for visualization purposes only. It shall not be claimed that—if TMP as a theoretical system can successfully be transferred into a neurocognitively based model—it actually derives lists with consecutively numbered candidates that have to be searched. The derivation of the ranked candidates from Table 4.2 is depicted in Figure 4.10. The layout of Step 2's placeholder seeks to resemble the threefold division of filter specification, candidates and their respective feature specification from Table 4.2.

Table 4.2: Ranked determiner candidates after an SP_{NOM}. The three constraints of incompatibility, non-retrievability and retrievability are symbolized by the glyphs "⚡", "⊖" and "⊕" respectively. Regarding the non-retrievability constraint, forward-directed searches from the filter specification to the candidates' specifications are represented by "⇒" while backward-directed searches from the candidates' specifications to the filter specification are symbolized by "⇐".

rank	filter specification: [−OBJ, −OBL, −PL] (by current material's SP_{NOM} + *hat*)		⚡	⊖		⊕
	determiner	specification		⇒	⇐	
1.	$das_{\text{NOM/ACC.N.SG}}$	[Ø]	0	3	0	0
2.	$der_{\text{NOM.M.SG}}$	[+M]	0	3	1	0
3.	$die_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[+PL ∨ +F]	1	3	1	0
	$des_{\text{GEN.M/N.SG}}$	[+OBL]	1	3	1	0
4.	$den_{\text{ACC.M.SG}}$	[+OBJ, +M]	1	3	2	0
5.	$dem_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL]	2	3	2	0
	$der_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL, [+PL ∨ +F]]	2	3	2	0
6.	$den_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	3	3	3	0

As can be seen in Table 4.2, the determiner $das_{\text{NOM/ACC.N.SG}}$ is the alternative that ranks highest. Since it is radically underspecified, it does not carry features that are incompatible with the filter specification of [−OBJ, −OBL, −PL] (incompatible: 0). This also means that three features of the filter specification cannot be found on $das_{\text{NOM/ACC.N.SG}}$

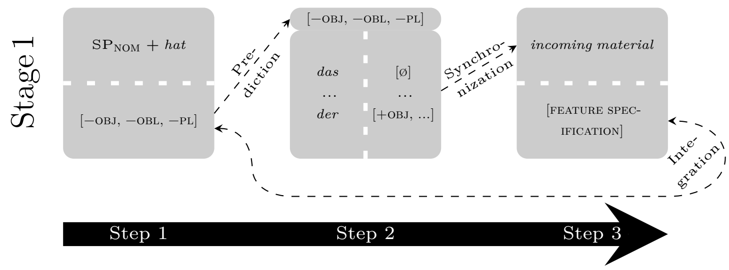


Figure 4.10: Ranked candidates are generated at Step 2.

(non-retrievable, filt. spec. ⇒ det.: 3), namely [−OBJ], [−OBL] and [−PL]. Conversely, zero features of *das*$_{\text{NOM/ACC.N.SG}}$ can be retrieved on the filter specification (non-retrievable, filt. spec. ⇐ det.: 0). Being entirely featureless also means that no features are retrievable. Put differently, *das*$_{\text{NOM/ACC.N.SG}}$ is the candidate which comes closest to realizing minimal feature deviance relative to the filter specification depicted in (22a). For these reasons, *das*$_{\text{NOM/ACC.N.SG}}$ occupies the first rank. Consequently, a possible integration of a later hypothetical integration of an incoming *das*$_{\text{NOM/ACC.N.SG}}$ would be *simple*. Looking at the least preferred determiner candidate *den*$_{\text{DAT.PL}}$, the constraints immediately reveal why it ranks low in the list. Firstly, its features of [+OBJ, +OBL, +PL] entirely oppose the filter specification of [−OBJ, −OBL, −PL]. Therefore, *den*$_{\text{DAT.PL}}$ is a maximally incompatible candidate (incompatible: 3). Secondly, due to this, three features of the filter specification cannot be found on *den*$_{\text{DAT.PL}}$ (non-retrievable, filt. spec. ⇒ det.: 3). Conversely, again, three features of *den*$_{\text{DAT.PL}}$ cannot be retrieved on the filter specification (non-retrievable, filt. spec. ⇐ det.: 3). In other words, *den*$_{\text{DAT.PL}}$ is the candidate that is far from realizing minimal feature deviance relative to the filter specification. It is far off from mirroring (22a). Instead, it reflects the incompatibility from (22d). For these reasons, *den*$_{\text{DAT.PL}}$ occupies the last rank. Accordingly, if this very determiner would be the incoming material, its later integration would be *complex*. The remaining six determiners rank between *das*$_{\text{NOM/ACC.N.SG}}$ and *den*$_{\text{DAT.PL}}$ according to the degree of obeying or violating the constraints.

Recall from the introduction of Bierwisch's framework that his inventory in Table 1.6 contained elements with disjunctive specifications. Self-evidently, the ranking in Table 4.2 that uses his approach contains the same two determiners, namely *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ on the third and *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ on the fifth rank, both providing disjunctive feature bundles. For now, TMP shall not be made additionally complex. However, it could be plausible to implement a secondary mechanism that selects one alternative of *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ with [+F] for the nominative and accusative feminine singular contexts or another alternative with [+PL] for nominative and accusative plural contexts. Similarly, the mechanism could split up *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ into *der*$_{\text{[DAT/GEN.F.SG]}}$ with [+OBJ, +F] or into *der*$_{\text{[GEN.PL]}}$ with [+OBJ, +PL]. In essence, this would result in two more candidates, rendering Bierwisch's inventory more redundant. For this and the reason of procedural simplicity, by keeping the disjunctive specifications of *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ and *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ united, no additional mechanism for resolving this disjunction shall be assumed. The Experimental Part II will reiterate on this mechanism's aspect.

Aside from the Bierwisch-specific disjunctions, the ranking's outcome provides some general insights into TMP's inner workings that will be examined below. The first observation reveals an apparently trivial but nonetheless very integral part of TMP as an approximation of reality in contrast to a real-world human language processing system. The three subsequent observations are concerned with practical aspects of TMP's mode of operation. In particular, Observations 2 and 3 will be essential when subject-object ambiguities are going to be parsed. Observations 5 and 6, in return, are rather abstract in nature but nevertheless important. The sixth observation is most central for the advancement of the present thesis' arguments.

> Observation 1: A meta-linguistic analysis — As mentioned in Sections 4.1.3 and 4.2.1, TMP is conceived as an approximation of a human language processing system. Since its space of hypotheses was tightly confined in Section 4.1.2, the target integration of any linguistic element is unambiguously clear. Observations 2 to 4 will show that TMP not only allows to argue for the integration of one determiner over the other but also to resolve the syncretism of *der*$_{\text{NOM.M.SG}}$ and *der*$_{\text{DAT.F.SG}}$ and to pursue the former rather than the latter. When the present thesis turns to the empirical assessment of TMP's forthcoming claims, it will become evident that no data acquisition method can look into the comprehender to observe and measure their definite integration of one *der* alternative over the other. This, in turn, reveals TMP's theoretical analysis as meta-linguistic which emphasizes once more that a stringent separation of its calculations on the one hand and later empirically measurable cognitive processes on the other hand is indispensable. This argument will be revisited in the Experimental Part II.

> Observation 2: From top to lower rank — Notably, *der*$_{\text{NOM.M.SG}}$ as the targeted determiner is not the most preferred candidate. Under the prevailing circumstances of Bierwisch's features, *der*$_{\text{NOM.M.SG}}$ occupies the second rank below *das*$_{\text{NOM/ACC.N.SG}}$. Figure 4.11 depicts parsing Step 2 with *das*$_{\text{NOM/ACC.N.SG}}$ as the confirmed top-ranked predicted candidate. The other alternatives are still part of the list but simply omitted in the following diagram for visual clarity. As it will turn out, it is seldom the case that the top-ranked candidate is indeed the actual incoming material. Thus, TMP most certainly will always have to change the analysis to a lower ranked candidate. However, since it is assumed that the top-ranked candidate is the preferred prediction as it maintains feature identity in the least violating way, it is this alternative that serves as a baseline against which the integration of lower ranked candidates is evaluated ultimately. How TMP switches from the top-ranked *das*$_{\text{NOM/ACC.N.SG}}$ to the lower ranked *der*$_{\text{NOM.M.SG}}$ alternative, will be explained for the third step of the parsing along with the Synchronization process.

> Observation 3: Resolution of syncretism — The third observation is con-

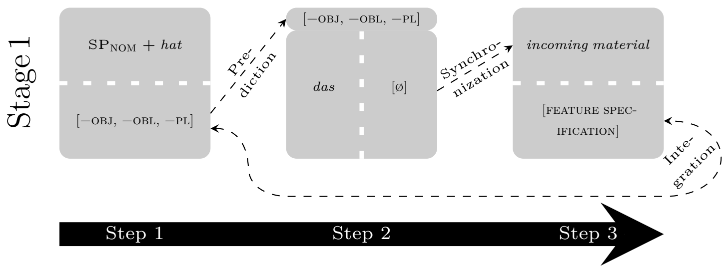


Figure 4.11: Top-ranked candidate.

cerned with accidentally syncretic candidates like *der*. The quasi-separation of lexical material and its respective features enables these syncretisms. This, in turn, makes is not only possible but also necessary to discriminate the two *der* candidates. This will be immediately relevant for the demonstration of the targeted integration of *der*$_{\text{NOM.M.SG}}$: Here, TMP's overarching bias towards feature identity comes into play again. The system desirably wants to integrate the less deviant candidate. Table 4.2 shows that *der*$_{\text{NOM.M.SG}}$ occupies the second spot and thus ranks over *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ which is on rank five. The latter determiner violates the filter specification more than the former. In this way, the integration of one alternative over another can be motivated. This kind of syncretism resolution is also crucial when TMP has to revise its initial analysis of a syncretic determiner. If this is the case, the current material and its specification at Step 1 and the filter specification at Step 2 may change as well in order to eventually integrate the respective determiner. This will be discussed in more detail at a later stage.

Observation 4: Equally ranked candidates — Another observation is concerned with the distribution of candidates and in particular the ranking of the accidentally syncretic determiner alternatives of *der* and *den*. Table 4.2 shows that it is generally possible for different candidates to occupy the exact same rank. This ranking tie occurs for four determiners occupying two different ranks. Both *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ and *des*$_{\text{GEN.M/N.SG}}$ occupy the third rank while *dem*$_{\text{DAT.M/N.SG}}$ and *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ both rank at the penultimate fifth spot. This issue is unproblematic as long as no accidentally syncretic candidates occupy the same rank. Bierwisch's way to underspecify the determiner does not result in a ranking tie of homophonous candidates. If, in turn, *der*$_{\text{NOM.M.SG}}$ as well as *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ were ranked equally, TMP's operation would be seriously hindered. For the current case of the integration of *der* as the targeted *der*$_{\text{NOM.M.SG}}$, TMP would not be able to discern the two alternatives. The same would hold true for a targeted integration of *den*. This worst case scenario will occur and be discussed in Section 5.3.2.1. Fortunately, within Bierwisch's approach, both *der* and both of the *den* alternatives hold their own separate ranks.

As already mentioned above, the implications of Observations 2 and 3 will become indispensable for the assessment of the pending parsing calculations of subject-object ambiguities. TMP most likely will always have to do two things. According to Observation 2, it has to switch from the higher ranked and thus predicted candidate to a lower ranked candidate that represents the actual input. Following Observation 3, TMP has to resolve possible syncretic input. When looking ahead, it becomes evident that, in order to make assumptions of what TMP predicts and how it would integrate that prediction, comparisons have to be made. These comparisons involve the top-ranked candidate as a starting point against which possibly lower ranked candidates are evaluated. Accidentally syncretic determiners are assessed in the same manner. If there are multiple candidates with the same form but different features, the one that violates the current filter specification will always automatically outrank the other candidate.

The remaining two observations are less concerned with actual feature processing. Observation 5 raises an issue about TMP's nature as a language processor. The sixth observation draws a connection to Section 4.1.1 and the question whether the features of an SP_{NOM} are necessary as a filter specification or if TMP has the capability to function properly without them.

> Observation 5: Forms versus features — The ranking in Table 4.2 raises the question of whether TMP predicts forms and assigns their respective feature bundles or whether it conversely predicts feature bundles and then searches for a form that carries this very set. The architecture put forward here would favor the latter interpretative attempt. Recall again that it is assumed that morphosyntactic information is associated with the lexical material. This enables Observation 3 in the first place. Since the feature specification of the preceding Step 1 acts like a filter, the feature specifications of different forms are being predicted by TMP. Parsing Step 3 will revisit Observation 5.
>
> Observation 6: About the presence or absence of SP_{NOM} features — The last and most important observation is concerned with the argument of the SP_{NOM}'s explicit specification that was originally brought up in Section 4.1.1. The previous paragraph is dependent on the presence of Bierwisch's [−OBJ, −OBL] features for the SP_{NOM}. This SP_{NOM} served as the filter specification that was prevalent even before the determiner entered TMP. Recall from Section 4.1.1 that it may be necessary to implement the SP_{NOM} in a different way. Since Blevins' approach is the only one that refers to negative features, while the others dispose of them, it may be feasible to test TMP without this a priori SP_{NOM} specification. Consequently, the auxiliary's [−PL] feature is also no longer part of a matching process and can also be neglected.[26] In doing so, the placeholder from Figure 4.1 may be either omitted entirely or be left empty. Envisioning the ranking in Table 4.2 without the SP_{NOM}'s filter specification as in Table 4.3 would render the compatibility, the forward-

[26] This does not mean that the auxiliary verb *hat*, that still occurs in the structures from Table 4.1, does not carry its [−PL] feature. However, this feature is considered to be no longer part of any of the featural comparisons in question here.

looking non-retrievability and the retrievability basically ineffective. If there is no filter to violate, no determiner can introduce incompatible features. In turn, no features are non-retrievable in a forward-looking fashion. If the filter specification is featureless, then there are no features that can be shared with a determiner candidate.

Table 4.3: Ranked determiner candidates after no SP_{NOM}.

rank	filter specification: [Ø] (by current material's lack of an SP_{NOM})		⚡	🔍−		🔍+
	determiner	specification		⇒	⇐	
1.	*das*$_{\text{NOM/ACC.N.SG}}$	[Ø]	0	0	0	0
	der$_{\text{NOM.M.SG}}$	[+M]	0	0	1	0
2.	*des*$_{\text{GEN.M/N.SG}}$	[+OBL]	0	0	1	0
	die$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[+PL ∨ +F]	0	0	1	0
	dem$_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL]	0	0	2	0
3.	*den*$_{\text{ACC.M.SG}}$	[+OBJ, +M]	0	0	2	0
	der$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL, [+PL ∨ +F]]	0	0	2	0
4.	*den*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	3	0

TMP's minimality bias towards feature identity would still be existent, yet solely expressed by the remaining backward-looking non-retrievability constraint. It would be this constraint that would specify the determiners' ranking. The number of features a candidate would introduce to TMP's analysis would determine its rank. The more features a determiner carries, the farther it is from the non-existent filter specification. Taking a second look at Table 4.2 reveals that the candidates with the lowest number of features are the ones that rank the highest. Furthermore, the three top-ranked candidates are *das*$_{\text{NOM/ACC.N.SG}}$, *der*$_{\text{NOM.N.SG}}$ and *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$. All three of them are valid determiners to realize a subject DP in nominative case. At this point, at least for Bierwisch, it may be possible to drop the SP_{NOM} and its specification that acts as a filter for the ranking entirely. The candidates' order in Table 4.3 is not that different from the one with the filter in Table 4.2. Again, *das*$_{\text{NOM/ACC.N.SG}}$, *der*$_{\text{NOM.N.SG}}$ and *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ occupy the first three positions. The presence of an SP_{NOM} interacts with TMP's inherent minimality bias towards feature identity. Against the background of those underspecification approaches that lacked negative features, a non-present SP_{NOM} within the parsing process shall not be neglected. Both explicit SP_{NOM} features as well as TMP's inherent mechanism—irrespective of these SP_{NOM} features—have to be investigated.

Resulting from the final Observation 6, the last Question 3 on TMP's quest for explanatory adequacy, that will be discussed in extensive detail in the remainder of the thesis at hand, becomes obvious. Now, all three issues originally foreshadowed in the dissertation's Introduction are completely derived:

> Question 1: How do the parses differ between the elements of the subject-object ambiguities?
>
> Question 2: Which one of the underspecification approaches by Bierwisch, Blevins, Wunderlich, Wiese and Müller is explanatorily more adequate?
>
> Question 3: Does the presence or absence of an SP_{NOM} filter specification contribute to TMP's predictions?

4.2.3.3 Step 3: Integrating new material

The current parse will now be resumed and eventually concluded with the assumed SP_{NOM} and the original ranking from Table 4.2. After the ranked candidates have been generated in accordance with the filter specification, the incoming material enters the system in a third step. It is assumed that the incoming material is perceived by the system without any features as it detects the sole lexical form. This is possible since it is assumed that lexical form and their respective morphosyntactic features are represented in an associative way. Curiously, this assumption is inversely related to the aforementioned Observation 5 which posed the question whether TMP predicted forms or features. By explaining how the incoming material relates to the ranked candidates and the current material, it may be possible to shed more light onto this issue. The incoming material is assumed to enter the system featureless since its input must be determined according to the ranked candidates. In this way, the mechanism exhibits its bias in case of syncretism. This bias is, again, given by minimality assumptions. It is represented by the Synchronization process. Synchronization is concerned with the evaluation of the incoming material in light of the ranked candidates. For the current example of an assumed input of *der*$_{NOM.M.SG}$, TMP simply "sees" *der* as depicted in the Figure 4.12.

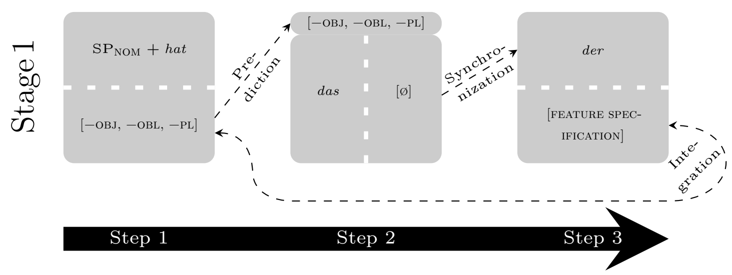


Figure 4.12: The newly incoming material enters the system.

Recall from Observation 1 that, in contrast to a real-world human language processor, TMP makes the actual integration process' unfolding transparent. The Experimental Part II will explain that a real language comprehender's analysis is obscured and that certain measurement methods can only detect the response to a linguistic input. TMP, being a theoretic approximation of this obscured processes, allows to gain insights into how new material is integrated. This is where TMP's real work begins: In comparison to the previously described processes, Synchronization at the transition from Step 2 to Step 3 can now be associated with calculatory load. TMP has to check whether the form of the incoming material matches the form of the top-ranked candidate. If this is the case, then the features of the top-ranked candidate from Step 2 are synchronized in a *simple* way with the bare form of the incoming material at Step 3. Recall from above that syncretisms are resolved in the same way. Whenever a syncretic form enters the system at Step 3, TMP will select the highest ranked candidate from the second step. If top-ranked candidate and incoming material do not match in form, a *complex* calculation will ensue since TMP has to consolidate the list for lower ranking candidates. Calculatory work will rise, too, because TMP has to synchronize more and possibly incompatible features the deeper it enters the list of ranked candidates.

Returning to Observation 5 and the question whether TMP predicts forms or features: The way it assigns the latter to the former at the Synchronization process of Step 2 and 3 at least further relies on the association of lexical material with morphosyntactic features. Since TMP assigns features to the incoming material at the third step, it is, in turn, plausible to assume that it predicts features associated with forms at Step 2.

In order to eventually integrate *der*, two operations are required: Firstly, TMP has to adopt *der* instead of the predicted $das_{\text{NOM/ACC.N.SG}}$. If the predicted $das_{\text{NOM/ACC.N.SG}}$ had really been the incoming material, then TMP would not even have to synchronize features. This should have been the most *simple* way of synchronization. This is, however, not the case in the example at hand. Instead, the top-ranked candidate of $das_{\text{NOM/ACC.N.SG}}$ has to be replaced by an alternative of *der*. Secondly, the incoming material of *der* has to be associated with its respective feature specification. This means that the syncretism between $der_{\text{NOM.M.SG}}$ and $der_{\text{DAT/GEN.F.SG, GEN.PL}}$ has to be resolved. Synchronization handles these issues. In order to adopt *der*, TMP has to search the ranked candidates from the second step. The list provides two alternatives, namely the higher ranked $der_{\text{NOM.M.SG}}$ and the lower ranked $der_{\text{DAT/GEN.F.SG, GEN.PL}}$. Again, TMP's bias towards minimal feature deviance comes into effect. Therefore, in order to ensure lower feature deviance, TMP selects the next higher ranked candidate that matches the form of *der*. As shown in Table 4.2, $der_{\text{NOM.M.SG}}$ with its [+M] feature has precedence over $der_{\text{DAT/GEN.F.SG, GEN.PL}}$ which carries [+OBL, [+PL ∨ +F]]. It is *simpler* for TMP to synchronize just a non-retrievable but still compatible feature—namely [+M]—with the incoming *der* at the third step than a specification that is incompatible with the filter specification—namely [+OBL]. That is why *der* will be associated with [+M] and not with [+OBL, [+PL ∨ +F]] as depicted in Figure 4.13. Again, recall from Observation 1 that such a statement is only possible with regard to TMP and not applicable for a later empirically investigated real-world language processor.

Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. Integration is envisioned as passing on the current material's features to the newly incoming material's features. In this add-up process, both specifications are combined in order of their sequential availability. Since the current material precedes the incoming material, the combination of the former and latter

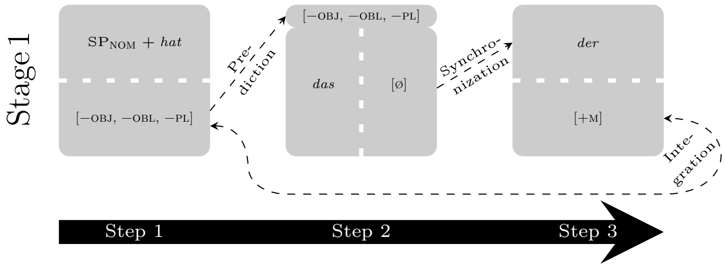


Figure 4.13: The specification of the next highest ranked *der* alternative is synchronized as the top-ranked candidate did not enter the system.

happens in this sequence. The only requirement for passing on features and combining both sets is their mutual compatibility. At this point in the process, it seems as Integration becomes redundant after successful Synchronization, since the specification of the incoming material from Step 3 could be readily combined with the current material's specification from Step 1 due to their mutual compatibility. However, incoming material that would necessitate the selection of a candidate with incompatible features would provide features that oppose the filter specification and therefore the current material's feature specification too. This would mean that the selected ranked candidate would oppose the current material's specification. The language processing system cannot change the input but the initial analysis of the current material and its specification. This causes reanalysis. The Integration process is required to cope with this eventuality. It allows both the combination of the current material's specification with the incoming material's specification as well as the erasure of the former in case of reanalysis. This will be described in more detail in Step 3'.

In the current case of the integration of *der* in the nominative masculine singular alternative, the current material's specification [−OBJ, −OBL, −PL] will thus be combined with the incoming material's specification [+M] as illustrated in Figure 4.14.

The sum of SP_{NOM}'s [−OBJ, −OBL, −PL] and *der*'s [+M] equals [−OBJ, −OBL, +M, −PL]. This is only possible because both feature bundles are mutually compatible and can thus be added up. Step 3' will demonstrate a case in which both specifications conflict and cannot be combined. However, as shown in Figure 4.15, the combined feature bundle can now be used for the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

4.2.3.4 Step 3': Lower ranked candidate and reanalysis

Recall from above that the Integration process would play a bigger and more elaborate role in case of an incoming material that would not be the targeted material but one that would make it necessary to select a lower or maybe incompatible ranked candidate. This is the case for *den* as incoming material. In order to depict this process, Figure 4.12 shall be repeated in Figure 4.16 with the incoming *den* instead of *der*.

In order to eventually integrate *den*, two operations are required: Firstly, TMP has

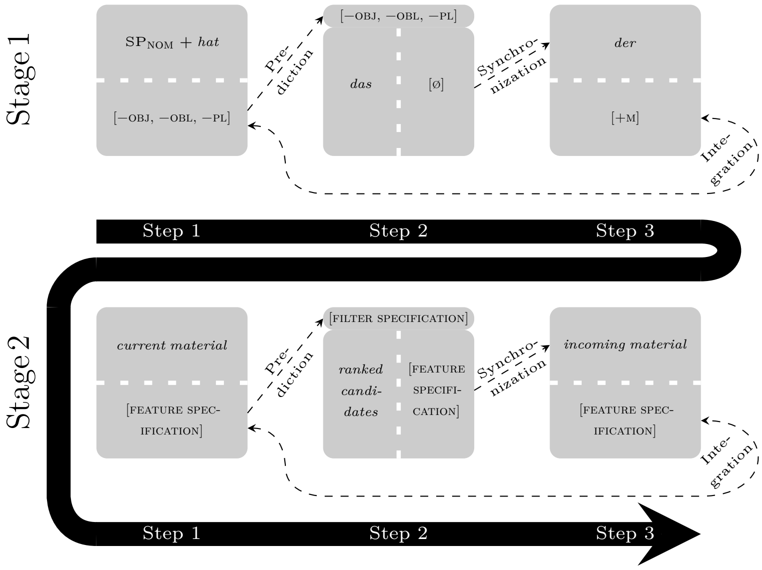


Figure 4.14: The processes feed into the next parsing stage in order to integrate the subsequent word.

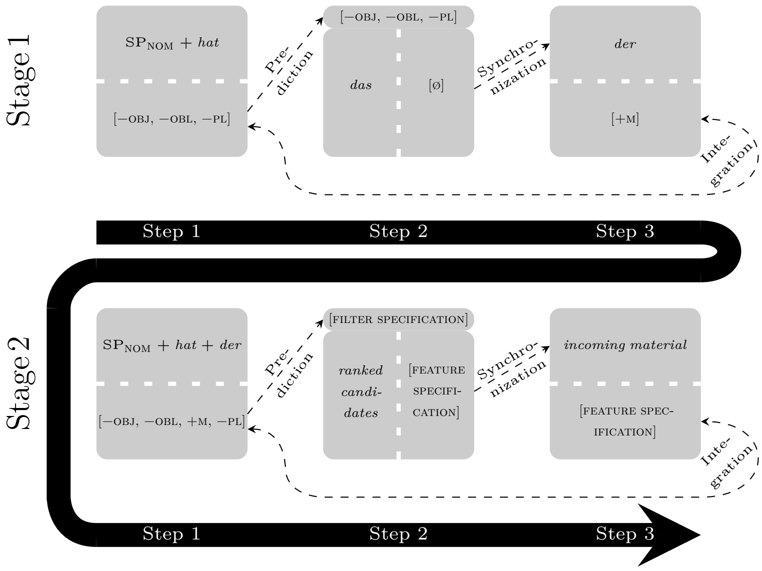


Figure 4.15: Combining current and incoming material: new current material at the subsequent parsing Step 1 of Stage 2.

to adopt *den* instead of the predicted *das*$_{\text{NOM/ACC.N.SG}}$. This means that the top-ranked candidate of *das*$_{\text{NOM/ACC.N.SG}}$ has to be replaced by an alternative of *den*. Secondly, the incoming material of *den* has to be associated with its respective feature specification. This means that the syncretism between *den*$_{\text{ACC.M.SG}}$ and *den*$_{\text{DAT.PL}}$ has to be resolved. Synchronization handles these issues. In order to adopt *den*, TMP has to search the ranked candidates from the second step. The list in Table 4.2 provides two alternatives,

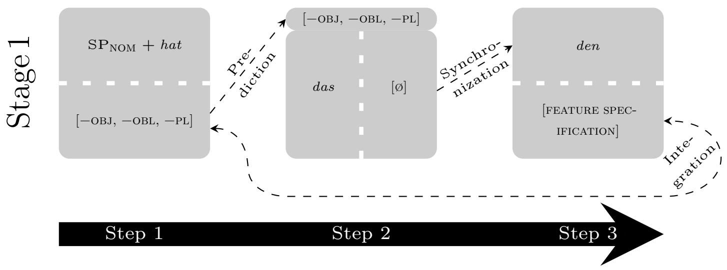


Figure 4.16: The newly incoming *den* enters the system.

namely the higher ranked $den_{\text{ACC.M.SG}}$ and the lower ranked $den_{\text{DAT.PL}}$. Again, TMP's bias toward minimal feature deviance comes into effect. Therefore, in order to ensure lower feature deviance, TMP selects the next higher ranked candidate that matches the form of *den*. As shown in Table 4.2, $den_{\text{ACC.M.SG}}$ with its features of [+OBJ,+M] has precedence over $den_{\text{DAT.PL}}$ which carries [+OBJ, +OBL, +PL]. It is *simpler* for TMP to synchronize just one incompatible specification with retrievable features—namely [+OBJ, +M,]—with the incoming *den* at the third step than three features that are entirely incompatible with the feature specification—namely [+OBJ, +OBL, +PL]. That is why *den* will be associated with [+OBJ, +M] and not with [+OBJ, +OBL, +PL] in Figure 4.17.

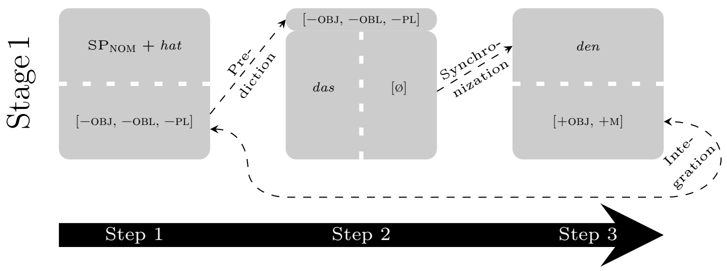


Figure 4.17: The specification of the next highest ranked *den* alternative is synchronized as the top-ranked candidate did not enter the system.

Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. As mentioned earlier, it may seem as if the Integration process becomes redundant after successful Synchronization since the specification of the incoming material from Step 3 could be readily combined with the current material's specification from Step 1 due to their mutual compatibility. But now with *den* as incoming material, the selection of a candidate with incompatible features is necessary. This particular ranked candidate provides a feature that is incompatible with the filter specification—namely *den*'s [+OBJ]. This means that $den_{\text{ACC.M.SG}}$ with its features of [+OBJ, +M] opposes the current material's specification. The language processing system cannot change the input but the initial analysis of the current material and its specification. Therefore, reanalysis becomes necessary. Selecting the other alternative of *den*—$den_{\text{DAT.PL}}$ which carries [+OBJ, +OBL, +PL]—would not be effective since it is even more incompatible with the current material's specification. The only way to maintain processing is by abandoning the SP_{NOM} as depicted in Figure 4.18. Deleting the SP_{NOM} and its specification within the Integration process renders the filter specification and the order of the ranked candidates for the determiners no longer applicable. By restarting with a clean slate, *den*$_{\text{ACC.M.SG}}$ no longer provides incompatible features.

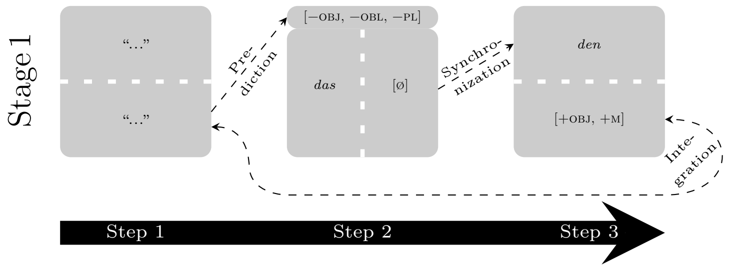


Figure 4.18: The SP_{NOM} is deleted.

In the present case of the integration of *den* in the accusative masculine singular alternative, the current material's specification will thus be combined with the incoming material's specification of [+OBJ, +M] as shown in Figure 4.19. After the SP_{NOM} and its specification have been deleted, the sum of virtually nothing and *den*'s [+OBJ, +M] equals [+OBJ, +M]. Figure 4.20 shows how this feature bundle can now be fed into the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

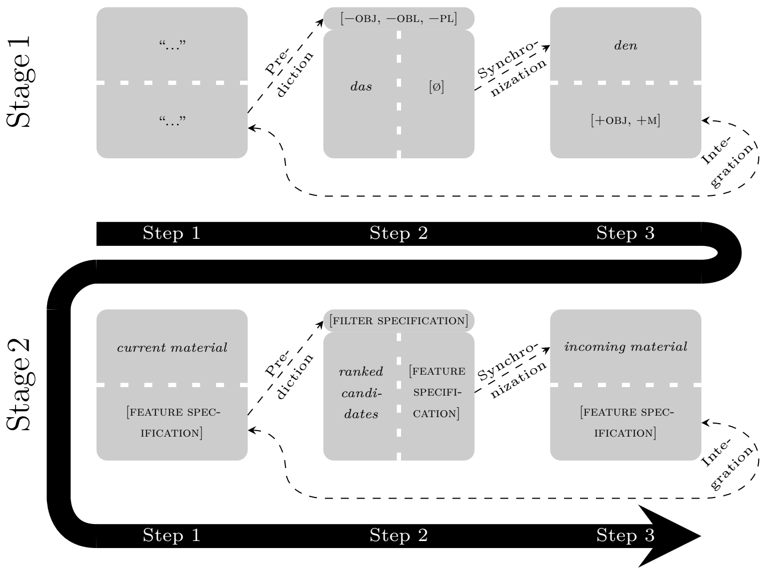


Figure 4.19: The processes feed into the next parsing stage in order to integrate the subsequent word.

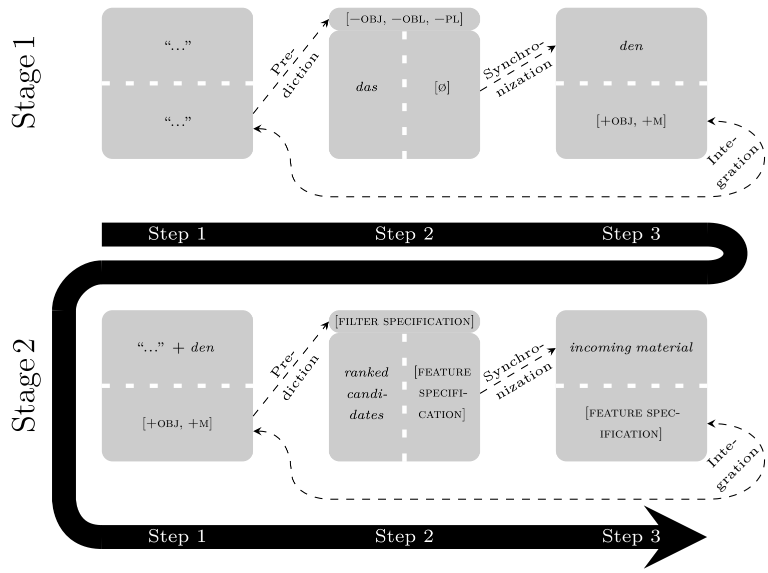


Figure 4.20: Combining current and incoming material: "..." and *den* equals [+OBJ, +M].

4.3 TMP's Provisional Test Runs

After TMP has been explained based on the integration of a determiner, it shall be tested very briefly with other structures, before it will be investigated in depth with subject-object asymmetries. Two possibilities come to mind. Firstly, O13's structures are the obvious choice for a first testing ground as they have attested results at their disposal. Secondly, TMP will revisit the idea of Schlesewsky and Frisch (2003) that the postulation of a special status for nominative case becomes necessary. Both tests shall serve the point that TMP provides an adequate mechanism to explain various structures.

4.3.1 Reassessment of O13's structures

In Appendices A.1 to A.3, TMP parsed O13's correct PPs in combination with O14's revised noun specification. These structures are repeated in (23). The presentation in Appendices A.1 to A.3 will also allow for conclusions on the corresponding ungrammatical structures from (9b–9c), (11a-ii–11a-iii) and (11b-ii–11b-iii).

(23) Correct adjective inflections:

a. ACC.N.SG:

durch$_{[+\text{OBJ},\ -\text{OBL}]}$	schlichtes$_{[-\text{F}]}$	Design$_{[-\text{F}]}$
by.ACC	plain.N	design.N.SG

b. ACC.F.SG:

durch$_{[+\text{OBJ},\ -\text{OBL}]}$	schlichte$_{[\emptyset]}$	Struktur$_{[\emptyset\ (/+\text{F})]}$
by.ACC	plain.F	structure.F.SG

c. ACC.M.SG:
durch$_{[+\text{OBJ},\ -\text{OBL}]}$ schlichten$_{[+\text{OBJ},\ -\text{OBL},\ +\text{M},\ -\text{F}]}$ Geschmack$_{[+\text{M},\ -\text{F}]}$
by.ACC plain.M taste.M.SG

The parses demonstrate that TMP successfully predicts grammatical structures: Table A.2 shows that the neuter *Design* is preferably predicted after *schlichtes*. In Table A.3, it is the feminine *Struktur* that occupies the top-ranked candidate after *schlichte*. Lastly, Table A.4 illustrates that the masculine *Geschmack* is the preferably predicted noun after *schlichten*.

However, TMP not only predicts the correct PPs effectively. Furthermore, it predicts the gradient processing pattern for the two incorrect versus the correct ACC.N.SG conditions in (23a). Recall that in O13 **durch schlichten Design* elicited a more pronounced LAN than **durch schlichte Design* in comparison to *durch schlichte Design*. The authors explained this with a compatibility violation between *schlichten* and *Design* while they only found a specificity violation for *schlichtes* and *Design*. O14 relocated these effects to failing feature searches which was the case more severely in **durch schlichten Design*. TMP predicts this modulation too: When comparing the correct integration of *Design* after *schlichte* with the incorrect *Design* after *schlichte*, in case of the latter, Table A.3 reveals that one backward feature retrieval fails on *Design* following *schlichte*, while there is no retrieval fail for *Design* after *schlichtes*. Furthermore, when comparing both incorrect PPs, Table A.4 shows that there are three forward feature retrieval failures on *Design* after *schlichten*. This leads to the ranking that is mirrored both by O13's and O14's results and conclusions: *Design* after *schlichtes* < *Design* after *schlichte* < *Design* after *schlichten*.

TMP's predictions go beyond what O13 and O14 could claim in the sense that it makes statements *on* the adjective's position *about* the adjective's integration. To the contrary, O13 measures on the subsequent noun and describes the integratability of the adjective into the context comprising the preposition's and the noun's features. Therefore, their model does not allow for statements about the integration of the adjective. According to TMP, however, the system preferably predicts *schlichten*$_{\text{ACC.M.SG}}$ at the transition from preposition to adjective. The other candidates *schlichte* and *schlichtes* are dispreferred after *durch*'s accusative masculine singular specification of [+OBJ, −OBL, +M, −F]. The proposal put forward here predicts the following scale of adjective integration: *schlichten* < *schlichte* < *schlichtes*. This means that, if O13 would have measured on the adjective, they should have detected a more effortful integration on *schlichtes* in comparison to *schlichte*, while *schlichten* should have elicited the lowest processing load.

However, recall that O14 did only discuss the ACC.N.SG condition since it made a revision of their parser necessary, as the new noun specification no longer provided a compatibility violation. O14 did not investigate the ACC.F.SG and ACC.M.SG conditions with their new parsing mechanism. One can only speculate whether leaving these two conditions out led to the total demise of their idea in Opitz and Pechmann (2016).

4.3.2 Reassessement of nominative case

Recall from Section 3.4 that Schlesewsky and Frisch (2003) assumed nominative case to have special properties in comparison to accusative and dative. They came to this conclusion by testing ungrammatical double case-marked structures in which double nominative sentences were judged "as more grammatical than their accusative or dative counterparts" (Schlesewsky and Frisch, 2003, p. 68). However, with TMP, such a stipulation is not necessary. At least, the author's strong claim can simply be attributed to the specifications of the cases. TMP's mode of operation would explain their results and conclusion in the following way: For the double nominative condition in (24), the processing of a verb like *lobte* ("commended") which assigns accusative would entail the system to expect an accusative argument as second DP, since the first had already been nominative-marked and integrated accordingly.

(24) * Welcher Kommissar aus der Vorstadt lobte der
[which inspector].NOM.M from the suburbs commended [the
Detektiv?
detective].NOM.M

In all underspecification approaches, the filter specification would therefore contain [+OBJ, −OBL] (or rather [+HR, −LR] in Wunderlich's model) for which TMP would consistently select $\textit{den}_{\text{ACC.M.SG}}$ as the top-ranked candidate. This is exemplified for Bierwisch in Table 4.4. This ranking shows that TMP "receiving" *der* instead of the expected $\textit{den}_{\text{ACC.M.SG}}$ is not as violating as in the case of the other two conditions. For the incoming *der*, TMP does not face any incompatible features, although two, namely [+OBJ, −OBL] from the filter specification, cannot be found on the determiner while, in turn, one from the determiner cannot be found on the filter specification.

Turning to the double accusative condition, for the second argument, TMP expects a nominative-marked subject DP since the first was already analyzed as an accusative object. For the expected nominative, the filter specification is [−OBJ, −OBL, −PL]. Accordingly, Table 4.5 shows that $\textit{der}_{\text{NOM.M.SG}}$ is the second top-ranked candidate after *das*. In comparison to the double nominative condition, the change from the expected *der* to the low-ranked incoming *den* is worse than the previous change from the expected *den* to the incoming *der*. This time, $\textit{den}_{\text{ACC.M.SG}}$ not only introduces an incompatible feature, but even three features of the filter specification cannot be found on the determiner. In turn, two features of the determiner cannot be retrieved on the filter specification. Note that Schlesewsky and Frisch (2003) did not find a significant difference in accuracy and latency between double accusative and double dative structures. However, in absolute numbers, the latter were rated ungrammatical with a higher accuracy suggesting that the second dative-marked DP gave a stronger ungrammaticality cue. With regard to these double dative sentences, Table 4.5 reveals that $\textit{der}_{\text{NOM.M.SG}}$ is the second top-ranked candidate. Analogously to the double accusative condition, the second DP is expected to realize a subject DP in nominative case again. The incoming *dem*, however, violates the filter specification with two incompatible features, three non-retrievable features on the determiner and two missing features of the determiner on the filter specification.

Table 4.4: Ranked determiner candidates after a verb assigning accusative case for DP2.

rank	filter specification: [+OBJ, −OBL] (by current material's verb's subcategorization frame from prior step)		⚡	🔍−		🔍+
	determiner	specification		⇒	⇐	
1.	*den*$_{\text{ACC.M.SG}}$	[+OBJ, +M]	0	1	1	1
2.	*das*$_{\text{NOM/ACC.N.SG}}$	[∅]	0	2	0	0
3.	*der*$_{\text{NOM.M.SG}}$	[+M]	0	2	1	0
	die$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[+PL ∨ +F]	0	2	1	0
4.	*dem*$_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL]	1	1	1	1
5.	*den*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	1	1	2	0
6.	*des*$_{\text{GEN.M/N.SG}}$	[+OBL]	1	2	1	0
7.	*der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL, [+PL ∨ +F]]	1	2	2	0

Whether TMP predicts a difference between accusative and dative shall not be discussed here. Both determiners that introduce either a second accusative or dative DP introduce a feature or features that violate the expected syntactic context. This is not the case for a second argument which is marked for nominative.

These short insights into TMP's approach suggest that there is no need to describe nominative as "special" in order to draw the conclusion that this case is most likely processed differently than accusative or dative. Like Schlesewsky and Frisch (2003), TMP predicts a less ungrammatical integration of a second nominative argument in comparison to double accusative or double dative-marked structures: nominative < accusative = (/<) dative.

Table 4.5: Ranked determiner candidates after a verb assigning nominative case for DP2.

rank	filter specification: [−OBJ, −OBL, −PL] (by current material's verb's subcategorization frame from prior step)		⚡	🔍−		🔍+
	determiner	specification		⇒	⇐	
1.	*das*$_{\text{NOM/ACC.N.SG}}$	[Ø]	0	3	0	0
2.	*der*$_{\text{NOM.M.SG}}$	[+M]	0	3	1	0
3.	*die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[+PL ∨ +F]	1	3	1	0
	des$_{\text{GEN.M/N.SG}}$	[+OBL]	1	3	1	0
4.	*den*$_{\text{ACC.M.SG}}$	[+OBJ, +M]	1	3	2	0
5.	*dem*$_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL]	2	3	2	0
	der$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL, [+PL ∨ +F]]	2	3	2	0
6.	*den*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	3	3	3	0

5 Feeding TMP with Grammatical Two-Element DPs

In this chapter, TMP will finally be fed with linguistic material carrying morphosyntactic features. The model will calculate appropriate parses for the DPs from (21). Their outcome may give answers to the three aforementioned questions:

> Question 1: How do the parses differ between the elements of the subject-object ambiguities?
>
> Question 2: Which one of the underspecification approaches by Bierwisch, Blevins, Wunderlich, Wiese and Müller is explanatorily more adequate?
>
> Question 3: Does the presence or absence of an SP$_{\text{NOM}}$ filter specification contribute to TMP's predictions?

For TMP's calculations, the Parsing Prerequisites I to III that were initially introduced in Section 4.2.3 have to be set. Regarding Parsing Prerequisite I, recall that the research cited in Chapter 2 failed to consider the syncretic nature of the tested determiners. The DPs in (21)—repeated for convenience in (25)—seek to show that the syncretic determiners are disambiguated by the subsequent noun. Figure 5.1 visualizes even more explicitly the syncretic and ambiguous nature of determiners as well as their eventually disambiguating DP-final noun. This very contact point of determiner and noun shall serve as a first testing ground for the investigation of morphosyntax-related processes. Satisfying Parsing Prerequisite I, the elements of (25) will be fed into the current and incoming material slots successively. These DPs allow for the investigation of changes in the initial analysis of the determiner as the subsequent noun disambiguates the syntactic function of the DP. Thus, insights into the transition properties will help with answering Question 1.

(25)	a.	der the.NOM.M, DAT.F	Bäcker baker.NOM.M
	b.	der the.NOM.M, DAT.F	Kundin customer.DAT.F
	c.	den the.ACC.M, DAT.PL	Bäcker baker.ACC.M
	d.	den the.ACC.M, DAT.PL	Bäckern bakers.DAT.PL

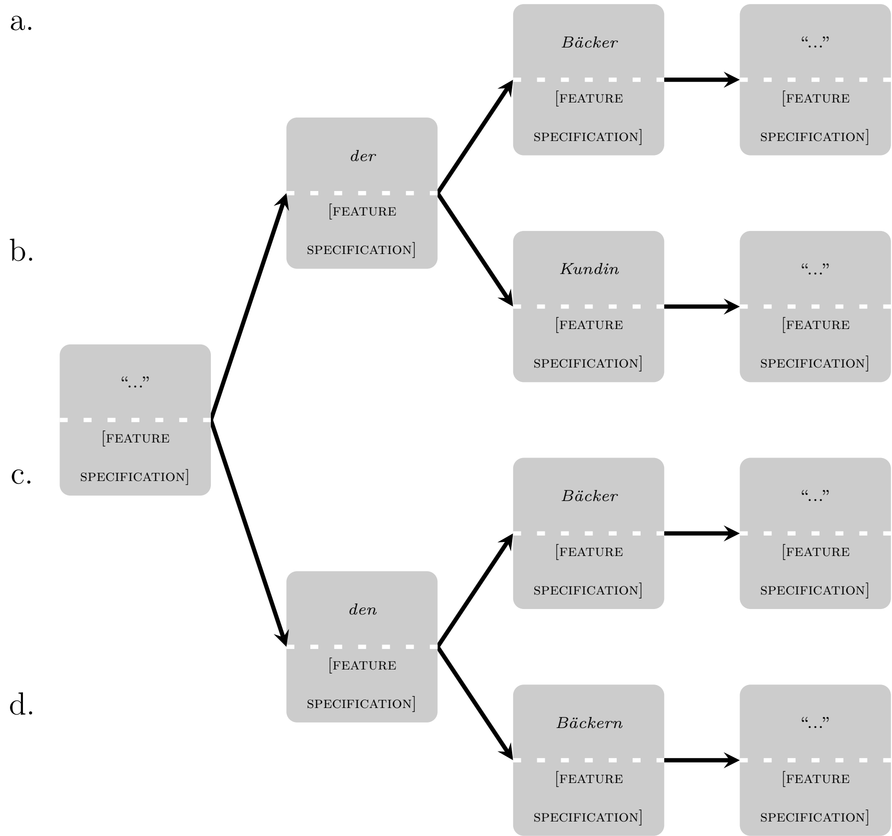


Figure 5.1: Visualization of (25a–25d).

This aforementioned disambiguation shall be caused by the underspecified morphosyntactic features that are associated with the lexical material. Hence, the DPs from (25) have to be equipped with morphosyntactic features in order to comply with Parsing Prerequisite II: The five different underspecification approaches from Section 1.2 provide the respective features. In Section 5.1, appropriate feature specifications for determiners and their subsequent nouns will be collected in order to satisfy Parsing Prerequisite II. This will be done initially for Bierwisch's approach, while the respective compilations for the frameworks of Blevins, Wunderlich and Wiese are relocated to Appendix B.1. Note that Section 1.2.5 also introduced Müller's underspecification approach. However, Appendix B.1.5 explains why his framework is not suitable for the current proposal and why his features cannot be applied by TMP. Assessing all accounts will eventually allow to address Question 2.

To conform to the final Parsing Prerequisite III, unsurprisingly, TMP serves as the relevant mechanism: Its basic properties and inner workings have been thoroughly laid out in Chapter 4. The mechanism has been envisioned as an incrementally operating system that incorporates the morphosyntactic features of lexical items. Based on the specification of the current material, TMP is able to predict the incoming material as a list of ranked candidates. Those are derived by means of minimality principles that ensure feature identity or—put differently—minimal feature deviance relative to the current material. The least deviant alternative shall be the one that demands the least processing effort. Thus, it would be the preferably predicted alternative for continuations. Representing the actual incoming material, this top-ranked candidate would be integrated in the calculatory most *simple* way. These assumptions expose TMP as a prediction-generating machine. Therefore, it is crucial to examine its behavior as a function of the lexical building blocks it is provided with.

After the Parsing Prerequisites I to III will have been set finally with the lexical material, its corresponding underspecified features and the mechanism readily available at the end of this chapter, it is then possible to let TMP do its work as described in Section 5.2. The model's analyses will consist of detailed position-dependent parses for the four DPs of (25). While the main analysis will focus on Bierwisch's approach, all of the calculations will be done for the remaining frameworks of Blevins, Wunderlich and Wiese too. In addition to that, all of these position- and framework-dependent parses will be performed in two fashions: Recall from Observation 6 that it may not be necessary to assume explicit SP_{NOM} features. For this reason, position- and framework-dependent parses will be calculated with an assumed SP_{NOM} and its respective features in Section 5.2.1, while the analysis in Section 5.2.2 will abstain from these SP_{NOM} features and revert to TMP's inherent mechanics. The dichotomy between analyses with a present or absent SP_{NOM} will allow to assess Question 3.

Crucially, Section 5.3 will gather TMP's parsing outcomes in order to find answers to the Questions 1 to 3. To do so, the individual parses and analyses have to be compared with regard to the expected calculatory *simplicity* or *complexity*. This will be done at the determiner and noun positions in order to assess Question 1, across all underspecification approaches to tackle Question 2 and in terms of a presence or absence of an SP_{NOM} to deal with Question 3. Eventually, these comparisons will then allow for precise hypotheses that will be empirically tested in the Experimental Part II.

It is important to indicate that feature preparations, parsing calculations, their respective comparisons and resulting claims as well as later hypotheses across all of TMP's investigations and subsequent experiments will profit from a parallel structure of descriptions for the following reasons: Since TMP was announced as a prediction-generating machine, the mechanism is envisioned to operate in a uniform way at any given time. This renders the lexical input and its associated morphosyntactic features the only things that change across the aforementioned parts of this thesis. Therefore, these parts will reuse particular descriptions throughout the investigation. The recurring text blocks do indeed serve the purpose of allowing for broad and detailed comparisons across sections and are by no means an expression of self-plagiarism. The degree of parallelism allows the reader to retrace a particular specification, structure or parsing outcome more easily. In this way, the reader does not need to take care of circumjacent, possibly varying descriptions.

5.1 Feature Preparations

The present section will be concerned entirely with the Parsing Prerequisite II: the features for the DP's elements. The underspecification approaches introduced in Section 1.2 will provide the necessary frameworks. However, as already mentioned, collecting appropriate specifications in the current section will be restricted to Bierwisch. The remaining feature compilations can be found in the appendix. Blevins' account, that will be split up into his original and a maximally underspecified approach inspired by O13, is available in Appendices B.1.1 and B.1.2 respectively. Wunderlich's feature compilation is relocated to Appendix B.1.3 while the collection for Wiese can be found in Appendix B.1.4. As already mentioned, Appendix B.1.5 addresses why Müller's account is not applicable to the current investigation. While the underspecification approaches were concerned with various inflected parts of speech, they lacked specifications for nouns. Therefore, feature bundles for nominal inflection have to be developed accordingly. Each of the four models will eventually allow to specify the DPs of (25) differently. The paradigms of the determiner and nouns of the relevant DP1 are displayed in Table 5.1.

Table 5.1: Inflectional paradigms of the German strong determiner and the nouns that comprise the DPs in (25).

	determiner				noun			
	SG			PL	*Bäcker*$_{\text{M}}$		*Kundin*$_{\text{F}}$	
	M	N	F		SG	PL	SG	PL
NOM	*der*	*das*	*die*	*die*	*Bäcker*	*Bäcker*	*Kundin*	*Kundinnen*
ACC	*den*	*das*	*die*	*die*	*Bäcker*	*Bäcker*	*Kundin*	*Kundinnen*
DAT	*dem*	*dem*	*der*	*den*	*Bäcker*	*Bäckern*	*Kundin*	*Kundinnen*
GEN	*des*	*des*	*der*	*der*	*Bäckers*	*Bäcker*	*Kundin*	*Kundinnen*

The following descriptions will provide Bierwisch-related features for the elements of the first DP. Since Bierwisch's way to underspecify the German strong determiner was introduced in Section 1.2.1, its inventory is repeated in Table 5.2 for the sake of completeness. Note again the partially disjunctive feature specifications in R_2 and R_3. With regard to the nouns *Bäcker*, *Kundin* and *Bäckern*, new inventories with new feature specifications have to be established.

Turning to the nouns, Bierwisch does not provide underspecified feature specifications. Therefore, a noun inventory has to be developed. When trying to maintain the way he underspecified the paradigm for pronominal inflection, the inventory for *Bäcker* from Table 5.1 should look like the one in Table 5.3a. It reflects Bierwisch's approach insofar as it assumes the lexical inherent [+M] feature for the singular noun. It also attempts to avoid negative specifications. However, this is not possible for the paradigm at hand. *Bäckers* carries a negative [OBJ] feature. This is not problematic as *Bäckers* is not part of (25). Like in Table 5.2 for the determiner, the ranking in Table 5.3a is not related to the order of ranked candidates. While Bierwisch stipulated the order of determiners

Table 5.2: Bierwisch's inventory of the strong determiner paradigm (Müller, 2002, p. 332).

determiner		feature specification
R_1 *den*$_{\text{DAT.PL}}$	↔	[+OBJ, +OBL, +PL]
R_2 *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	↔	[+OBL, [+PL ∨ +F]]
R_3 *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	↔	[+PL ∨ +F]
R_4 *dem*$_{\text{DAT.M/N.SG}}$	↔	[+OBJ, +OBL]
R_5 *des*$_{\text{GEN.M/N.SG}}$	↔	[+OBL]
R_6 *den*$_{\text{ACC.M.SG}}$	↔	[+OBJ, +M]
R_7 *der*$_{\text{NOM.M.SG}}$	↔	[+M]
R_8 *das*$_{\text{NOM/ACC.N.SG}}$	↔	[Ø]

himself, the elements of the noun inventory are simply ordered by decreasing specificity. Similar to *Bäcker*, the paradigm for *Kundin* from Table 5.1 would be specified and ordered accordingly like in Table 5.3b.

Table 5.3: Noun inventories in Bierwisch's manner.

(a) Inventory of the *Bäcker* paradigm.

noun		feature specification
R_1 *Bäckers*$_{\text{GEN.M.SG}}$	↔	[−OBJ, +OBL, +M]
R_2 *Bäckern*$_{\text{DAT.PL}}$	↔	[+OBJ, +OBL, +PL]
R_3 *Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	↔	[+PL]
R_4 *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	↔	[+M]

(b) Inventory of the *Kundin* paradigm.

noun		feature specification
R_1 *Kundinnen*$_{\text{NOM/ACC/DAT/GEN.F.PL}}$	↔	[+PL]
R_2 *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	↔	[+F]

All the determiners' and nouns' features have now been gathered, satisfying the remaining Parsing Prerequisite II. With regard to Question 1, it will now be interesting to see how TMP will analyze the initial determiner, which prediction it will make according to the previous integration, how the parser will integrate the subsequent noun and whether it has to initiate reanalysis due to the encounter of this very noun. These fine-grained issues are immediately influenced by the five different frameworks of Bierwisch, Blevins, Wunderlich and Wiese as well as the presence or absence of an SP_{NOM} filter specification at the same time. Consequently, these sub-questions are equally relevant to Question 2 respectively as they are to Question 1. Question 2 will be touched insofar as the featural contact points of determiner and noun will vary depending on the specifications by the five different frameworks. Therefore, the answers to Question 1's sub-questions will be altered in accordance to the underspecification model. The issue of Question 3's presence or absence of an SP_{NOM} alters the specification of the DP again and thus touches the aforementioned sub-questions.

5.2 TMP's Calculations

Since all of the Parsing Prerequisites I to III have been set in place for TMP to start its calculations, the parsings and analyses of the following sections seek to present answers to the concluding remarks of Section 5.1. As already mentioned, position- and framework-dependent parses will be calculated for the four DPs of (25) with an assumed SP_{NOM} and its respective features in Section 5.2.1, while the analysis in Section 5.2.2 will dispense with these SP_{NOM} features and rely on TMP's intrinsic mechanisms. The former section will include detailed descriptions of the individual parsing stages and their internal steps while the latter will be restricted to the ranked candidates for determiners and nouns for each underspecification approach.

As already mentioned above, the investigation of the DPs from (25) will be performed in two ways: In Section 5.2.1, the DPs will be combined with a postulated precursory SP_{NOM}. In comparison to that, the analyses of Section 5.2.2 TMP's input will not be preceded by SP_{NOM} features. Due to their complexity, however, the subsequent investigations will be limited to Bierwisch's approach. Appendix B.2 continues the SP_{NOM}-related calculations in Appendix B.2.1 and all SP_{NOM}-free analyses in Appendix B.2.2 for the remaining underspecification approaches.

5.2.1 Parsing with a prior SP_{NOM} using Bierwisch's features

In the present section, the four DPs of (25) will be parsed one after another with a preceding SP_{NOM}. All descriptions will consist of step by step and stage by stage calculations of each individual DP. Recall that these structures are actually the DP1 and thus part of the entire sentences of Table 4.1. It was postulated that they are affected by a precursory SP_{NOM}. Chapter 3 presented reasons to assume such preference and where to locate it within theory. Furthermore, Section 4.1.1 discussed how to implement the SP_{NOM} in an underspecification approach following the models of Bierwisch, Blevins, Wunderlich and Wiese. As indicated above, the current investigation will revert to Bierwisch only, while the other approaches' features are applied in Appendix B.2.1 respectively. According to (20), a Bierwisch-realized SP_{NOM} would carry [−OBJ, −OBL].

5.2.1.1 Parsing *der Bäcker*

The DP *der Bäcker* from (25a) shall be parsed. It is the first clause-medial syntactic argument of sentence (a) from Table 4.1 and thus part of the sentence *Gestern hat der Bäcker den Konditor gesehen* ("Yesterday, the baker saw the confectioner"). The DP's conclusive parse will be illustrated in Figure 5.2.

5.2.1.1.1 Stage 1: SP$_{\text{NOM}}$ + *hat* → *der*

Step 1 The current material and its specification are the SP$_{\text{NOM}}$ with [−OBJ, −OBL, −PL] that also includes [−PL] from the auxiliary verb *hat*. This bundle will be inserted into the current material slot and its specification respectively. The sentence initial adverb *gestern* does not provide relevant morphosyntactic features with respect to the parsing of the DP. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [−OBJ, −OBL, −PL] was the current material's specification and is maintained in the filter specification of the subsequent Step 2.

Step 2 Ranked candidates are derived and thoroughly presented in Table 5.4. The determiner *das*$_{\text{NOM/ACC.N.SG}}$ is the top-ranked candidate while others are still part of the list. The targeted *der*$_{\text{NOM.M.SG}}$ is the second-ranked candidate according to Bierwisch's account. Recall from the initial exemplification of TMP's Step 2 the assessment that Bierwisch's partially disjunctive feature bundles could require a secondary mechanism to resolve these disjunctions. Still, no additional operations shall be assumed. The Experimental Part II will reiterate on this mechanism's aspect. How TMP switches from the top-ranked *das*$_{\text{NOM/ACC.N.SG}}$ to the lower ranked *der*$_{\text{NOM.M.SG}}$ alternative will be explained for the third step of the parsing along with the Synchronization process.

Table 5.4: Ranked determiner candidates after an SP$_{\text{NOM}}$.

rank	filter specification: [−OBJ, −OBL, −PL] (by current material's SP$_{\text{NOM}}$ + *hat*)		⚡	⊖		⊕
	determiner	specification		⇒	⇐	
1.	*das*$_{\text{NOM/ACC.N.SG}}$	[Ø]	0	3	0	0
2.	*der*$_{\text{NOM.M.SG}}$	[+M]	0	3	1	0
3.	*die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[+PL ∨ +F]	1	3	1	0
	des$_{\text{GEN.M/N.SG}}$	[+OBL]	1	3	1	0
4.	*den*$_{\text{ACC.M.SG}}$	[+OBJ, +M]	1	3	2	0
5.	*dem*$_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL]	2	3	2	0
	der$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL, [+PL ∨ +F]]	2	3	2	0
6.	*den*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	3	3	3	0

Step 3 The determiner *der* enters the system as newly incoming material. It is assumed that TMP simply "sees" *der* initially without any specification. In order to assign a specification and eventually integrate *der*, two operations are required: Firstly, TMP has to adopt *der* instead of the predicted *das*$_{\text{NOM/ACC.N.SG}}$. If the predicted *das*$_{\text{NOM/ACC.N.SG}}$ had really been the incoming material, then TMP would not even have to synchronize features. This should have been the most effortless way of synchronization. This is not the case in the example at hand. This means that the top-ranked candidate of *das*$_{\text{NOM/ACC.N.SG}}$ has to be replaced by an alternative of *der*. Secondly, the incoming ma-

terial of *der* has to be associated with its respective feature specification. This means that the syncretism between *der*$_{\text{NOM.M.SG}}$ and *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ has to be resolved. Synchronization handles these issues. In order to adopt *der*, TMP has to search the ranked candidates from the second step. The list provides two alternatives, namely the higher ranked *der*$_{\text{NOM.M.SG}}$ and lower ranked *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$. Again, TMP's bias toward minimal featural deviance comes into effect. Therefore, in order to ensure lower featural deviance, TMP selects the next higher ranked candidate that matches the form of *der*. As shown in Table 5.4, *der*$_{\text{NOM.M.SG}}$ with its feature of [+M] has precedence over the syncretic *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ which carries [+OBL, [+PL ∨ +F]]. It is *simpler* for TMP to synchronize just one feature that is not retrievable—namely [+M]—with the incoming *der* at the third step than a specification that is entirely incompatible with the feature specification. That is why *der* will be associated with [+M] and not with [+OBL, [+PL ∨ +F]]. For the integration of *der* in the nominative masculine singular alternative, the current material's feature set of [−OBJ, −OBL, −PL] will thus be combined with the incoming material's specification [+M]. They will eventually be fed into the next parsing stage. The sum of the features of SP$_{\text{NOM}}$, *hat* and *der* equals [−OBJ, −OBL, −PL, +M]. This is only possible since both feature bundles are mutually compatible and can thus be added up. This feature bundle can now be fed into Step 1 of Stage 2 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

5.2.1.1.2 Stage 2: SP$_{\text{NOM}}$ + *hat* + *der* → *Bäcker*

Step 1 The first step here is identical to the outcome of Step 3 from Paragraph 5.2.1.1.1. The current material and its specification are the combination of the SP$_{\text{NOM}}$ + *hat*'s *der* that is [−OBJ, −OBL, +M, −PL] in total. This bundle will be inserted into the current material slot and its specification respectively. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [−OBJ, −OBL, +M, −PL] was the current material's specification and is maintained in the filter specification at Step 2.

Step 2 Ranked candidates are derived following the integration of *der* and thoroughly given in Table 5.5. The noun *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ is the top-ranked candidate while others are still part of the list. How TMP adopts the top-ranked *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ will be explained for the third step of the parsing along with the Synchronization process.

Step 3 The noun *Bäcker* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäcker* initially without any specification. In order to assign a specification and eventually integrate *Bäcker*, TMP can use the top-ranked candidate. As shown in Table 5.5, *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ with its feature of [+M] has precedence over the syncretic *Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$ which carries [+PL]. It is *simpler* for TMP to synchronize just one feature that is retrievable—namely [+M]—with the incoming *Bäcker* at the third step than a specification that is partially incompatible with the

Table 5.5: Ranked noun candidates after SP$_{\text{NOM}}$ + *der*$_{\text{NOM.M.SG}}$.

rank	filter specification: [−OBJ, −OBL, +M, −PL] (by current material's SP$_{\text{NOM}}$ + *hat* + *der*$_{\text{NOM.M.SG}}$)		⚡	⊖		⊕
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	3	0	1
2.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	4	1	0
3.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	1	2	1	2
4.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	1	4	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	1	4	1	0
5.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	3	4	3	0

feature specification—namely [+PL]. That is why *Bäcker* will be associated with [+M] and not with [+PL]. For the integration of *Bäcker* in the nominative/accusative/dative masculine singular alternative, the current material's specification [−OBJ, −OBL, +M, -PL] will thus be combined with the incoming material's specification [+M]. They will be fed into the first step at Stage 3, eventually concluding the parse.

5.2.1.1.3 Stage 3: Conclusion

The sum of the features of SP$_{\text{NOM}}$, *hat*, *der* and *Bäcker* equals [−OBJ, −OBL, +M, −PL]. This is only possible since both feature bundles are mutually compatible and can thus be added up. As shown in Figure 5.2, this feature bundle can now enter the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

5.2.1.2 Parsing *der Kundin*

The DP *der Kundin* from (25b) shall be parsed. It is the first clause-medial syntactic argument of sentence (b) from Table 4.1 and thus part of the sentence *Gestern hat der Kundin der Konditor geholfen* ("Yesterday, the confectioner helped the costumer"). The DP's conclusive parse will be illustrated in Figures 5.3 and 5.4.

5.2.1.2.1 Stage 1: SP$_{\text{NOM}}$ + *hat* → *der*

At this point, Steps 1–3 parallel Stage 1 in Paragraph 5.2.1.1.1 since the material is identical. The SP$_{\text{NOM}}$ + *hat* provide the feature specification for Step 2 via the Prediction process. Subsequently, the ranked candidates are derived. In Step 3, the incoming *der* is synchronized and integrated.

5.2.1.2.2 Stage 2: "..." + *der* → *Kundin*

Steps 1–2 At this point, Steps 1–2 parallel Steps 1–2 from Stage 1 in Paragraph 5.2.1.1.2 since the material is identical. The SP$_{\text{NOM}}$ + *hat* + *der* provide the feature specification for Step 2 via the Prediction process.

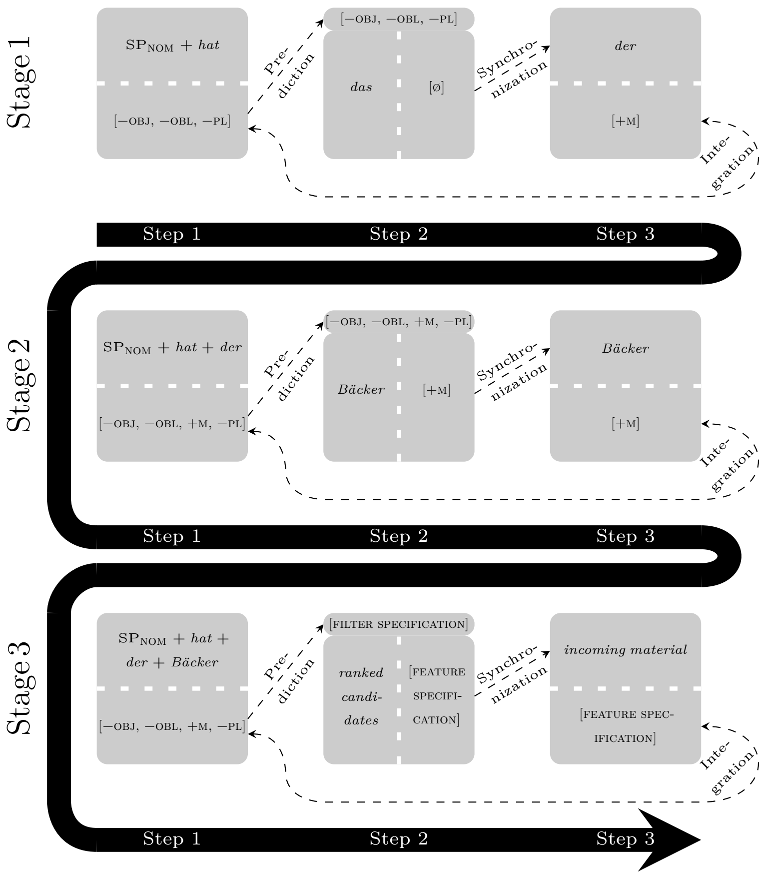


Figure 5.2: Combining current and incoming material: SP_{NOM}, *hat*, *der* and *Bäcker* equals [−OBJ, −OBL, +M, −PL].

Step 3 The noun *Kundin* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Kundin* initially without any specification. In order to assign a specification and eventually integrate *Kundin*, two operations are required: Firstly, TMP has to adopt *Kundin* instead of the predicted *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$. This means that the top-ranked candidate of *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ has to be replaced by *Kundin*. Secondly, the incoming material of *Kundin* has to be associated with its respective feature specification. In order to adopt *Kundin*, TMP has to search the ranked candidates from the second step. The list provides *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$. No other candidate is available. Therefore, TMP synchronizes [+F] with the incoming *Kundin* at the third step. Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. Now, two continuations are conceivable: The [+F] of *Kundin* can either be treated as being incompatible or compatible with the feature specification of [−OBJ, −OBL, −PL, +M]. Both alternatives will be discussed in the following two paragraphs and enfolded in Paragraph 5.2.1.2.3.

Step 3's incompatibility route Pursuing the route of incompatibility, one would have to derive the incompatibility by Bierwisch's exclusion of a specification that carries both [+M] and [+F]. With *Kundin* as incoming material, the selection of an incompatibly ranked candidate would be necessary. This particular ranked candidate would provide a feature that is incompatible with the feature specification—namely *Kundin*'s [+F]. This would mean that *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$ with its feature of [+F] would oppose the current material's specification that carries [+M]. The language processing system cannot change the input but the initial analysis of the current material and its specification. This necessitates reanalysis. Selecting another alternative of *Kundin* would not be effective since there is none. The only way to maintain processing is by abandoning the SP$_{\text{NOM}}$. Deleting the SP$_{\text{NOM}}$ and its specification within the Integration process renders the feature specification and the order of the ranked candidates for the determiners at Step 2 no longer applicable. By restarting with a clean slate, the other syncretic alternative of *der*, that is *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ which carries [+OBL, [+PL ∨ +F]], can be synchronized. This, however, also overwrites the contents of the first step of the subsequent parsing stage which would once again render the feature specification and the order of the ranked candidates for the nouns at Step 2 no longer applicable. By restarting with a clean slate, *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$'s [+F] at Step 3 no longer provides incompatible features to the current material's specification with [+OBL, [+PL ∨ +F]] of Step 1. The current material's feature set of [+OBL, [+PL ∨ +F]] will thus be combined with the incoming material's specification [+F]. They will eventually be fed into the first parsing step at Stage 3. The parse will be concluded in Paragraph 5.2.1.2.3.

Step 3's compatibility route Pursuing the route of compatibility, which is that the [+F] of Kundin would be compatible with the feature specification of [−OBJ, −OBL, −PL, +M], one would have to disregard the possible incompatibility between [+M] and [+F] and assume that they are mutually compatible instead. For the integration of *Kundin* in the nominative/accusative/dative/genitive feminine singular alternative, the current material's feature set of [−OBJ, −OBL, −PL, +M] will thus be combined with the incoming material's specification [+F]. They will eventually be fed into the first parsing step at Stage 3. The parse will be concluded in Paragraph 5.2.1.2.3.

5.2.1.2.3 Stage 3: Conclusion

Continuing Stage 2, Step 3's incompatibility route By continuing the incompatibility route from Stage 2, Step 3 in Paragraph 5.2.1.2.2, TMP will now combine the specifications of the reanalyzed *der* with the one of *Kundin* after the SP$_{\text{NOM}}$ and its specification have been abandoned. That is the sum of [+OBL, [+PL ∨ +F]] and [+F] which equals [+OBL, [+PL ∨ +F]]. As depicted in Figure 5.3, this feature bundle can now be used for the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

Continuing Stage 2, Step 3's compatibility route By continuing the compatibility route from Stage 2, Step 3 in Paragraph 5.2.1.2.2, TMP will combine the specifications of the SP$_{\text{NOM}}$, *hat* and *der* with the one of *Kundin*. That is the sum of [−OBJ, −OBL, +M, −PL] and [+F] which equals [−OBJ, −OBL, +M, +F, −PL]. This is only possible if one assumes that both feature bundles are mutually compatible and can thus be added up. Figure 5.4 depicts how this feature bundle can now be fed into the next parsing stage's Step 1 where the entire process starts over again for the next

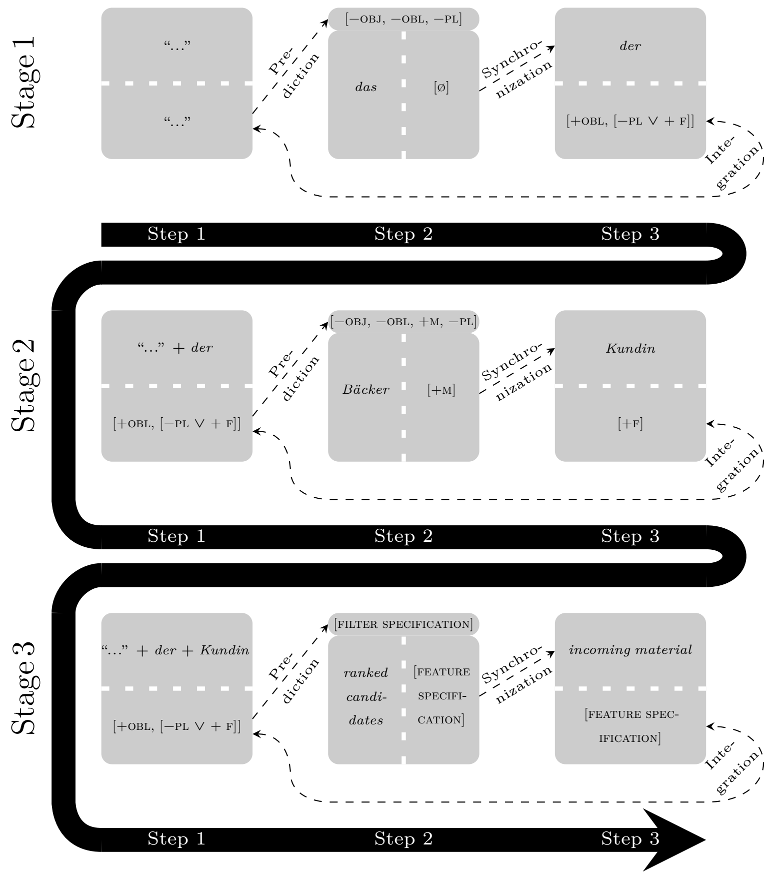


Figure 5.3: Combining current and incoming material: *der* and *Kundin* equals [+OBL, [+PL ∨ +F]].

ranked candidates and incoming material at Steps 2 and 3 respectively. The combination of SP$_{\text{NOM}}$ + *hat* + *der*$_{\text{NOM.M.SG}}$ *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$ yields, however, an illicit combination since there is no way to combine a masculine determiner with a feminine noun in order to realize a grammatical subject in nominative case.

5.2.1.3 Parsing *den Bäcker*

The DP *den Bäcker* from (25c) shall be parsed. It is the first clause-medial syntactic argument of sentence (c) from Table 4.1 and thus part of the sentence *Gestern hat den Bäcker der Konditor gesehen* ("Yesterday, the confectioner saw the baker"). The DP's conclusive parse will be illustrated in Figure 5.5.

5.2.1.3.1 Stage 1: SP$_{\text{NOM}}$ + *hat* → *den*

Steps 1–2 At this point, Steps 1–2 parallel Steps 1–2 from Stage 1 in Paragraph 5.2.1.1.1 since the material is identical. The SP$_{\text{NOM}}$ + *hat* provide the feature specification for Step 2 via the Prediction process.

Step 3 The determiner *den* enters the system as newly incoming material. It is

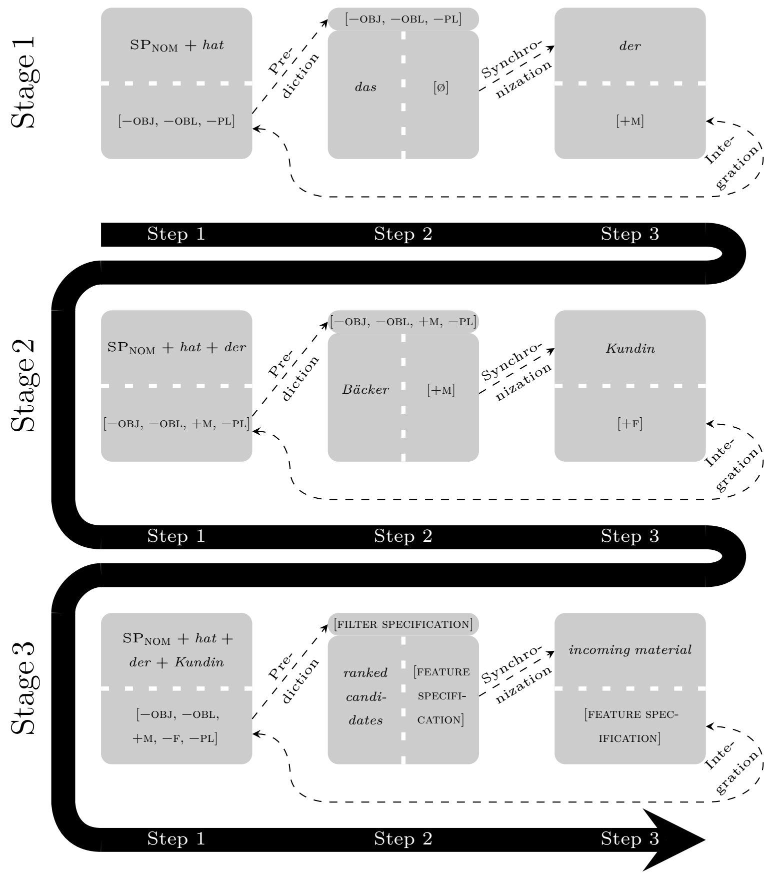


Figure 5.4: Combining current and incoming material: SP_{NOM}, *hat*, *der* and *Kundin* equals [−OBJ, −OBL, +M, +F, −PL].

assumed that TMP simply "sees" *den* initially without any specification. In order to assign a specification and eventually integrate *den*, two operations are required: Firstly, TMP has to adopt *den* instead of the predicted $das_{\text{NOM/ACC.N.SG}}$. This means that the top-ranked candidate of $das_{\text{NOM/ACC.N.SG}}$ has to be replaced by an alternative of *den*. Secondly, the incoming material of *den* has to be associated with its respective feature specification. This means that the syncretism between $den_{\text{ACC.M.SG}}$ and $den_{\text{DAT.PL}}$ has to be resolved. Synchronization handles these issues. In order to adopt *den*, TMP has to search the ranked candidates from the second step. The list in Table 5.4 provides two alternatives, namely the higher ranked $den_{\text{ACC.M.SG}}$ and lower ranked $den_{\text{DAT.PL}}$. Again, TMP's bias toward minimal featural deviance comes into effect. Therefore, in order to ensure lower featural deviance, TMP selects the next higher ranked candidate that matches the form of *den*. As shown in Table 5.4, $den_{\text{ACC.M.SG}}$ with its features of [+OBJ, +M] has precedence over the syncretic $den_{\text{DAT.PL}}$ which carries [+OBJ, +OBL, +PL]. It is *simpler* for TMP to synchronize a less incompatible specification with a retrievable feature—namely [+OBJ, +M]—with the incoming *den* at the third step than three features that are maximally incompatible with the feature specification—namely [+OBJ, +OBL, +PL]. That is why *den* will be associated with [+OBJ, +M].

Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. With *den* as incoming material, the selection of an incompatibly ranked candidate was necessary. This particular ranked candidate provides a feature that is incompatible with the feature specification—namely *den*'s [+OBJ]. This means that *den*$_{\text{ACC.M.SG}}$ with its features of [+OBJ, +M] opposes the current material's specification. The language processing system cannot change the input but the initial analysis of the current material and its specification. Therefore, reanalysis becomes necessary. Selecting the other alternative of *den*—*den*$_{\text{DAT.PL}}$ which carries [+OBJ, +OBL, +PL]—would not be effective since it is even more incompatible with the current material's specification. The only way to maintain processing is by abandoning the SP_{NOM}.

Deleting the SP_{NOM} and its specification within the Integration process renders the feature specification and the order of the ranked candidates for the determiners no longer applicable. By restarting with a clean slate, *den*$_{\text{ACC.M.SG}}$ no longer provides incompatible features to any specification. In the current case of the integration of *den* in the accusative masculine singular alternative, the current material's feature set that is now empty will thus be combined with the incoming material's specification of [+OBJ, +M]. They will eventually be fed into the next parsing stage. After the SP_{NOM} and its specification have been deleted, the sum of virtually nothing and *den*'s [+OBJ, +M] equals [+OBJ, +M]. This feature bundle can now enter the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

5.2.1.3.2 Stage 2: "..." + *den* → *Bäcker*

Step 1 The first step here is identical to the outcome of Step 3 from Paragraph 5.2.1.3.1. The current material and its specification are the combination of virtually nothing with *den*'s [+OBJ, +M]. This bundle will be inserted into the current material slot and its specification respectively. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [+OBJ, +M] was the current material's specification and is maintained in the filter specification.

Step 2 Ranked candidates are derived following the integration of *den* and thoroughly given in Table 5.6. The noun *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ is the top-ranked candidate while others are still part of the list. How TMP adopts the top-ranked *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ will be explained for the third step of the parsing along with the Synchronization process.

Step 3 The noun *Bäcker* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäcker* initially without any specification. In order to assign a specification and eventually integrate *Bäcker*, TMP can use the top-ranked candidate. As shown in Table 5.6, *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ with its feature of [+M] has precedence over the syncretic *Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$ which carries [+PL]. It is *simpler* for TMP to synchronize just one feature that is retrievable—namely [+M]—with the incom-

Table 5.6: Ranked noun candidates after *den*$_{\text{ACC.M.SG}}$.

rank	filter specification: [+OBJ, +M] (by current material's *den*$_{\text{ACC.M.SG}}$)		⚡	⊖		⊕
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	0	1
2.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	1	2	1
3.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	2	1	0
	Kundin$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	2	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	2	1	0
4.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	1	1	2	1

ing *Bäcker* at the third step than a specification that is partially incompatible with the feature specification—namely [+PL]. That is why *Bäcker* will be associated with [+M] and not with [+PL]. For the integration of *Bäcker* in the nominative/accusative/dative masculine singular alternative, the current material's specification [+OBJ, +M] will thus be combined with the incoming material's specification [+M]. They will be fed into the first step at Stage 3, eventually concluding the parse.

5.2.1.3.3 Stage 3: Conclusion

The sum of the features of "...", *den* and *Bäcker* equals [+OBJ, +M]. This is only possible since both feature bundles are mutually compatible and can thus be added up. As shown in Figure 5.5, this feature bundle can now enter the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

5.2.1.4 Parsing *den Bäckern*

The DP *den Bäckern* from (25d) shall be parsed. It is the first clause-medial syntactic argument of sentence (d) from Table 4.1 and thus part of the sentence *Gestern hat den Bäckern der Konditor geholfen* ("Yesterday, the confectioner helped the bakers"). The DP's conclusive parse will be illustrated in Figures 5.6 and 5.7.

5.2.1.4.1 Stage 1: SP$_{\text{NOM}}$ + *hat* → *den*

At this point, Steps 1–3 parallel Stage 1 in Paragraph 5.2.1.3.1 since the material is identical. The SP$_{\text{NOM}}$ + *hat* provide the feature specification for Step 2 via the Prediction process. Subsequently, the ranked candidates are derived. In Step 3, the incoming *den* is synchronized and integrated.

5.2.1.4.2 Stage 2: "..." + *den* → *Bäckern*

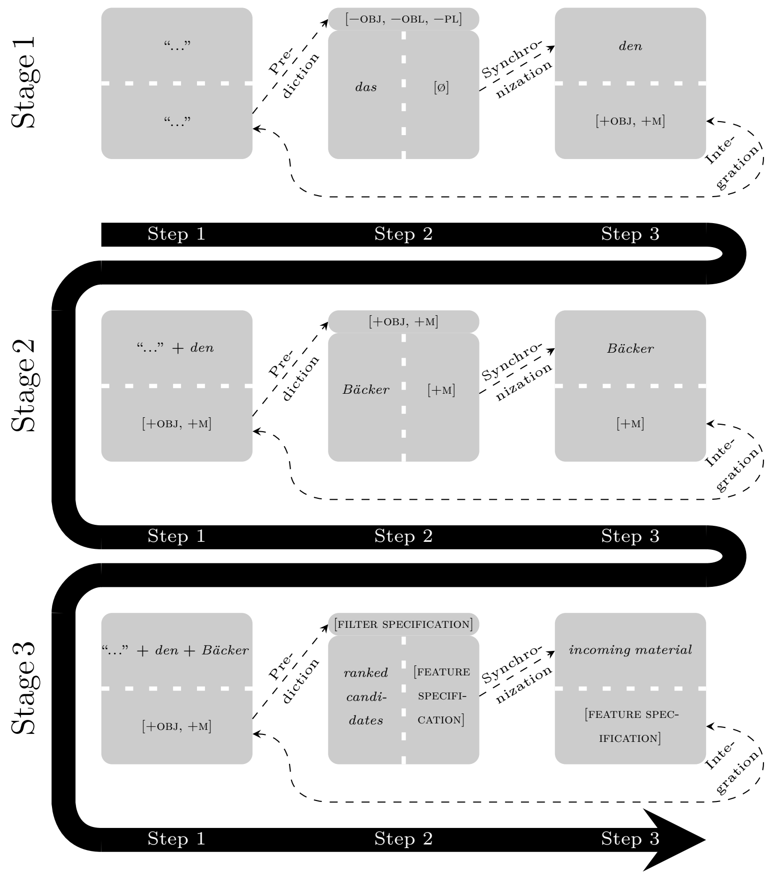


Figure 5.5: Combining current and incoming material: "...", *den* and *Bäcker* equals [+OBJ, +M].

Steps 1–2 At this point, Steps 1-2 parallel Steps 1–2 from Stage 2 in Paragraph 5.2.1.3.2 since the material is identical. The SP_{NOM} + *hat* + *den* provide the feature specification for Step 2 via the Prediction process.

Step 3 The noun *Bäckern* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäckern* initially without any specification. In order to assign a specification and eventually integrate *Bäckern*, two operations are required: Firstly, TMP has to adopt *Bäckern* instead of the predicted $\textit{Bäcker}_{\text{NOM/ACC/DAT.M.SG}}$. This means that the top-ranked candidate of $\textit{Bäcker}_{\text{NOM/ACC/DAT.M.SG}}$ has to be replaced by *Bäckern*. Secondly, the incoming material of *Bäckern* has to be associated with its respective feature specification. In order to adopt *Bäckern*, TMP has to search the ranked candidates from the second step. The list provides $\textit{Bäckern}_{\text{DAT.PL}}$. No other candidate is available. Therefore, TMP synchronizes [+OBJ, +OBL, +PL] with the incoming *Bäckern* at the third step. Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. Now, two continuations are conceivable: The [+OBJ, +OBL, +PL] of *Bäckern* can either be treated as being incompatible or compatible with the feature specification of [+OBJ, +M]. Both alternatives will be discussed in the following two paragraphs and enfolded in Paragraph 5.2.1.4.3.

Step 3's incompatibility route Pursuing the route of incompatibility, one would have to derive the incompatibility by Bierwisch's exclusion of a specification that carries both [+M] and [+PL]. With *Bäckern* as incoming material, the selection of an incompatibly ranked candidate would then be necessary. This particular ranked candidate would provide a feature that is incompatible with the feature specification—namely *Bäckern*'s [+PL]. This would mean that $\textit{Bäckern}_{\text{DAT.PL}}$ with its feature of [+PL] would oppose the current material's specification that carries [+M]. The language processing system cannot change the input but the initial analysis of the current material and its specification. This necessitates reanalysis. Selecting another alternative of *Bäckern* would not be effective since there is none. The only way to maintain processing is by abandoning the integration of *den* as $\textit{den}_{\text{ACC.M.SG}}$ in the previous parsing stage. Since the SP_{NOM} has already been deleted when *den* instead of *der* had to be integrated, the other syncretic alternative of *den*, that is $\textit{den}_{\text{DAT.PL}}$ which carries [+OBJ, +OBL, +PL], can be synchronized right away. This, in turn, also overwrites the contents of the first step of the subsequent parsing stage which would once again render the feature specification and the order of the ranked candidates for the nouns at Step 2 no longer applicable. By restarting with a clean slate, $\textit{Bäckern}_{\text{DAT.PL}}$'s [+OBJ, +OBL, +PL] at Step 3 no longer provide incompatible features to the current material's specification with [+OBJ, +OBL, +PL] of Step 1. The current material's feature set of [+OBJ, +OBL, +PL] will thus be combined with the incoming material's specification [+OBJ, +OBL, +PL]. They will eventually be fed into the next parsing step at Stage 3. The parse will be concluded in Paragraph 5.2.1.4.3.

Step 3's compatibility route Pursuing the route of compatibility, which is that the [+PL] of *Bäckern* would be compatible with the feature specification of [+OBJ, +M], one would have to disregard the possible incompatibility between [+M] and [+PL] and assume that they are mutually compatible instead. For the integration of *Bäckern* in the dative plural alternative, the current material's feature set of [+OBJ, +M] would thus be combined with the incoming material's specification [+OBJ, +OBL, +PL]. They would eventually be fed into the next parsing step at Stage 3. The parse will be concluded in Paragraph 5.2.1.4.3.

5.2.1.4.3 Stage 3: Conclusion

Continuing Stage 2, Step 3's incompatibility route By continuing the incompatibility route from Stage 2, Step 3 in Paragraph 5.2.1.4.2, TMP will now combine the specifications of the reanalyzed *den* with the one of *Bäckern* after the SP_{NOM} and its specification have been abandoned. That is the sum of [+OBJ, +OBL, +PL] and [+OBJ, +OBL, +PL] which equals [+OBJ, +OBL, +PL]. Figure 5.6 shows how this feature bundle can now be fed into the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

Continuing Stage 2, Step 3's compatibility route By continuing the compatibility route from Stage 2, Step 3 in Paragraph 5.2.1.2.2, TMP will combine the specifications of "..." and *den* with the one of *Bäckern*. That is the sum of [+OBJ,

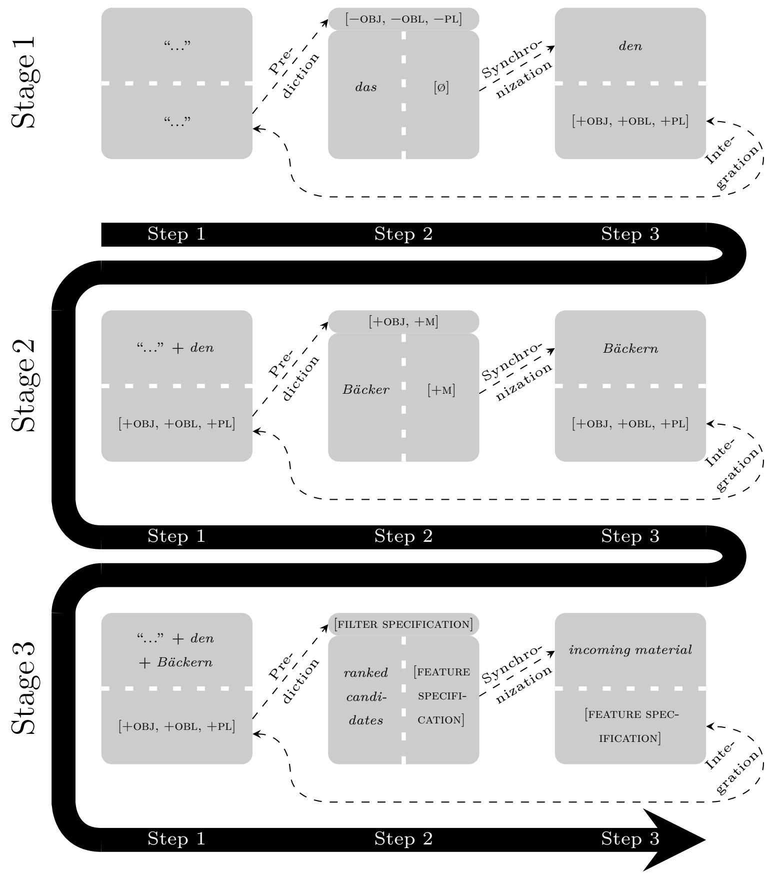


Figure 5.6: Combining current and incoming material: *den* and *Bäckern* equals [+OBJ, +OBL, +PL].

+M] and [+OBJ, +OBL, +PL] which equals [+OBJ, +OBL, +M, +PL]. This is only possible if one assumes that both feature bundles are mutually compatible and can thus be added up. As Figure 5.7 depicts, this feature bundle can now be used for the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively. The combination of "..." + *den* + *Bäckern* yields an illicit combination since there is no way to combine a masculine singular determiner with a plural noun in order to realize a grammatical object in accusative case.

5.2.2 Parsing with no prior SP_{NOM} using Bierwisch's features

In Section 5.2.1 and Appendix B.2.1, the four DPs from (25a) were parsed individually with an assumed a priori existing SP_{NOM}. As demonstrated in the previous chapter, the presence of an SP_{NOM} was primarily affecting the first position in the sense that it served as the filter specification for the determiner position. The determiner candidates were ranked according to the SP_{NOM}'s filter specification. Furthermore, if a determiner that was compatible with the filter was to be selected, the SP_{NOM} passed its features on to the

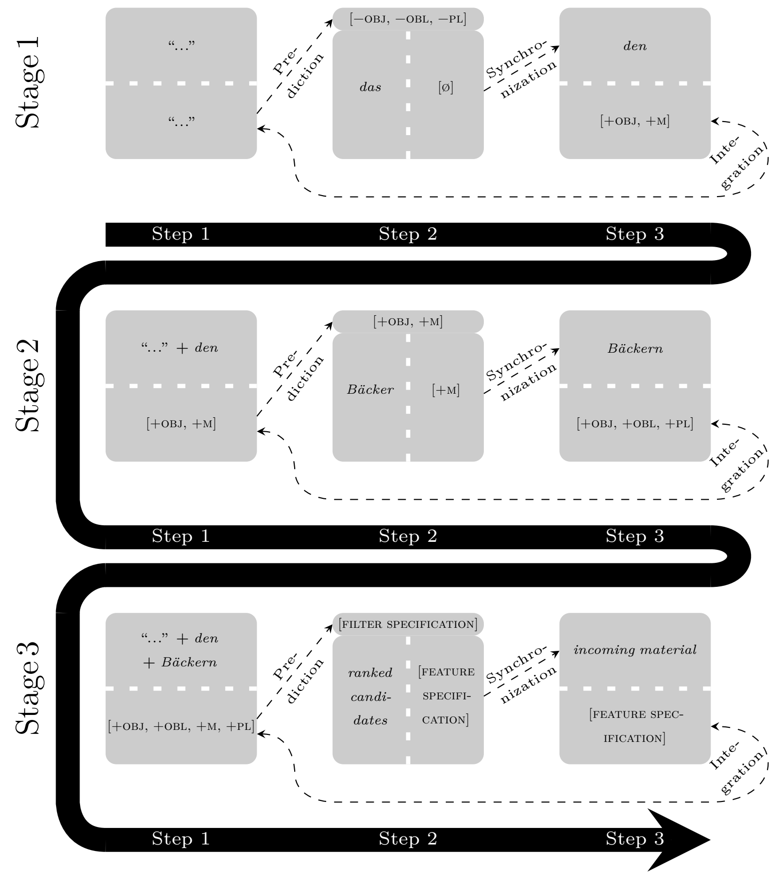


Figure 5.7: Combining current and incoming material: "…", *den* and *Bäckern* equals [+obj, +obl, +m, +pl].

determiner and so on. The present section, however, will introduce a slightly different parsing strategy. Observation 6 raised the question whether the postulation of a hard-coded a priori SP_{NOM} filter specification is actually necessary. It was proposed that a lack of this filter specification will surely also affect the determiner position. As it turns out, TMP seems to provide the necessary mechanics to preferably predict the correct determiners without the initially assumed SP_{NOM} filter specification. Therefore, the analyses in this section will discard the SP_{NOM} and its features for the DP examinations. Therefore, for all ranked determiner candidates in the sections below, the filter specification will be empty. If there is no filter to violate, no determiner can introduce incompatible features. In turn, no features are non-retrievable in a forward-looking fashion. If the filter specification is featureless, then there are no features that can be shared with a determiner candidate. Hence, the compatibility, the forward-looking non-retrievability and the retrievability constraints are rendered ineffective. As a result, the candidates's ranking is solely determined by the backward-looking non-retrievability constraint. In other words, it is the number of features a determiner provides that decides on its rank.

Also, in contrast to Section 5.2.1, the DPs will not be parsed in detail like before since the mechanism is the same. As TMP was announced as a prediction-generating machine, it is the ranking of candidates that is most relevant for the parses. Therefore, this section focuses on the top-ranked candidates of the two DP elements. However, similar to Section 5.2.1, the current investigation will again revert to Bierwisch only, while Blevins' original features are used in Appendix B.2.2.1, his maximally underspecified approach in Appendix B.2.2.2, Wunderlich's features in Appendix B.2.2.3 and Wiese's approach in Appendix B.2.2.4 respectively.

5.2.2.1 Determiner position

Table 5.7 shows the rankings of the determiner candidates in the absence of an SP_{NOM} filter specification. It reveals that *der* in its nominative masculine singular alternative is preferably selected in comparison to the dative feminine singular alternative. Furthermore, $den_{\text{ACC.M.SG}}$ ranks above $den_{\text{DAT.PL}}$. This means that for both the DPs in (25a–25b), *der* will be integrated in its nominative masculine singular alternative while for (25c–25d), *den* will be integrated in its accusative masculine singular alternative. Additionally, since there is no filter specification, none of the determiner candidates can introduce incompatible features. Thus, no prior analysis has to be abandoned regardless of the determiner input.

Table 5.7: Ranked determiner candidates after no SP_{NOM}.

rank	filter specification: [Ø] (by current material's lack of an SP_{NOM})		ϟ	🔍−		🔍+
	determiner	specification		⇒	⇐	
1.	$das_{\text{NOM/ACC.N.SG}}$	[Ø]	0	0	0	0
2.	$der_{\text{NOM.M.SG}}$	[+M]	0	0	1	0
	$des_{\text{GEN.M/N.SG}}$	[+OBL]	0	0	1	0
	$die_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[+PL ∨ +F]	0	0	1	0
3.	$dem_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL]	0	0	2	0
	$den_{\text{ACC.M.SG}}$	[+OBJ, +M]	0	0	2	0
	$der_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL, [+PL ∨ +F]]	0	0	2	0
4.	$den_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	3	0

5.2.2.2 Noun position

Following the integration of *der* as $der_{\text{NOM.M.SG}}$ in (25a–25b) with its [+M] feature that acts as the filter specification, Table 5.8 shows the ranked noun continuations. It exhibits TMP's preference to predict $Bäcker_{\text{NOM/ACC.M/DAT.SG}}$ after $der_{\text{NOM.M.SG}}$ and not $Kundin_{\text{NOM/ACC/DAT/GEN.F.SG}}$. Furthermore, similar to the ranking of a present SP_{NOM}, none of the target candidates provides features that are incompatible with the filter specification. In relevant Stages 2 and 3 of Paragraphs 5.2.1.2.2 and 5.2.1.2.3, for *Kundin*, both a compatibility and an incompatibility route were calculated. The latter case assumed a categorical incompatibility between the filter specification's [+M] and *Kundin*'s [+F]. The same scenario is applicable for the current case of a lacking SP$_{\text{NOM}}$: *Kundin* still provides [+F] which may be incompatible with the [+M] feature of the filter specification.

In case of the integration of *den* as *den*$_{\text{ACC.M.SG}}$ in (25c–25d) with its [+OBJ, +M] features that act as the filter specification, Table 5.9 shows the ranked noun continuations. It exhibits TMP's preference to predict *Bäcker*$_{\text{NOM/ACC.M/DAT.SG}}$ after *den*$_{\text{ACC.M.SG}}$ and not *Bäckern*$_{\text{DAT.PL}}$. In addition, notice again that, similar to the ranking of a present SP$_{\text{NOM}}$, none of the target candidates provides features that are incompatible with the filter specification. In corresponding Stages 2 and 3 of Paragraphs 5.2.1.4.2 and 5.2.1.4.3, for *Bäckern*, both a compatibility and an incompatibility route were calculated. Similarly, the latter case assumed a categorical incompatibility between the filter specification's [+M] and *Bäckern*'s [+PL]. Therefore, the same pattern occurs for the present case of a non-present SP$_{\text{NOM}}$ filter specification: *Bäckern* still carries [+PL] which may be incompatible with the [+M] feature of the filter specification.

Table 5.8: Ranked noun candidates after *der*$_{\text{NOM.M.SG}}$.

rank	filter specification: [+M] (by current material's *der*$_{\text{NOM.M.SG}}$)		⚡	⊖		⊕
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	0	0	1
2.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	0	0	2	1
	Kundin$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	1	1	0
3.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	1	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	1	1	0
4.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	1	3	0

Table 5.9: Ranked noun candidates after *den*$_{\text{ACC.M.SG}}$.

rank	filter specification: [+OBJ, +M] (by current material's *den*$_{\text{ACC.M.SG}}$)		⚡	⊖		⊕
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	0	1
2.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	1	2	1
	Bäcker$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	2	1	0
3.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	2	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	2	1	0
4.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	1	1	2	1

5.3 TMP's Claims

To recapitulate, a total of twelve featural contact points were investigated using Bierwisch's features with and without an SP_{NOM}. In the outset of this chapter, these transitions were visualized in Figure 5.1. For Section 5.2.1, these transitions were concerned with the assumption of an SP_{NOM} and followed by *hat*. The first transition proceeded to either the determiner *der* that could either be *der*$_{NOM.M.SG}$ or *der*$_{DAT.F.SG}$, from there on via the second transition to either *Bäcker*$_{NOM.M.SG}$ or along the third transition to *Kundin*$_{DAT.F.SG}$. The fourth transition proceeded again from SP_{NOM} and followed by *hat* to the determiner *den* that could either be *den*$_{ACC.M.SG}$ or *den*$_{DAT.PL}$ and from there via the fifth transition either to *Bäcker*$_{ACC.M.SG}$ or with the sixth transition to *Bäckern*$_{DAT.PL}$. In Section 5.2.2, the same six transitions were again analyzed without the assumption of an SP_{NOM} filter specification. Appendices B.2.1 and B.2.2 carry out the same calculations for the remaining underspecification models by Blevins, Wunderlich and Wiese. All calculations can now be used to answer the three aforementioned questions:

> Question 1: How do the parses differ between the elements of the subject-object ambiguities?
>
> Question 2: Which one of the underspecification approaches by Bierwisch, Blevins, Wunderlich, Wiese and Müller is explanatorily more adequate?
>
> Question 3: Does the presence or absence of an SP_{NOM} filter specification contribute to TMP's predictions?

In order to answer these questions, the subsequent section will summarize the parsing results. Therefore, not only Bierwisch's but also the calculations of the other three underspecification frameworks from Appendix B.2 will be taken into account. This consolidation will put the various integrations into perspective and eventually enable claims about TMP's processing strategy.

This section will be concerned with one of the most intricate parts of the thesis at hand: formalizing TMP's calculations. Formalizing means that the individual parsing outcomes and analyses from Section 5.2 and Appendix B.2 have to be compared and contrasted per position as well as across positions, underspecification approaches and in dependence of a present or absent SP_{NOM} in order to reveal *simpler* or more *complex* calculatory work. These comparisons will make up TMP's claims and serve as the basis for sound experimental hypotheses against which the model can be tested.

Following the concluding questions of the previous section, the present chapter's purpose is therefore threefold: Firstly, statements about TMP's processing effort regarding the different candidates of both the determiner and the noun position shall be made. Secondly, it seeks to decide on the question whether any of the four underspecification approaches by Bierwisch, Blevins, Wunderlich and Wiese turn out to be explanatorily more adequate. Thirdly, it has to be evaluated in which way the SP_{NOM} filter specification affects the parsings. Three kinds of cross-comparisons are necessary: For the first mode of comparisons, determiner- and noun-dependent comparisons need to be carried out within one underspecification approach. The target determiners have to be compared with one another. Equally, the target nouns have to be contrasted with one another. However, this will be done for Bierwisch, Blevins' original and maximally underspecified models, Wunderlich and Wiese. For the second kind of comparisons, individual structures of one approach can be contrasted with the outcome of the same structure of another underspecification model. The third way to compare the parsing outcomes allows to decide if and how the presence or absence of an SP_{NOM} interacts with both the determiner and the noun integration as well as with a particular underspecification approach.

Determiner- and noun-dependent contrasts within one framework will be the starting point for comparisons. Two positions of the parsing mechanism that was laid out in Chapter 4 are relevant for that. Firstly, and most prominently, Synchronization, that is Step 2 and the transition to Step 3, is crucial for the evaluation whether TMP is a good prediction machine since it is concerned with the derivation of predicted ranked candidates. Recall from Observations 2 and 3 that switching from the highest ranked candidate to a lower as well as resolving syncretism are TMP's main tasks. Since the integration of the incoming material at Step 3 is dependent on the preceding predicted ranked candidates at Step 2, the top-ranked alternative is pivotal for the comparison. The candidate occupying the first rank is the alternative that is the easiest to integrate and thus preferably selected. If, on the other hand, a lower ranked candidate serves as incoming material at Step 3, its integration is performed relatively to the previous top-ranked candidate from Step 2. TMP has to depart from this alternative in order to integrate the incoming lower ranked deviant. Therefore, the top-ranked candidate acts as a reference point against which the incoming material at Step 3 will be assessed. Consequently, this will result in gradings of candidates. These gradings represent the candidates' conformity to or their disobedience against the filter specification by means of the sub-mechanisms of incompatibility and non-retrievability. Therefore, the gradings' left-to-right cline from lower to higher feature deviance reflects TMP's calculatory work at parsing Step 2 from *simple* to *complex*. For the remainder of the investigation, it is very important to recall that "the gradation's left side refers to TMP's calculatory *simplicity* and its right side refers to TMP's calculatory *complexity*". The exemplary gradation in (26)[27] allows to draw conclusions about TMP's position-dependent processing effort across the four underspecification frameworks:

(26)	low	to	high feature deviance
	simple	to	*complex* calculatory work
	$candidate_1$	<	$candidate_2$

The second parsing position of interest is the Integration process of Step 3 and onwards as it is relevant for the handling of possibly incoming incompatible features. Even though opposing features are also important at Step 2 as they demote a candidate further down the list of ranked candidates, incompatibility is assumed to trigger reanalysis of

[27] The reasons for the gradations' buildup with regard to feature deviance and calculatory work will be omitted from hereon.

a previously disregarded alternative. However, since the attention is on the derivation of ranked candidates, only minor remarks will be made about feature incompatibility. These remarks will be limited to mentions of the candidate that does carry opposing features in comparison to the one which does not.

These considerations entail the following comparisons: With regard to the DPs in (25), at the determiner position, both *der* occasions from (25a–25b) have to be compared to both *den* instances from (25c–25d). A comparison between *der* in (25a) with *der* in (25b) will not be carried out since both structures are identical up to this position. TMP has no evidence for the target integration of $der_{\text{NOM.M.SG}}$ in (25a) or $der_{\text{DAT.F.SG}}$ in (25b). Thus, it is assumed that the system will follow one analysis of the determiner. For the same reasons, no comparison between *den* in (25c) and (25d) will be carried out. At the subsequent noun position, $Bäcker_{\text{NOM.M.SG}}$ has to be compared to $Kundin_{\text{DAT.F.SG}}$ since both are preceded by *der*. Likewise, $Bäcker_{\text{ACC.M.SG}}$ will be contrasted with $Bäckern_{\text{DAT.PL}}$ since both are preceded by *den*. This comparison will allow inferences on the targeted determiner differences that are initially invisible for TMP. Conversely, the noun comparisons within one underspecification approach may reveal a graded modulation ranging from easier to harder to integrate. These gradations could then be compared across frameworks revealing different processing paths for the four approaches of Bierwisch, Blevins, Wunderlich and Wiese. This would allow for crucial insights into their explanatory adequacy.

5.3.1 Assuming a prior SP_{NOM}

The following paragraphs will list all necessary cross-comparisons for the parses with a preceding SP_{NOM}. They will primarily refer to the derivation of ranked candidates but also include remarks towards the handling of incoming incompatible features.

5.3.1.1 Determiner position

Table 5.10 summarizes the determiner rankings. It consists of the SP_{NOM} filter specification per underspecification approach, the top-ranked candidate and all alternatives of *der* and *den* determiners from (25). The overview amasses all the ranks and constraint violations directly from the rankings in Table 5.4 for Bierwisch, Tables B.5 and B.8 for both of Blevins' accounts, Table B.11 for Wunderlich and Table B.14 for Wiese.

It reads in the following way, exemplified for Bierwisch: The top-ranked candidate after a preceding SP_{NOM} filter specification is $das_{\text{NOM/ACC.N.SG}}$. There are four lower ranked target determiners for *der* in (25a–25b) and *den* in (25c–25d): The determiner *der* in the $der_{\text{NOM.M.SG}}$ alternative outranks $der_{\text{DAT.F.SG}}$. The former occupies the second while the latter occupies the fifth rank. With regard to *den*, the candidate in the $den_{\text{ACC.M.SG}}$ alternative ranks above $den_{\text{DAT.PL}}$ with the former at the fourth and the latter at the sixth rank.[28] The resulting scale is not exclusive to Bierwisch. Taking the remaining

[28]The third rank is missing for Bierwisch since it is neither occupied by, obviously, the top-ranked candidate nor by one of the determiners *der* or *den*. The corresponding Table 5.4 for Bierwisch shows that *die* and *des* rank at the third position.

Table 5.10: Overview of all relevant ranked candidates for the determiner position with an SP$_{\text{NOM}}$.

	rank	filter specification: [−OBJ, −OBL, −PL] (by current material's SP$_{\text{NOM}}$ + *hat* from prior step)		⚡	🔍−		🔍+
		determiner	specification		⇒	⇐	
Bierwisch	1.	*das*$_{\text{NOM/ACC.N.SG}}$	[Ø]	0	3	0	0
	2.	*der*$_{\text{NOM.M.SG}}$	[+M]	0	3	1	0
	4.	*den*$_{\text{ACC.M.SG}}$	[+OBJ, +M]	1	3	2	0
	5.	*der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL, [+PL ∨ +F]]	2	3	2	0
	6.	*den*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	3	3	3	0
Blevins, original	1.	*das*$_{\text{NOM/ACC.N.SG}}$	[−OBL, −F]	0	2	1	1
	2.	*der*$_{\text{NOM.M.SG}}$	[−OBL, +M, −F]	0	2	2	1
	4.	*den*$_{\text{ACC.M.SG}}$	[+OBJ, −OBL, +M, −F]	1	2	3	1
	5.	*der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL]	1	3	1	0
	8.	*den*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	3	3	3	0
Blevins, max. underspec.	1.	*die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[Ø]	0	3	0	0
	3.	*der*$_{\text{NOM.M.SG}}$	[+M, −F]	0	3	2	0
	4.	*den*$_{\text{ACC.M.SG}}$	[+OBJ, −OBL, +M, −F]	1	2	3	1
	5.	*der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL]	1	3	1	0
	8.	*den*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	3	3	3	0
Wunderlich		filter specification: [−HR, −LR, −PL]					
	1.	*die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[Ø]	0	3	0	0
	2.	*der*$_{\text{NOM.M.SG}}$	[+M]	0	3	1	0
	4.	*den*$_{\text{ACC.M.SG}}$	[+HR, +M]	1	3	2	0
	6.	*der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+HR, [+LR ∨ +N], [+PL ∨ +F]]	3	3	5	0
		den$_{\text{DAT.PL}}$	[+HR, +LR, +PL, [+PL ∨ +F]]	3	3	5	0
Wiese		filter specification: [−OBJ, −OBL, −PL]					
	1.	*die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[Ø]	0	3	0	0
	2.	*der*$_{\text{NOM.M.SG}}$	[+M]	0	3	1	0
	4.	*der*$_{\text{GEN.PL}}$	[+OBL]	1	3	1	0
	5.	*den*$_{\text{ACC.M.SG}}$	[+OBJ, +M]	1	3	2	0
		der$_{\text{DAT/GEN.F.SG}}$	[+OBL +F]	1	3	2	0
	6.	*den*$_{\text{DAT.PL}}$	[+OBJ, +OBL]	2	3	2	0

underspecification approaches' rankings into account in the same way, Table 5.10 reveals that this gradation applies to all underspecification approaches. (27) depicts TMP's calculatory work for the four target determiners at its processing Step 2.

(27) Approach-independent:

$der_{\text{NOM.M.SG}} < den_{\text{ACC.M.SG}} < der_{\text{DAT.F.SG}} < den_{\text{DAT.PL}}$

The gradation in (27) shows two things. Firstly, approach-independently, if *der* enters TMP, it will be integrated preferably as $der_{\text{NOM.M.SG}}$ since it ranks higher than the other *der* and both *den* alternatives. If *den* enters the system, it will be integrated preferably as $den_{\text{ACC.M.SG}}$ since it ranks higher than $den_{\text{DAT.PL}}$. Secondly, $der_{\text{NOM.M.SG}}$ ranks above $den_{\text{ACC.M.SG}}$. Considering the structures in (25), the second insight implies that both *der* determiners in (25a–25b) will be integrated as $der_{\text{NOM.M.SG}}$, while both *den* determiners in (25c–25d) will be integrated as $den_{\text{ACC.M.SG}}$. Returning to the exemplary Bierwisch discussion, this means, that for the subsequent noun position, ranked candidates for (25a–25b) will be derived according to $der_{\text{NOM.M.SG}}$'s filter specification of [−OBJ, −OBL, +M, −PL], while for (25c–25d) they will be derived according to $den_{\text{ACC.M.SG}}$'s filter specification of [+OBJ, +M]. The other underspecification approaches adjust their respective filter specification in equal measures.

With regard to incompatibility, Table 5.10 shows that for all approaches, *den* introduces a feature that opposes the filter specification. This necessitates abandoning the SP_{NOM} which, in turn, influences the subsequent noun processing. This is not the case for $der_{\text{NOM.M.SG}}$ as it does not carry incompatible features. The selection of ranked noun candidates according to the aforementioned filter specifications will be demonstrated for the noun position in the next section.

5.3.1.2 Noun position

Turning to the nouns, Table 5.11 gives an overview of the relevant rankings. It consists of two filter specifications per underspecification model, the top-ranked candidate and the alternatives of the targeted nouns from (25). The overview amasses all the ranks and constraint violations directly from the rankings in Tables 5.5 and 5.6 for Bierwisch, Tables B.6 and B.7 for Blevins' original and Tables B.9 and B.10 for Blevins' maximally underspecified approaches, Tables B.12 and B.13 for Wunderlich and Tables B.15 and B.16 for Wiese.

Like the summary for the determiner above, it reads in the following way, again exemplified for Bierwisch: The top-ranked candidate after a preceding $der_{\text{NOM.M.SG}}$ filter specification is *Bäcker* which outranks *Kundin*. The top-ranked candidate after a preceding $den_{\text{ACC.M.SG}}$ filter specification is *Bäcker* which outranks *Bäckern*. Taking all underspecification approaches into account in the same way, they all predict the following gradation after *der*: $Bäcker_{\text{NOM.M.SG}} < Kundin_{\text{DAT.F.SG}}$. Similarly, for *den*, all underspecification accounts yield this scale: $Bäcker_{\text{ACC.M.SG}} < Bäckern_{\text{DAT.PL}}$. However, these gradations do not take into account that both are preceded by different determiners and thus by different filter specifications which, in turn, are preceded by an SP_{NOM}. Returning to the exemplary Bierwisch description, Table 5.11 also reveals that the transition from $den_{\text{ACC.M.SG}}$'s filter specification to *Bäcker* is less violating than from $der_{\text{NOM.M.SG}}$'s to *Bäcker*: In the former case, only one feature from the filter specification cannot be found on the noun while three cannot be found in the latter scenario. Considering these determiner variations for all underspecification approaches yields the gradations in (28).

Table 5.11: Overview of all relevant ranked candidates for the noun position with an SP_{NOM}.

	rank	noun	specification	⚡	⊖ ⇒	⊖ ⇐	⊕
Bierwisch		filter specification: [−OBJ, −OBL, +M, −PL] (by current material's SP_{NOM} + *hat* + *der*$_{\text{NOM.M.SG}}$ from prior step)					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	3	0	1
	2.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	4	1	0
		filter specification: [+OBJ, +M] (by current material's *den*$_{\text{ACC.M.SG}}$ from prior step)					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	0	1
	2.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	1	2	1
Blevins, original		filter specification: [−OBJ, −OBL, +M, −F, −PL]					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M, −F]	0	3	0	2
	4.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[−M, +F]	2	5	2	0
		filter specification: [+OBJ, −OBL, +M, −F]					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M, −F]	0	2	0	2
	3.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	1	3	2	1
Blevins, max. underspec.		filter specification: [−OBJ, −OBL, +M, −F, −PL]					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M, −F]	0	3	0	2
	3.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[∅]	0	5	0	0
		filter specification: [+OBJ, −OBL, +M, −F]					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M, −F]	0	2	0	2
	4.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	1	3	2	1
Wunderlich		filter specification: [−HR, −LR, +M, −PL]					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	3	0	1
	3.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	4	1	0
		filter specification: [+HR, +M]					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	0	1
	3.	*Bäckern*$_{\text{DAT.PL}}$	[+LR, +M, +PL]	0	1	2	0
Wiese		filter specification: [−OBJ, −OBL, +M, −PL]					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	3	0	1
	2.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	4	1	0
		filter specification: [+OBJ, +M]					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	0	1
	4.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	1	2	0

(28) a. Bierwisch; Wunderlich; Wiese:
Bäcker$_{\text{ACC.M.SG}}$ < *Bäckern*$_{\text{DAT.PL}}$ < *Bäcker*$_{\text{NOM.M.SG}}$ < *Kundin*$_{\text{DAT.F.SG}}$

b. Blevins, original:
Bäcker$_{\text{ACC.M.SG}}$ < *Bäcker*$_{\text{NOM.M.SG}}$ < *Bäckern*$_{\text{DAT.PL}}$ < *Kundin*$_{\text{DAT.F.SG}}$

c. Blevins, max. underspec.:
Bäcker$_{\text{ACC.M.SG}}$ < *Bäcker*$_{\text{NOM.M.SG}}$ < *Kundin*$_{\text{DAT.F.SG}}$ < *Bäckern*$_{\text{DAT.PL}}$

The ranking in (28) gives several insights: Recall that *Kundin* in (25b) was targeted as *Kundin*$_{\text{DAT.F.SG}}$ and preceded by *der* that was integrated as *der*$_{\text{NOM.M.SG}}$. Similarly, *Bäckern* in (25c) was targeted as *Bäckern*$_{\text{DAT.PL}}$ and preceded by *den* that was integrated as *den*$_{\text{ACC.M.SG}}$. Therefore, (28) still shows across all models that *Bäcker* after *der* is integrated preferably over *Kundin* and *Bäcker* after *den* over *Bäckern*. However, the gradations also show that, irrespective of the underspecification account, *Bäcker*$_{\text{ACC.M.SG}}$ after *den* should be integrated preferably if compared to *Bäcker*$_{\text{NOM.M.SG}}$ after *der*. These differences will be addressed later in the Experimental Part II.

Concerning incompatibility, Table 5.11 shows that *Kundin* and *Bäckern* in Blevins' original and maximally underspecified approaches definitely introduce incompatible features that necessitate abandoning prior analyses compared to *Bäcker*. Apart from that, the other approaches' *Kundin* and *Bäckern* do not introduce incompatible features per se. However, recall from Bierwisch's, Wunderlich's and Wiese's calculations in Paragraphs 5.2.1.2.2 and 5.2.1.4.2, Paragraphs B.2.1.3.2.2 and B.2.1.3.4.2 and Paragraphs B.2.1.4.2.2 and B.2.1.4.4.2 respectively that these analyses calculated both a compatible and an incompatible route. It still has to be decided which path is more feasible. For now, it has to be noted that both routes are plausible. Thus, incompatibility is possible for *Kundin* and *Bäckern*.

To conclude the determiner and noun integrations, TMP makes the claim that after an SP_{NOM} and irrespective of the underspecification approach, an incoming *der* should be integrated as *der*$_{\text{NOM.M.SG}}$. This matches the target determiner in (25a). TMP correctly predicts *Bäcker* following *der*$_{\text{NOM.M.SG}}$. From thereon, TMP can build up the grammatical DP *der Bäcker*$_{\text{NOM.M.SG}}$ that is eventually the target DP in (25a). In contrast to that, TMP does not predict *Kundin* following *der*. Conversely, integrating the dispreferred *Kundin* after *der*$_{\text{NOM.M.SG}}$ makes a reanalysis of *der* necessary in order to end up at the grammatical target DP *der Kundin*$_{\text{DAT.F.SG}}$ from (25b). Turning to the other determiner, independent of the underspecification account, TMP predicts *den* to be integrated as *den*$_{\text{ACC.M.SG}}$. This matches the target determiner in (25c). Again, TMP correctly predicts *Bäcker* following *den*$_{\text{ACC.M.SG}}$, allowing it to build up the grammatical DP *den Bäcker*$_{\text{ACC.M.SG}}$ that is eventually the target DP in (25c). With regard to *Bäckern*, TMP does not predict this candidate after *den*. Conversely, integrating the dispreferred *Bäckern* after *den*$_{\text{ACC.M.SG}}$ makes a reanalysis of *den* necessary in order to end up at the grammatical target DP *den Bäckern*$_{\text{DAT.PL}}$ from (25d).

5.3.2 Assuming no prior SP_{NOM}

The following paragraphs will list all necessary cross-comparisons for the parses without a precursory SP_{NOM}. Again, they will mainly refer to the derivation of ranked candidates but also include comments towards the processing of incoming incompatible features.

5.3.2.1 Determiner position

Table 5.12 gives an overview of the determiner rankings. Since there is no SP_{NOM}, it consists of an empty filter specification, the top-ranked candidate and all alternatives of *der* and *den* determiners from (25). The summary compiles all the ranks and constraint violations directly from the rankings in Table 5.7 for Bierwisch, Tables B.17 and B.20 for both of Blevins' accounts, Table B.23 for Wunderlich and Table B.26 for Wiese.

It reads in the same way as Table 5.10, here again demonstrated for Bierwisch: The top-ranked candidate after no preceding SP_{NOM} filter specification is $das_{NOM/ACC.N.SG}$. There are four lower ranked target determiners for *der* in (25a–25b) and *den* in (25c–25d): The determiner *der* in the $der_{NOM.M.SG}$ alternative outranks $der_{DAT.F.SG}$. The former occupies the second while the latter occupies the third rank. With regard to *den*, the candidate in the $den_{ACC.M.SG}$ alternative ranks above $den_{DAT.PL}$ with the former at the third and the latter at the fourth rank. This yields the following ranking: $der_{NOM.M.SG} < den_{ACC.M.SG} = der_{DAT.F.SG} < den_{DAT.PL}$. This scale, however, is not exclusive to Bierwisch. Taking the remaining underspecification approaches' rankings into account in the same way, Table 5.12 reveals that this gradation applies to Wunderlich as depicted in (29). The two Blevins frameworks and Wiese's model differ. These are the claims that have to be considered as hypotheses for the Experimental Part II in Section 7.3.2.1.

(29) a. Bierwisch/Wunderlich:
$der_{NOM.M.SG} < den_{ACC.M.SG} = der_{DAT.F.SG} < den_{DAT.PL}$
b. Blevins, original:
$der_{DAT.F.SG} < der_{NOM.M.SG} = den_{DAT.PL} < den_{ACC.M.SG}$
c. Blevins, max. underspec.:
$der_{DAT.F.SG} < der_{NOM.M.SG} < den_{DAT.PL} < den_{ACC.M.SG}$
d. Wiese:
$der_{NOM.M.SG} < den_{ACC.M.SG} = der_{DAT.F.SG} = den_{DAT.PL}$

The gradation in (29) reveals some interesting findings. The underspecification approaches no longer show a uniform picture. Bierwisch and Wunderlich mirror their rankings from Section 5.3.2 with an SP_{NOM}. Therefore, the implications from above with regard to the filter specifications for the subsequent noun position also apply here. However, for both of Blevins' accounts, (29) shows different gradations. If *der* enters TMP, it will be integrated preferably as $der_{DAT.F.SG}$ since it ranks higher than the other *der* and both *den* alternatives. If *den* enters the system, it will be integrated preferably as $den_{DAT.PL}$ since it ranks higher than $den_{ACC.M.SG}$. The determiner $der_{DAT.F.SG}$ ranks above $den_{DAT.PL}$. Considering the structures in (25), this finding implies that both *der* determiners in (25a–25b) will be integrated as $der_{DAT.F.SG}$, while both *den* determiners in (25c–25d)

Table 5.12: Overview of all relevant ranked candidates for the determiner position with no SP_{NOM}.

	rank	filter specification: [Ø] (by current material's lack of an SP_{NOM})		↯	🔍−		🔍+
		determiner	specification		⇒	⇐	
Bierwisch	1.	$das_{\text{NOM/ACC.N.SG}}$	[Ø]	0	0	0	0
	2.	$der_{\text{NOM.M.SG}}$	[+M]	0	0	1	0
	3.	$den_{\text{ACC.M.SG}}$	[+OBJ, +M]	0	0	2	0
		$der_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL, [+PL ∨ +F]]	0	0	2	0
	4.	$den_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	3	0
Blevins, original	1.	$die_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[Ø]	0	0	0	0
	2.	$der_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL]	0	0	1	0
	4.	$der_{\text{NOM.M.SG}}$	[−OBL, +M, −F]	0	0	3	0
		$den_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	3	0
	5.	$den_{\text{ACC.M.SG}}$	[+OBJ, −OBL, +M, −F]	0	0	4	0
Blevins, max. underspec.	1.	$die_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[Ø]	0	0	0	0
	2.	$der_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL]	0	0	1	0
	3.	$der_{\text{NOM.M.SG}}$	[+M, −F]	0	0	2	0
	5.	$den_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	3	0
	6.	$den_{\text{ACC.M.SG}}$	[+OBJ, −OBL, +M, −F]	0	0	4	0
Wunderlich	1.	$das_{\text{NOM/ACC.N.SG}}$	[Ø]	0	0	0	0
	2.	$der_{\text{NOM.M.SG}}$	[+M]	0	0	1	0
	4.	$den_{\text{ACC.M.SG}}$	[+HR, +M]	0	0	2	0
	5.	$der_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+HR, [+LR ∨ +N], [+PL ∨ +F]]	0	0	3	0
	6.	$den_{\text{DAT.PL}}$	[+HR, +LR, +PL, [+PL ∨ +F]]	0	0	4	0
Wiese	1.	$die_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[Ø]	0	0	0	0
	2.	$der_{\text{NOM.M.SG}}$	[+M]	0	0	1	0
		$der_{\text{GEN.PL}}$	[+OBL]	0	0	1	0
	3.	$den_{\text{ACC.M.SG}}$	[+OBJ, +M]	0	0	2	0
		$der_{\text{DAT/GEN.F.SG}}$	[+OBL +F]	0	0	2	0
		$den_{\text{DAT.PL}}$	[+OBJ, +OBL]	0	0	2	0

will be integrated as $den_{\text{DAT.PL}}$. For both of Blevins' accounts, this means, that for the subsequent noun position, ranked candidates for (25a–25b) will be derived according to $der_{\text{DAT.F.SG}}$'s filter specification of [+OBL], while for (25c–25d) they will be derived according to $den_{\text{DAT.PL}}$'s filter specification of [+OBJ, +OBL, +PL]. Wiese's account also reveals a different scale. Recall from Observation 4 that any ranking generally allows for different candidates to occupy the exact same rank. This poses no problem as long as the equally ranked candidates are non-syncretic. In Wiese's case, however, *der*$_{\text{NOM.M.SG}}$ and *der*$_{\text{GEN.PL}}$ are at the second rank while *den*$_{\text{ACC.M.SG}}$ and *den*$_{\text{DAT.PL}}$ occupy the third rank. TMP is not be able to discern the two alternatives of *der* or *den*. Therefore, both *der* determiners in (25a–25b) can either be integrated as *der*$_{\text{NOM.M.SG}}$ or *der*$_{\text{DAT.F.SG}}$, while both *den* determiners in (25c–25d) can either be integrated as *den*$_{\text{ACC.M.SG}}$ or *den*$_{\text{DAT.PL}}$. Consequently, for the subsequent noun position, ranked candidates for (25a–25b) will either be derived according to *der*$_{\text{NOM.M.SG}}$'s filter specification of [+M] or *der*$_{\text{DAT.F.SG}}$'s filter specification of [+OBL], while for (25c–25d) they will be either derived according to *den*$_{\text{ACC.M.SG}}$' filter specification of [+OBJ, +M] or *den*$_{\text{DAT.PL}}$'s filter specification of [+OBJ, +OBL].

Considering incompatibility, Table 5.12 shows that, for all approaches, *den*, just like *der*—in contrast to the SP$_{\text{NOM}}$ approach from Section 5.3.1.1—does not introduce a feature that opposes the filter specification since there was no SP$_{\text{NOM}}$ filter specification in the first place. This, in turn, does not necessitate abandoning any prior analysis which would influence the subsequent noun processing. The selection of ranked noun candidates according to the aforementioned filter specifications will be demonstrated for the noun position in the next section.

5.3.2.2 Noun position

With regard to the nouns, Table 5.13 summarizes the noun rankings. It consists of two filter specifications for Bierwisch, for both of Blevins' accounts and for Wunderlich, four filter specifications for Wiese, the top-ranked candidate and the alternatives of the targeted nouns from (25). The overview compiles all the ranks and constraint violations directly from the rankings in Tables 5.8 and 5.9 for Bierwisch, Tables B.18 and B.19 for Blevins' original and Tables B.21 and B.22 for Blevins' maximally underspecified approaches, Tables B.24 and B.25 for Wunderlich and Tables B.27 to B.30 for Wiese.

The overview reads as before: For the underspecification accounts of Blevins and Wiese, the overview in Table 5.11 allows a very distinct view on their candidate prediction for the subsequent noun. Logically, the rankings are still based on the determiner integration from the prior Section 5.3.2.1. For both of Blevins' accounts, the top-ranked candidate after a preceding *der*$_{\text{DAT.F.SG}}$ filter specification is *Bäckern* which outranks *Bäcker* and *Kundin*. The top-ranked candidate after a preceding *den*$_{\text{DAT.PL}}$ filter specification is *Bäckern* which outranks *Bäcker*.

Regarding incompatibility, again, Table 5.13 shows that *Kundin* and *Bäckern* in Blevins' original and maximally underspecified approaches definitely introduce incompatible features that necessitate abandoning prior analyses compared to *Bäcker*. Apart from that, the other approaches' *Kundin* and *Bäckern* do not introduce incompatible features per se. However, recall that Bierwisch's, Wunderlich's and Wiese's analyses in Section 5.2.2.2 and Paragraphs B.2.2.3.2 and B.2.2.4.2 also included remarks on applicability of calculating compatibility and incompatibility routes. The same argument holds true for TMP's claims. While both of Blevins' accounts calculated inappropriate determiner candidates, the other approaches' *Kundin* and *Bäckern* introduced features that still might be categorically incompatible with the filter specification. It still has to

Table 5.13: Overview of all relevant ranked candidates for the noun position with no SP_{NOM}.

	rank	noun	specification	⚡	🔍− ⇒	🔍− ⇐	🔍+
Bierwisch		filter specification: [+M] (by current material's *der*$_{\text{NOM.M.SG}}$)					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	0	0	1
	3.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	1	1	0
		filter specification: [+OBJ, +M] (by current material's *den*$_{\text{ACC.M.SG}}$)					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	0	1
	2.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	1	2	1
Blevins, original		filter specification: [+OBL] (by current material's *der*$_{\text{DAT.F.SG}}$)					
	1.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	2	1
	2.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	1	1	0
	3.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[−M, +F]	0	1	2	0
		filter specification: [+OBJ, +OBL, +PL] (by current material's *den*$_{\text{DAT.PL}}$)					
	1.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	0	3
	3.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	2	0	1
Blevins, max. underspec.		filter specification: [+OBL] (by current material's *der*$_{\text{DAT.F.SG}}$)					
	1.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	2	1
	2.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	1	0
		Kundin$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	1	1	0
		Bäcker$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	1	1	0
		filter specification: [+OBJ, +OBL, +PL] (by current material's *den*$_{\text{DAT.PL}}$)					
	1.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	0	3
	2.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	2	0	1
Wunderlich		filter specification: [+M] (by current material's *der*$_{\text{NOM.M.SG}}$)					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	0	0	1
	3.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	1	1	0
		filter specification: [+HR, +M] (by current material's *den*$_{\text{ACC.M.SG}}$)					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	0	1
	3.	*Bäckern*$_{\text{DAT.PL}}$	[+LR, +M, +PL]	0	1	2	0
Wiese		filter specification: [+M] (by current material's *der*$_{\text{NOM.M.SG}}$)					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	0	0	1
	3.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	1	1	0
		filter specification: [+OBL] (by current material's *der*$_{\text{GEN.PL}}$)					
	1.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	2	1
	2.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	1	0
		Kundin$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	1	1	0
		Bäcker$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	1	1	0
		filter specification: [+OBJ, +M] (by current material's *den*$_{\text{ACC.M.SG}}$)					
	1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	0	1
	2.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	1	2	0
		filter specification: [+OBJ, +OBL] (by current material's *den*$_{\text{DAT.PL}}$)					
	1.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	1	2
	2.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	2	1	1
		Bäcker$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	2	1	0

be decided whether the compatibility or incompatibility path is more feasible. For now, is has to be noted that both routes are plausible. For this reason, it is possible that *Kundin* and *Bäckern* entail incompatibility.

In order to conclude the determiner and noun integration for Blevins' original and maximally underspecified frameworks, TMP makes the claim that, after no SP_{NOM}, an incoming *der* should be integrated as *der*$_{\text{DAT.F.SG}}$. This does not match the target determiner in (25a). TMP incorrectly predicts *Bäckern* following *der*$_{\text{DAT.F.SG}}$. From thereon, TMP cannot build up the grammatical DP *der Bäcker*$_{\text{NOM.M.SG}}$ that is eventually the target DP in (25a). Rather, TMP builds up the illicit DP *der*$_{\text{DAT.F.SG}}$ *Bäcker*$_{\text{NOM/ACC/DAT.M.PL}}$ since the incoming *Bäcker* would be integrated in its plural alternative. Turning to the other determiner, TMP predicts *den* to be integrated as *den*$_{\text{DAT.PL}}$. This does not match the target determiner in (25c). TMP correctly predicts *Bäckern*$_{\text{DAT.PL}}$, allowing to build up the grammatical DP *den Bäckern*$_{\text{DAT.PL}}$ that is eventually the target DP in (25d). With regard to *Bäcker*, TMP does not predict this candidate after *den*. Conversely, integrating the dispreferred *Bäcker* after *den*$_{\text{DAT.PL}}$ makes a reanalysis of *den* necessary in order to end up at the grammatical target DP *den Bäcker* from (25c).

The picture becomes even more obscure for Wiese. Since a ranking tie occurred between *der*$_{\text{NOM.M.SG}}$ and *der*$_{\text{DAT.F.SG}}$ and between *den*$_{\text{ACC.M.SG}}$ and *den*$_{\text{DAT.PL}}$ at the determiner position, the ranked candidates for four filter specifications shall be analyzed. If *der* had previously been integrated as *der*$_{\text{NOM.M.SG}}$, TMP predicts *Bäcker* and will also integrate this candidate in case it enters the system. *Kundin* is not predicted. If, on the other hand, *der* was integrated as *der*$_{\text{GEN.PL}}$, TMP preferably predicts *Bäckern*. If *Bäcker* enters the system, it cannot decide whether to integrate it in its singular or plural alternative. Critically, *Kundin* is ranked as high as both *Bäcker* alternatives. No matter what combination TMP decides for, they are all ungrammatical and will not match any target structure from (25a–25b). Similarly, if *den* was previously integrated as *den*$_{\text{ACC.M.SG}}$, TMP predicts *Bäcker* and will also integrate this candidate in case it enters the system. *Bäckern* is not predicted. If *den* was integrated as *den*$_{\text{DAT.PL}}$, TMP preferably predicts *Bäckern*. If *Bäcker* enters the system, it cannot decide whether to integrate it in its singular or plural alternative. Again, no matter what combination TMP decides for, they are all ungrammatical and will not match any target structure from (25c–25d).

Since TMP makes both illicit predictions as well as ungrammatical integrations for the structures in (25) when applying the features of both of Blevins' accounts and the framework of Wiese, the overview in Table 5.11 offers the most intriguing insights for Bierwisch and Wunderlich. For these two approaches, nothing has changed with regard to how the nouns are predicted and integrated in comparison to the presence of an SP_{NOM} in Section 5.3.1.2. Both predict the following gradation after *der*: *Bäcker*$_{\text{NOM.M.SG}}$ $<$ *Kundin*$_{\text{DAT.F.SG}}$. Similarly, for *den*, Bierwisch's and Wunderlich's accounts yield this scale: *Bäcker*$_{\text{ACC.M.SG}}$ $<$ *Bäckern*$_{\text{DAT.PL}}$. However, these gradations again do not take into account that both are preceded by different determiners and thus by different filter specifications which, in turn, are not preceded by an SP_{NOM}. Returning to the exemplary Bierwisch description, Table 5.13 also reveals that now the transition from *der*$_{\text{NOM.M.SG}}$'s filter specification to *Bäcker* is less violating than from *den*$_{\text{ACC.M.SG}}$'s to *Bäcker*: In the former case, no feature retrievals fail between the filter specification and the noun while one feature cannot be found on the noun and on the filter specification in the latter case. Considering these determiner variations for Bierwisch's and Wunderlich's approaches yields the following gradations:

(30) Bierwisch/Wunderlich:
Bäcker$_{\text{NOM.M.SG}}$ < *Bäcker*$_{\text{ACC.M.SG}}$ < *Kundin*$_{\text{DAT.F.SG}}$ < *Bäckern*$_{\text{DAT.PL}}$

Several insights can be drawn from (30) for Bierwisch and Wunderlich: Firstly, the accounts of Blevins and Wiese are ignored since they predict and generate illicit DPs. Therefore, only Bierwisch and Wunderlich will be considered. Recall that *Kundin* in (25b) was targeted as *Kundin*$_{\text{DAT.F.SG}}$ and preceded by *der* that was integrated as *der*$_{\text{NOM.M.SG}}$. Similarly, *Bäckern* in (25c) was targeted as *Bäckern*$_{\text{DAT.PL}}$ and preceded by *den* that was integrated as *den*$_{\text{ACC.M.SG}}$. Therefore, (28) still shows across Bierwisch's and Wunderlich's models that *Bäcker* after *der* is integrated preferably over *Kundin* and *Bäcker* after *den* over *Bäckern*. However, in contrast to Section 5.3.1.2, the gradations also show that *Bäcker*$_{\text{NOM.M.SG}}$ after *der* should be integrated preferably if compared to *Bäcker*$_{\text{ACC.M.SG}}$ after *den*. These differences will be addressed later in the Experimental Part II.

To conclude the determiner and noun integrations for Bierwisch and Wunderlich, TMP makes the claim that, after no SP$_{\text{NOM}}$, an incoming *der* should be integrated as *der*$_{\text{NOM.M.SG}}$. This matches the target determiner in (25a). TMP correctly predicts *Bäcker* following *der*$_{\text{NOM.M.SG}}$. From thereon, TMP can build up the grammatical DP *der Bäcker*$_{\text{NOM.M.SG}}$ that is eventually the target DP in (25a). In contrast to that, TMP does not predict *Kundin* following *der*. Conversely, integrating the dispreferred *Kundin* after *der*$_{\text{NOM.M.SG}}$ makes a reanalysis of *der* necessary in order to end up at the grammatical target DP *der Kundin*$_{\text{DAT.F.SG}}$ from (25b). Turning to the other determiner, TMP predicts *den* to be integrated as *den*$_{\text{ACC.M.SG}}$. This matches the target determiner in (25c). Again, TMP correctly predicts *Bäcker* following *den*$_{\text{ACC.M.SG}}$, allowing it to build up the grammatical DP *den Bäcker*$_{\text{ACC.M.SG}}$ that is eventually the target DP in (25c). With regard to *Bäckern*, TMP does not predict this candidate after *den*. Conversely, integrating the dispreferred *Bäckern* after *den*$_{\text{ACC.M.SG}}$ makes a reanalysis of *den* necessary in order to end up at the grammatical target DP *den Bäckern* from (25d).

5.3.3 Interim conclusion: Present versus absent SP$_{\text{NOM}}$

The previous sections compared the different determiners and nouns within each underspecification approach. Afterwards, they were contrasted across Bierwisch, Blevins, Wunderlich and Wiese. Müller's approach was neglected as his feature configuration's and exponency's destructive nature was considered incompatible with the additively operating proposed parsing mechanism. The relevant comparisons were done for a present SP$_{\text{NOM}}$ in Section 5.3.1 and subsequently for a non-present SP$_{\text{NOM}}$ in Section 5.3.2. Ultimately, those SP$_{\text{NOM}}$-dependent differences shall now be addressed.

Under the assumption of a prevalent SP$_{\text{NOM}}$ filter specification, all underspecification models predicted *der* instead of *den* as incoming determiner. To be precise, irrespective of the model, *der*$_{\text{NOM.M.SG}}$ was preferably predicted over *der*$_{\text{DAT.F.SG}}$. Thus, if *der* entered TMP, it would be integrated in the nominative masculine alternative. Similarly, *den*$_{\text{ACC.M.SG}}$ was preferably predicted over *den*$_{\text{DAT.PL}}$. Therefore, if *den* entered TMP, it would be integrated in the accusative masculine alternative. For the subsequent noun position, all underspecification frameworks again predicted *Bäcker* after *der* and *Bäcker* after *den*. Interestingly, TMP predicted an easier integration of *Bäcker* after *den* in comparison to *Bäcker* after *der* across accounts.

These insights could only partially be maintained for the parses without a precursory SP$_{\text{NOM}}$ filter specification. Critically, TMP made false predictions and illicit integrations when using Blevins' or Wiese's features. The comparisons revealed that only Bierwisch and Wunderlich predicted grammatical structures and that their eventual integration path would line up with the targeted DPs from Section 5.3.1.2. However, in contrast to an existing SP$_{\text{NOM}}$, both models assume an easier integration of *Bäcker* after *der* in comparison to *Bäcker* after *den* if the SP$_{\text{NOM}}$ is omitted.

6 Summary of Theoretical Part I

The Theoretical Part I of the present thesis culminated in the creation of a system that picks up the underspecified morphosyntactic features of individual, incrementally available lexical elements and builds up a larger structure from that information: The Morphosyntactic Parser. In essence, TMP basically consists of two ingredients, namely a morphosyntax-related mechanism and a particular understanding of parsimony. The former component hinges on Chapter 1's insight that the phenomenon of syncretism can be captured by means of underspecification. Section 1.2 introduced four approaches on how to underspecify syncretic inflected elements. It was revealed in Chapter 2 that underspecification may not only be a theoretical construct but that it may equally be relevant for language processing. More specifically, Section 2.4 introduced a system that processes underspecified morphosyntactic features. Subsequently, Chapter 3 acknowledged the relationship between syncretism and subject-object ambiguities in German. These structures reveal a subject-first preference that can be motivated by structural minimality which could be identified as TMP's second main characteristic. In Chapter 4, the former component—the morphosyntax-related mechanism—and said notion of minimality were fused into TMP under the aforementioned insight that syncretism in German enables subject-object ambiguities in the first place. For this reason, TMP was appropriately tested with subject-object ambiguities that would supply the necessary morphosyntactic information. In particular, it was the first DP of those structures that entered the system. These DPs consisted of the accidentally syncretic determiners *der* and *den* that could be either $der_{\text{NOM.M.SG}}$ or $der_{\text{DAT.F.SG}}$ and $den_{\text{ACC.M.SG}}$ or $den_{\text{DAT.PL}}$ respectively, depending on the subsequent disambiguating noun. These elements were equipped with the morphosyntactic features. At the transition of each word, TMP's bias for minimal feature deviance applied resulting in a ranking of predicted candidates. Lower and higher ranked candidates determined later calculatory *simple* or *complex* work when integrating the actual input. Lexical elements were equipped with features by four approaches by Bierwisch, Blevins, Wunderlich and Wiese that were introduced in Section 1.2. Blevins' model was extended by another sub-assumption resulting in a total of five different ways to underspecify lexical elements. As mentioned before, subject-object ambiguities show a preference to integrate the first argument as subject in nominative case (SP_{NOM}). Therefore, it appeared to be feasible to incorporate such an SP_{NOM} into the targeted structures as an overarching umbrella. However, as it turned out, it might not be necessary to assume a prevalent SP. TMP was designed in a way that it automatically predicts preferably elements that would allow to be integrated as a subject in nominative case. Consequently, three questions emerged that guide the current investigation:

Question 1: How do the parses differ between the elements of the subject-object ambiguities?

Question 2: Which one of the underspecification approaches by Bierwisch, Blevins, Wunderlich and Wiese is explanatorily more adequate?

Question 3: Does the presence or absence of an SP_{NOM} filter specification contribute to TMP's predictions?

Chapter 5 was entirely concerned with evaluating these three questions from a theoretical point of view. Complete parsing sequences were laid out for the first DP of subject-object ambiguities. This was done for Bierwisch's, Blevins' original and maximally underspecified approaches, Wunderlich's and Wiese's frameworks. In Section 5.2.1 and Appendix B.2.1 respectively, the structures in question were analyzed across underspecification frameworks with an assumed preceding SP_{NOM}, while Section 5.2.2 and Appendix B.2.2 respectively dealt with the same DPs also across all underspecification models but this time without said SP_{NOM}. It turned out that, at the determiner position, if an SP_{NOM} was indeed assumed, TMP would make the same prediction for all underspecification accounts: *der* would be preferably predicted and integrated in comparison to *den*. This behavior would change if the SP_{NOM} was abandoned. In this case, only Bierwisch and Wunderlich made predictions matching the target structures. Both Blevins' and Wiese's approaches ran into the problem of predicting determiners that would, in turn, predict the wrong nouns at the subsequent parsing step. All parsing outcomes were compared in claims in Section 5.3. These claims collected supposed calculatory *simplicity* or *complexity* for each DP position.

The subsequent Experimental Part II will assess these claims by mapping TMP's *simple* or *complex* work on hypothetical low or high processing effort. Basing TMP's claims on empirical grounds, will finally allow to answer Questions 1 to 3. In order to do so, they will be transformed into detailed hypotheses which will be tested in three ERP studies. If TMP's claims can eventually be mapped onto the ERP results, the present dissertation would successfully provide evidence that underspecified morphosyntactic features are mentally represented and used by the human language processing system.

Experimental Part

So far, the Theoretical Part I of the thesis at hand worked towards the evaluation of TMP's processing of the DPs from (25) repeated here in (31). The Experimental Part II seeks to mirror the statements of the previous part. In order to validate or falsify the claims from TMP's incremental parsing steps, they will be empirically assessed. Since individual parsing steps from one word to another within and across underspecification approaches for the presence and absence of an SP_{NOM} all yielded different parsing claims from which hypotheses can be derived, the experimental results allow for insights into the Questions 1 to 3. Thus, the second part's main goal is to reveal whether the model's position-dependent claims from Section 5.3 are reflected by human language processing.

> Question 1: How do the parses differ between the elements of the subject-object ambiguities?
>
> Question 2: Which one of the underspecification approaches by Bierwisch, Blevins, Wunderlich and Wiese is explanatorily more adequate?
>
> Question 3: Does the presence or absence of an SP_{NOM} filter specification contribute to TMP's predictions?

(31)	a.	der the.NOM.M, DAT.F	Bäcker baker.NOM.M
	b.	der the.NOM.M, DAT.F	Kundin customer.DAT.F
	c.	den the.ACC.M, DAT.PL	Bäcker baker.ACC.M
	d.	den the.ACC.M, DAT.PL	Bäckern bakers.DAT.PL

In order to gain insights into actual comprehension, Experiment 1 will test the clause-medial grammatical two-element DPs from (31) by means of recording ERPs. This method of data collection and its distinct measurable effects will be introduced in detail in Section 7.1. The implications of Experiment 1 will lead to two more experiments that will prolong the DPs by an intermediate weak adjective between determiner and noun. In addition, the third study will also introduce a third determiner and ungrammatical structures. These measures allow to gradually increase the variance and intricacy of featural contact points under investigation. The experimental results will eventually allow to assess the Questions 1 to 3 and consequently whether TMP made appropriate predictions for incremental language processing.

7 Experiment 1: Processing of Grammatical Two-Element DPs

7.1 Introduction: An ERP Investigation

As already stated above, the experiments will collect neurophysiological data in order to uncover morphosyntactic processing. Briefly introduced in Section 2.4, the technique of ERPs describes a procedure to record minute differences in electrophysiological brain activity by means of EEG. The method dates back to Berger (1929) who showed that non-invasive electrodes, that are applied to the scalp, are able to pick up small electrical charge differentials over a time-course. Walter et al. (1964) discovered that particular electric brain responses could be triggered by sensory input and thus allowed for the investigation of spontaneous online processes with a high temporal resolution. In the present investigation, the feature variations from one parsing step to a subsequent one but also across the various underspecification approaches and with regard to the presence or absence of an SP_{NOM} are minuscule. Thus, the method of ERP is an appropriate tool to reveal equally small processing differences. Countless studies established various ERP components in dependence of stimulus properties. Some of them which are relevant for the present investigation shall be introduced below. These studies also helped to characterize these patterns along four main factors: amplitude, polarity, topography and latency. The ERP method is called "event-related" because the latency relative to the onset of a stimulus that evokes the respective effect is of interest. Furthermore, this effect can vary in its amplitude and polarity. The former factor can be viewed as the effect's strength while the latter can be deflected positively and negatively. The topography states the location on the scalp. The combination of these factors defines an ERP effect. Two ERP patterns will be relevant for the current undertaking: the LAN and the P600. However, references to related components will be made when necessary.

7.1.1 Negatively deflected ERP components

The first language-related ERP effect relevant for the present investigation is a negative-going component that has its maximum at around 300 to 500 ms after stimulus onset at left and anterior electrode sites: the LAN. Kutas and Hillyard (1983) were among the first to observe this effect. It was observed for verbs that did not agree with a preceding subject noun regarding number. As mentioned in Section 3.2, for German scrambling sentences, Rösler et al. (1998) measured LAN effects for canonicity-violating DPs in ditransitive constructions. Also for German, Gunter et al. (2000) found LAN effects for gender violations. If the noun of a clause-medial DP did not agree with the preceding determiner with regard to its gender, a more pronounced LAN was elicited. Molinaro et al. (2008) obtained similar results for Italian when DPs were introduced by incorrectly inflected determiners. For Spanish, Barber et al. (2004) found that violations of grammatically marked gender on predicate adjectives elicited a LAN in comparison to semantic gender violations that lacked explicit morphological marking. Barber and Carreiras (2005) replicated these results for gender and number agreement violations of Spanish adjective-noun pairs. O13's aforementioned study also found LAN effects for incorrectly inflected adjectives within a PP. They argued that the effect seemed to be "sensitive to grammatical violations that hinder integration of the stimulus into the morphosyntactic context" (Opitz et al., 2013, p. 240). According to these findings, it can be concluded that the LAN component is typically elicited by the processing of morphosyntactic manipulations or violations. Apart from morphosyntactic processing, Münte et al. (1998) also reported a LAN effect for the mere alternation of the sentence-initial adverbials *after* and *before*. They attribute the effect for *before* to the different temporal information it provides in comparison to *after*. This deviant working-memory access induced processing difficulty when creating a discourse representation in the case of *before*. Therefore, Münte et al. (1998) concluded that the LAN effect seems to be sensitive for discourse manipulations too.

Notably, Gunter et al. (2000) observed a clear distinction between the LAN they found to be morphosyntax-related and another negatively deflected ERP component: They reported that nouns with a low expectability showed a so-called N400 effect. The effect is generally measurable between 250 and 500 ms at centro-parietal or fronto-central electrode sites with a peak at around 400 ms after stimulus onset. This ERP component was first observed by Kutas and Hillyard (1980) after the onset of *socks* as the continuation of *He spread the warm bread with...* in comparison to a continuation like *butter*. In contrast to that, a mere physical deviation induced by capitalization of the stimulus word did not result in the pronounced negativity. Kutas and Hillyard (1980) concluded that the N400 was sensitive for the violation of semantic expectancy. Along these lines, Federmeier and Kutas (1999) obtained graded N400 effects for varyingly expectable sentence-final nouns. In a given context of a tropical resort, the driveway was either planted with *palms*, *pines* or *tulips*. This cline in expectancy was mirrored by graded N400 effects. The unexpected but related *pines* elicited an N400 which was surpassed by a more pronounced N400 for the unexpected and unrelated *tulips* both in comparison to the targeted and expected *palms*. Apart from lexico-semantic violations, the N400 effect also occurs during discourse processing. Burkhardt (2006) reported graded N400 responses for varying givenness. DPs that were new relative to a prior context elicited the most pronounced effect while those that could be inferentially bridged evoked an attenuated N400. DPs that were introduced already evoked a reduced N400 effect. Thus, Burkhardt (2006) argued for the N400 to mirror the integration processes of inferential information. However, to decouple the argument from a possibly confounding lexical semantic access, Schumacher and Baumann (2010) conducted an auditory experiment in which they investigated the influence of prosody on discourse processing. Three accent types expressing givenness, accessibility and newness modulated the accessibility of inferable referents. The authors found graded N400 effects with the most pronounced peak for givenness and the lowest for accessibility with the newness accent in between. They concluded that both newness but even more givenness accents, which are inappropriate deaccentuations, mirrored difficulties in integrating the inferable referent into prior discourse. In this way, Schumacher and Baumann (2010) found evidence for a lexically independent N400 that reflects discourse processes.

According to this brief overview, it seems to be established that manipulations on lexical, sentence or discourse level elicit N400 responses and that morphosyntactic mismatches evoke LAN effects—of which Gunter et al.'s (2000) aforementioned clear component distinction is a great example. Nevertheless, it has been argued that "scalp topography seems a rather unreliable definition criterion" (Dröge et al., 2016, p. 150) for distinguishing functional components and their related processing mechanisms since they can be obscured by component overlap. Irrespective of topography, Dröge et al. (2016, p. 158) viewed negative-going components all to be "sensitive to expectancy violations". Osterhout (1997) investigated the processing of syntactically anomalous open class words in sentence-final positions. A syntactically disambiguating word such as *sank* could not be attached to the preceding *The boat sailed down the river...* if an active voice analysis was pursued. The authors observed subject-dependent negatively deflected effects for these sentence-final violations. Osterhout (1997) suspected that the sentence-final effect for reanalysis—the P600 (see Section 7.1.2)—overlapped with the preceding N400 effect of anomaly detection. This, in turn, "would tend to reduce the size of the N400 over posterior regions and to increase its relative size over anterior regions" (Osterhout, 1997, p. 515) rendering the ERP result LAN-like. Similarly, Tanner and Van Hell (2014) argued for the same possible N400-P600 overlap. They reported both LAN and N400 effects for morphosyntax-related agreement violations on the verb in two participant groups. Thus, they assumed that in some cases even "the LAN may be a variant of the N400 component" (Tanner and Van Hell, 2014, p. 298). For a review of 29 ERP studies with overlapping research questions that obtained varying negatively deflected ERP results see Molinaro et al. (2011). Consolidating these observations, Bornkessel-Schlesewsky and Schlesewsky (2016) entertained a broader understanding of negative ERP deflections, namely that they reflected "mismatches with predicted information" (Bornkessel-Schlesewsky and Schlesewsky, 2016, p. 366). Under this view, O13's feature-related LAN effects can be interpreted as signaling the violation of expected morphosyntactic compatibility and specificity between two elements.

To conclude, the LAN is nevertheless the expected effect for the morphosyntactic manipulations of the present investigation. However, the notion "that the negative-going components N400 [and] LAN [...] are all sensitive to expectancy violations" (Dröge et al., 2016, p. 158) and thus representing a more general cognitive process shall not be neglected.

7.1.2 Positively deflected ERP components

Sometimes, the sole emergence of an N400, however, is equivocal and thus requires a closer investigation. In a series of experiments on lexical–semantic relations, Roehm et al. (2007) showed that the N400 can be accompanied by another ERP effect: the P300. This component generally occurs with a positive amplitude between 300 and 600 ms after stimulus onset and hence overlaps with the N400. Roehm et al. (2007) detected this effect when the expected antonym to *black*—*white*—was presented. Thus, they revealed the P300 to be task-related in comparison to the language-related N400 that appeared more pronounced in the unrelated (*nice*) and related (*yellow*) conditions. As a result, the superimposing P300 reduced the N400 in the antonym relation. Alday and Kretzschmar (2019) replicated these findings. Since the P300 can also be measured in so-called oddball paradigms in which an infrequent stimulus occurs along frequent ones (Bornkessel-Schlesewsky and Schlesewsky, 2009b, p. 227), the effect can be interpreted as mirroring the detection of "task-relevant and predictable stimuli" (Hartikainen and Knight, 2003, p. 102). To this view, Roehm et al. (2007, p. 1272) added that "ERP studies on language processing require a much more detailed screening for possible task- or strategy-related positivity effects than previously assumed." This, in turn, "call[s] for [...] fundamentally different interpretation in their presence"(Roehm et al., 2007, p. 1272): Is one event a representation of an N400 in comparison to another event or is the other event an occurrence of a P300 compared to the first?[29] Since an interpretation would be inseparably connected to the research question and related hypotheses, this issue will be revisited when appropriate.

The positively deflected ERP component that is more relevant for the current investigation has its maximum between 500 and 900 ms after the stimulus onset. Famously, the occurrence of this effect was attributed to the processing of syntactic anomalies firstly by Osterhout and Holcomb (1992). They investigated sentences like *The broker ?hoped/persuaded to sell the stock was sent to jail* that contained either an intransitive or a transitive main verb. For the latter, the processing system recognized the need for a passivized relative clause attachment while, for the former, Osterhout and Holcomb (1992) observed a positive-going wave starting at the disambiguating auxiliary verb *was* and continuing onwards. They called this component P600 (Osterhout and Holcomb, 1992, p. 791) and interpreted it as the effect of reanalysis in the following way: Triggered by not being able to attach *was* to the previous syntactic structure, the previously assumed active voice for *hoped* was disambiguated towards passive voice. As a result, the reanalysis allowed for attaching the reduced relative clause. Aside from further general evidence for the P600 to reflect the parser's later response to encountering syntactic anomalies (e.g., Hagoort et al., 1993; Osterhout et al., 1994), syntactic integration-related difficulties (e.g., Kaan et al., 2000) or syntactic ambiguity (e.g., Frisch et al., 2002), it has to be noted that these effects can be preceded by LAN and N400 effects and thus by various expectancy violations, including morphosyntactic ones. For example, Gunter et al. (2000) not only found a LAN for gender disagreeing DPs but the same condition also elicited a subsequent P600 which the authors interpreted as a reflection of repair processes. Molinaro et al. (2008) came to the same conclusion as they also found biphasic LAN-P600 patterns for grammatical gender violating DPs. Also, Barber et al. (2004) and O13 recorded P600 effects for incorrectly gender-marked predicate adjectives

[29] For the relation of P300 and N400 see also Arbel et al. (2011).

or adjectives that were part of PPs.

However, the observation of the P600 effect is not limited to being a response to syntactic and morphosyntactic violations or difficulties. The effect has been shown to be sensitive to semantic and discourse anomalies too. Burkhardt (2006) found not only the aforementioned graded N400s with the smallest effect for contextually given and the largest for newly introduced DPs but also P600 effects for the latter as well as for inferentially bridged DPs. She interpreted the P600 occurrence as “an index of anaphoric integration cost due to the establishment of an independent, new discourse referent” (Burkhardt, 2006, p. 166). In this line, Burkhardt (2007) obtained different P600 responses for a DP like *the pistol* across three prior contexts. In a shooting scenario, the DP was “necessary”, in a killing context, it was “probable” and in relation to somebody found dead, *the pistol* was rendered “inducible”. In the latter two contexts that “require the integration of an unexpected instrument role” (Burkhardt, 2007, p. 1854), a P600 was elicited. Burkhardt (2007) interpreted this finding as an indicator for memory demands when updating the mental discourse model. Developing on this idea, Schumacher (2011) shifted the interpretation of a DP even further away from syntactic and lexical relations. Relative to a given physician-patient context, she examined the processing of DPs like *the hepatitis* that necessitated a metonymical reference transfer towards an individual. In contrast to DPs that did not require this reference shift, she found a “positivity” which she attributed to the costly updating of the discourse model. See Bornkessel-Schlesewsky and Schlesewsky (2008) and Regel et al. (2011) for further semantics- and pragmatics-related occurrences of the P600.

Since the P600 was, just like the negative-going ERP components, presented as being indicative for a number of similar processes, a comparably coalescing understanding for its appearance shall be adopted. Therefore, the P600 will be viewed as an indicator for a subsequent or later stage of general reanalysis and repair processes.

7.2 From Claims to Hypotheses

In the first experiment, the processing of two subsequent inflected elements will be investigated. The elements in question are a strong determiner and a following noun. Both elements form a grammatical DP. ERPs will be collected at each respective position within the DP in order to investigate the transition to the determiner and from thereon to the subsequent noun. Thus, hypotheses for the processing of both positions will be derived considering the position-dependent predictions from TMP’s claims. Consequently, the effects obtained for both positions will be interpreted with these claims in mind.

In order to do so, a very simple but crucial step has to be taken first to set the stage for deriving hypotheses later on. As already mentioned above, the subsequent empirical sections seek to mirror the assumptions from the Theoretical Part I. This makes the following conjecture inevitable: From Chapter 4 to this point, TMP was viewed as a mere approximation of reality. But from now on, in order to motivate the entire Experimental Part II and to enable the mapping of TMP’s claims onto the forthcoming experimental results, the existence of a TMP-equivalent calculation system in real-world human language processing is going to be assumed. It is hypothesized that TMP has a neurocognitive counterpart. The purpose of the following sections is to evaluate this conjecture.

The link allowing for this mapping is the Synchronization process that was discussed in Section 4.2.3 and constitutes an integral part of TMP's claims in Section 5.3. At this time in TMP's calculations, it is assumed that the incoming material is evaluated in light of the predicted ranked candidates by means of TMP's bias for minimal feature deviance. The resulting lists of ranked candidates are crucial in order to create and retrace the experiments' hypotheses regarding the respective ERP effect. However, it shall not be claimed that a search deeper down the list along the consecutively numbered candidates adds to processing load in comparison to the top rank and consequently leads to a more pronounced ERP response. In previous delineations, the fit of a candidate was determined by its rank. A higher ranked candidate was more likely predicted than a lower ranked candidate. The lower the rank, the higher the feature deviance and the more complex the calculatory work. Recall from Steps 1 and 2 that the depiction of the ranked candidates as a list was for mere illustrative reasons. Rather, the strength of the ERP effect that is associated with the Synchronization process is assumed to be modulated by the constraints of compatibility and non-retrievability from Step 2. Incompatible and non-retrievable features at TMP's Synchronization increased TMP's calculatory work and thus the feature deviance. Consequently, they lowered the preference to predict and thus integrate the candidate in question. It is now assumed that actual processing load should be correspondingly high instead. This case should be mirrored by a pronounced ERP effect. TMP's claims in Section 5.3 that were expressed by comparative gradings of ranked candidates along their conformity to or their disobedience against the filter specification follow from these assumptions. Consequently, these gradings have to be mapped onto expected ERP effects. In the same way as the claims ranked from lower to higher feature deviance, that is from *simple* to *complex* calculatory work, ERP effects will be listed from absent to present or attenuated to pronounced.

Since these gradations are rooted in the ranked candidates, the derivation is concerned with morphosyntax as TMP's Synchronization associates the morphosyntactic features of a preferably high-ranked prediction with the newly incoming material. In accordance to the description in Section 7.1.1, Synchronization will be associated with a LAN along the gradation from left to right. Exemplarily, (32) maps two candidates that differ according to TMP's calculations onto the respective expected LAN effect. Crucially, it is assumed that the extremely fine-grained featural distinctions in TMP's calculatory claims from Section 5.3 will be responsible for equally granular processing differences. In consequence, it will later be hypothesized that a variance in specification as small as a binary opposing value will be reflected in a smaller or larger effect; it will be predicted that a putatively trivial absence or presence of a feature will elicit an attenuated or pronounced effect. Naturally, the measurable effects will be expectably minuscule.

(32)		low	to	high feature deviance
		simple	to	*complex* calculatory work
	TMP:	*candidate*$_1$	$<$	*candidate*$_2$
	LAN:	attenuated	$<$	pronounced

In addition to the occurrence of a LAN effect, feature incompatibility should also trigger a reanalysis as it was also discussed as a secondary process in TMP's claims. This effect will be related to the Integration process and associated with a P600 that was described in Section 7.1.2. In Step 3', incoming material that was associated with incompatible features triggers the abandoning of the previous analysis of the current material and thus the filter specification. In the argument put forward here, reanalysis as an effect is viewed to be secondary to a more important cause. In fact, a reanalysis process is actually not integral in order to assess whether TMP is able to make morphosyntactically appropriate predictions for the upcoming material: This revision or reanalysis of a syntactic context can only be set in motion by a prior morphosyntax-related process that linked the incompatible features to the incoming material in the first place. These mechanisms will be associated with another ERP effect.

Note that the upcoming gradations within the hypotheses as in (32) are *not* redundant with TMP's claims in Section 5.3: Inherent to the empirical investigation by means of ERPs is—as described in Sections 7.1.1 and 7.1.2—the fact that these electrophysiological effects do not allow for drawing direct conclusions on a human language processor's definite analyses of its input. Rather, it is the comprehension system's by-product in form of electrophysiological activity that can be measured. Initially addressed in Observation 1, this reveals TMP's analyses in Chapter 5 as meta-linguistic investigations since its target elements above all analyses have always been univocally clear since the space of hypotheses was defined in Section 4.1.2. TMP allows to disclose its integration preference via the top-ranked candidate and the subsequent actual integration. In contrast to that, no such meta-analysis is possible for the natural language comprehender's processing system as their space of hypotheses is unconfined. A human's comprehension mechanism is obscure and only tentatively observable i.e. by means of stimulus responses in form of ERPs. Therefore, even more so than with TMP when it "sees" a syncretic, ambiguous element, for a natural processing mechanism, only the electrophysiological results of this encounter can be measured. Thus, the gradations in Section 5.3 are transparent metalinguistic analyses while later hypotheses are opaque predictions.

7.2.1 Position-dependent designations

Following the aforementioned assumption that TMP can only be investigated empirically if it is assumed to have an equivalent in real-world processing, it is obvious that the same DPs that TMP dealt with will be tested in respective experiments. In light of Observation 1, it is not transparent how a TMP-equivalent real-world mechanism analyses and integrates a DP position in question. Rather, only the position-dependent responses for syncretic, ambiguous and disambiguating elements are measurable. Therefore, recall the objection to O13's interpretation of their ERP results from Section 2.4:

Measuring position Y reveals the system's response to this very position Y in relation to its preceding position X. What the obtained data of position Y does not transparently reveal, is the system's response to the prior position X. Practically speaking, this means that initial observations of the respective ERP responses only allow for a separation of *der* and *den*, while TMP can predict an integration of *der*$_{\text{NOM.M.SG}}$ over *der*$_{\text{DAT.F.SG}}$ and of *den*$_{\text{ACC.M.SG}}$ over *den*$_{\text{DAT.PL}}$ that result in the claimed gradation of, for example, *der*$_{\text{NOM.M.SG}}$ $<$ *den*$_{\text{ACC.M.SG}}$ $<$ *der*$_{\text{DAT.F.SG}}$ $<$ *den*$_{\text{DAT.PL}}$ in (27). This dissociation of discrete positions in a partially syncretic, locally ambiguous structure on the one hand and the way the language comprehension analyzes this very position on the other hand necessitates it to descriptively discern the ambiguous and disambiguating lexical elements of the structures under investigation. Foreshadowing the second and third experiments which investigate three subsequent possibly ambiguous and disambiguating elements, position-specific designations that will discern position X from position Y are required. These designations have to respect the possibly ambiguous or disambiguating nature of their lexical content while also expressing the ambiguous or disambiguating nature of preceding positions. Furthermore, such labels are indispensable for later statistical analyses.

All of the following position-specific designations will be kept in sans serif font in order to further discern the positions from their content. Since the current Experiment 1 will recur to the DPs of (25), the determiner position will be designated with a "D". In particular, the ambiguous *der* alternatives of the two sentences (25a–25b) will be called Der while, analogously, both *den* determiners in (25c–25d) will be denoted as Den. In the same fashion, an "N" generally designates the subsequent noun position, while $_{\text{Der}}$Ner specifies the noun *Bäcker* after *der* in (25a), $_{\text{Der}}$Nin stands for the noun *Kundin* after *der* in (25b), $_{\text{Den}}$Ner is the designation for the noun *Bäcker* after *den* in (25c) and $_{\text{Den}}$Nern specifies the noun *Bäckern* after *den* in (25d). The designations allow for comprehensive, position-dependent hypotheses introduced in Section 7.3 as they dispense with syntactic contexts when still being ambiguous. In addition, they will be used in the description for the experimental sentence material in Section 7.4.2. Accordingly, the labels will be indispensable for statistical comparisons in Section 7.5. Apart from that, they also avoid reader-unfriendly and unintuitive consecutive numbering like D1 and N1 or descriptions like "For *Bäcker* after *der* in (33a), it is predicted that...", as they allow to refer to sub-conditions. In effect, they yield two sub-conditions for the determiner and four sub-conditions for the noun position as showcased in (33). Consequently, both positions appear in four grammatical syntactic contexts that are disambiguated by the noun, yielding the four syntactic target structures of NOM.M.SG, DAT.F.SG, ACC.M.SG and DAT.PL. Note that these syntactic contexts are similar to O13's PP condition labels. However, O13 tested the one position within a PP that finalized the PP's syntactic context, namely the noun. Therefore, in the current experiment, the syntactic target contexts will not be used as condition designations. Even though the DP-final noun also disambiguates the syntactic context, TMP's comparative claims and upcoming hypotheses render condition designations like "NOM.M.SG" not very meaningful when the focus is on $_{\text{Der}}$Ner. $_{\text{Der}}$Ner is then in fact the condition code. Nevertheless, NOM.M.SG is a useful description of the syntactic target context of a sequence of determiner and noun when describing a structure's analysis as complete.

(33) a. NOM.M.SG:

der	Bäcker
the.NOM.M, DAT.F	baker.NOM.M
Der	$_{\text{Der}}$Ner

b. DAT.F.SG:

der	Kundin
the.NOM.M, DAT.F	customer.DAT.F
Der	$_{\text{Der}}$Nin

c. ACC.M.SG:

den	Bäcker
the.ACC.M, DAT.PL	baker.ACC.M
Den	$_{\text{Den}}$Ner

d. DAT.PL:

den	Bäckern
the.ACC.M, DAT.PL	bakers.DAT.PL
Den	$_{\text{Den}}$Nern

The examples in (33) show that the determiner position is ambiguous between (33a) and (33b) for Der and between (33c) and (33d) for Den and that the subsequent noun position disambiguates the preceding determiner. In turn, the noun designation makes it transparent that both $_{\text{Der}}$Ner and $_{\text{Der}}$Nin in (33a) and (33b) respectively originate from Der, while $_{\text{Den}}$Ner and $_{\text{Den}}$Nern originate from Den in (33c) and (33d) respectively. This makes the structures to be tested one-stage disambiguations. The designation conventions allow to formulate hypotheses of the real-world processing mechanism with regard to the integration preference of Der versus Den at the determiner position but not about the integration of Der in (33a) versus Der in (33a), that is $der_{\text{NOM.M.SG}}$ versus $der_{\text{DAT.F.SG}}$. The respective ERP responses will only allow to discern the former but not the latter contrast. Crucially, however, the ERP pattern for the subsequent noun position will then reveal the prior determiner integration against the background of TMP's noun gradations.

7.2.2 Mapping TMP's claims onto expected ERP effects

The dissertation at hand went to great lengths to calculate the parsing outcomes in Section 5.2 and Appendix B.2 respectively. However, this provides the advantage that TMP's claims from Section 5.3 that discussed TMP's different efforts at the Synchronization and Integration processes can now be easily transformed into hypotheses with respect the two ERP components onto the determiner positions Der and Den and the noun positions $_{\text{Der}}$Ner, $_{\text{Der}}$Nin, $_{\text{Den}}$Ner and $_{\text{Den}}$Nern in the way specified above: Synchronization's predicted ranked candidates that are arranged along a gradation from left to right, that is from lower to higher feature deviance and from *simple* to *complex* calculatory work respectively, can now simply be mapped onto the predicted LAN. As laid out in Section 7.1.1, this effect was reported by Barber and Carreiras (2005), Gunter et al. (2000), Kutas and Hillyard (1983), Molinaro et al. (2008), and Rösler et al. (1998) and most appropriately for this current investigation by (Opitz et al., 2013) for complications in morphosyntactic processing. Accordingly, its emergence is expected for the calculatory *simple* or *complex* feature-related Synchronization process of associating features to the incoming material according to the predicted candidates. In accordance to the mapping in (32), gradations like (27)—repeated here in (34)—will be associated with the expected LAN occurrences.

(34) Approach-independent:
$der_{\text{NOM.M.SG}} < den_{\text{ACC.M.SG}} < der_{\text{DAT.F.SG}} < den_{\text{DAT.PL}}$

The gradation that was the result of TMP's claims lists the syncretic *der* determiners above the syncretic *den* determiners. Since, as mentioned before, the natural processing mechanism "sees" either *der* or *den*, the position-dependent designations will be used here to associate Der with the lower feature deviance as it entailed a *simple* calculation and Den with the higher feature deviance as it entailed a more *complex* calculation. Consequently, (34) can be translated into (35) which maps higher feature deviance onto a more pronounced LAN. This effect, in turn, corresponds to lower and higher processing effort from left to right. On the TMP side of the mapping, this scale is equally associated with TMP's *simple* and *complex* calculatory work.

(35) Approach-independent:
LAN: Der < Den

Apart from that, Integration's resolving of possible incompatibility can be mapped onto the predicted P600. The input of a candidate's incompatible features not only demotes it in the list of predicted ranked candidates at the prior steps relevant for Synchronization, but also triggers reanalysis at the subsequent Integration process. As discussed in Section 7.1.2, the P600 was elicited by syntactic and morphosyntactic violations or difficulties. Barber et al. (2004), Gunter et al. (2000), Hagoort et al. (1993), Kaan et al. (2000), Molinaro et al. (2008), Osterhout and Holcomb (1992), and Osterhout et al. (1994) understood this effect as an indicator for general reanalysis and repair processes. Accordingly, a P600 is expected to be present when the input is incompatible in comparison to an absent effect in case the input does not carry opposing features. Crucially, this means also that—in comparison to the Synchronization-related LAN—no graded P600 effects will be hypothesized. Therefore, the mere presence or absence of a P600 for one condition is predicted in comparison to another condition.

(36) Approach-independent:
P600: compatibility < incompatibility

7.3 Hypotheses

Since TMP's claims were already tightly connected with sentence material in Section 5.3, appropriate hypotheses will also be derived based on the target DPs from (33). As described in the previous section, the ERP effects will be associated with the different integration gradations for each DP position, underspecification approach as well as with and without an assumed SP_{NOM}, eventually allowing to address Questions 1 to 3. It has to be reiterated that these gradations will be based on the assumption that minuscule differences in value or presence of features are enough to trigger varying ERP effect strengths. Foreshadowing the predictions, a two-way comparison of determiners might not pose a problem. However, for the subsequent noun position, four-way gradations are predicted in which every comparison element carries a different specification. Expectably, the predicted graded ERP differences will be as small as the featural differences themselves. It should be noted that this procedure is problematic: Hypotheses for subsequent positions are dependent on the predictions of the preceding position.

Nevertheless, it has to be shown that in (33a), the language comprehender will eventually analyze Der as *der*$_{\text{NOM.M.SG}}$ and $_{\text{Der}}$Ner as *Bäcker*$_{\text{NOM.M.SG}}$ to complete a NOM.M.SG context. Similarly, evidence must be found that in (33b), the comprehension system finally integrates Der as *der*$_{\text{DAT.F.SG}}$ and $_{\text{Der}}$Nin as *Kundin*$_{\text{DAT.F.SG}}$ in order to realize the targeted DAT.F.SG structure. For (33c), it must be proven that—in the end—Den will be analyzed as *den*$_{\text{ACC.M.SG}}$ and $_{\text{Den}}$Ner as *Bäcker*$_{\text{ACC.M.SG}}$ for the target context of ACC.M.SG while, in (33d), Den will be integrated as *den*$_{\text{DAT.PL}}$ and $_{\text{Den}}$Nern as *Bäckern*$_{\text{DAT.PL}}$ for the desired DAT.PL context.

7.3.1 Assuming a prior SP_{NOM}

7.3.1.1 Determiner position

Under the assumption of a prior SP_{NOM}, TMP's claimed determiner gradation in (27) can be transformed into (37) since only a difference between *der* and *den* would be measurable. This scale assumes a more pronounced LAN for Den in comparison to Der rendering Den conditions to be harder to integrate than Der structures. However, recall from Observation 1 and (27) that TMP provided a more fine-grained gradation in which one syncretic determiner ranked above the other. While no hypothesis regarding which of the syncretic alternatives will be integrated can be derived for the determiner position, the subsequent noun position will allow to infer the analysis in light of TMP's noun gradation.

(37) Approach-independent:
LAN: Der < Den

With regard to an expected P600, the introduction of incompatible features is of relevance. This is the case for Den according to the ranked candidates of all approaches in Tables 5.4, B.5, B.8, B.11 and B.14 respectively. Since Den introduced a feature that is incompatible with the SP_{NOM}, a P600 is expected for Den in contrast to Der.

(38) Approach-independent:
P600: Der < Der

7.3.1.2 Noun position

Turning to the subsequent position, TMP's claimed noun gradation in (28) can be translated into the scale in (39). As explained in Section 7.2.2, the cline from left to right is associated with increased processing effort, rendering for example DerNin in Bierwisch's, Wunderlich's, Wiese's and Blevins' original approaches the most effortful noun condition to be integrated. TMP's four-way noun gradation will also allow to infer which of the syncretic determiners from the prior position was integrated.

(39) a. Bierwisch/Wunderlich/Wiese:
LAN: DenNer $<$ DenNern $<$ DerNer $<$ DerNin
b. Blevins, original:
LAN: DenNer $<$ DerNer $<$ DenNern $<$ DerNin
c. Blevins, max. underspec.:
LAN: DenNer $<$ DerNer $<$ DerNin $<$ DenNern

Furthermore, for Bierwisch, Wunderlich and Wiese, a P600 can be expected for the occurrences of DerNin in comparison to DerNer if the incompatibility routes from Paragraph 5.2.1.2.2 are taken. If the compatibility route is taken, a P600 should fail to appear for DerNin. The same reasoning applies for DenNern's incompatibility or compatibility routes in Paragraph 5.2.1.4.2. In both of Blevins' approaches, a P600 is expected for both the incompatible DerNin in comparison to DerNer and DenNern compared to DenNer.

(40) a. Bierwisch/Wunderlich/Wiese:
P600: DerNer $<$ DerNin $=$ DenNern for incompatibility route
P600: DerNer $=$ DerNin $=$ DenNern for compatibility route

b. Blevins, original/max. underspec.:
P600: DerNer $<$ DerNin
P600: DenNer $<$ DenNern

7.3.2 Assuming no prior SP_{NOM}

7.3.2.1 Determiner position

Assuming no precursory SP_{NOM}, TMP's claimed determiner gradation in (29) can be transformed into (41) since only a difference between *der* and *den* would be measurable. This scale assumes a more pronounced LAN for Den in comparison to Der. However, recall from Observation 1 and (29) that TMP provided a more fine-grained gradation in which one syncretic determiner ranked above the other. While no hypothesis regarding which of the syncretic alternatives will be integrated can be derived for the determiner position, the subsequent noun position will allow to infer the analysis in light of TMP's noun gradation.

(41) Approach-independent:
LAN: Der < Den

According to the ranked candidates of all approaches in Tables 5.7, B.17, B.20, B.23 and B.26 respectively, no P600 is predicted for Den versus Der since there is no filter specification of an SP_{NOM} that could be violated by the determiners' features. Thus, no P600 can be elicited due to which Den should not differ from Der.

(42) Approach-independent:
P600: Der = Den

7.3.2.2 Noun position

Turning to the subsequent position, TMP can only make predictions for Bierwisch's and Wunderlich's approaches. Recall from Section 5.3.2 that both of Blevins' approaches as well as Wiese made ungrammatical predictions with regard to the determiner integration. From these illicit integrations follow equally ungrammatical noun integrations. According to TMP's claimed noun gradation, (30) can be translated into the scale in (43). TMP's four-way noun gradation will also allow to infer which of the syncretic determiners from the prior position was integrated.

(43) Bierwisch/Wunderlich:
LAN: $_{\text{Der}}$Ner < $_{\text{Den}}$Ner < $_{\text{Der}}$Nin < $_{\text{Den}}$Nern

Furthermore, for Bierwisch and Wunderlich, a P600 can be expected for the occurrences of $_{\text{Der}}$Nin in comparison to $_{\text{Der}}$Ner if the incompatibility route is taken. If the compatibility route is taken, a P600 should fail to appear for $_{\text{Der}}$Nin. The same reasoning applies for $_{\text{Den}}$Nern.

(44) Bierwisch/Wunderlich:
P600: $_{\text{Der}}$Ner = $_{\text{Den}}$Ner < $_{\text{Der}}$Nin = $_{\text{Den}}$Nern for incompatibility route
P600: $_{\text{Der}}$Ner = $_{\text{Der}}$Nin = $_{\text{Den}}$Ner = $_{\text{Den}}$Nern for compatibility route

To sum up, the position-dependent predictions regarding the occurrence of a LAN and a subsequent P600 are uniform across underspecification approaches for the determiner and the noun position if an SP_{NOM} is assumed. On the noun position, it will also be interesting to see whether the language processing system follows the incompatibility or the compatibility route with Bierwisch's, Wunderlich's and Wiese's features. The noun position will further reveal the prior determiner integration in light of TMP's gradation for that very position. If there is no SP_{NOM}, TMP can maintain proper claims for Bierwisch and Wunderlich only. For these, the hypotheses predict the same pattern as if there was an SP_{NOM}. However, at the subsequent noun position, only Bierwisch and Wunderlich entertain plausible continuations. The predictions differ slightly from a present SP_{NOM} with other modulations for the four target nouns. The ERP results shall resolve the issue of which account renders the best fit.

7.4 Method

7.4.1 Participants

Twenty-four adults (21 females) recruited from the participant pool of the XLinC Lab at the University of Cologne (mean age: 22.83 years, range: 20-30) participated in the experiment. They were paid 8 € per hour for their participation. Participants were right-handed and had normal or corrected-to-normal vision. None of them reported neurological or psychological disorders. All participants were naïve with respect to the purpose of the study. Two of the participants were excluded from the final data analysis due to excessive artifacts in their recordings. Therefore, 22 subjects entered the analysis (20 females, mean age: 22.63 years, range: 20-27 years). The experiment was performed in accordance with the ethical standards laid down in the Declaration of Helsinki. Participants gave written informed consent and were instructed that they could discontinue the study at any time in case they wished to do so.

7.4.2 Materials

In order to draw conclusions from TMP's parsings and eventually compare the empirical results with TMP's claims, the experimental sentences obviously needed to have the same structure as those TMP dealt with in Section 5.2. All experimental items were grammatical German main declarative clauses with accusative and dative verbs in perfect tense. In addition, they were expanded by PPs after the two DP arguments allowing for the following sequence: [PREFIELD WITH AN ADVERBIAL PHRASE] + *hat* + DP1 + PP1 + DP2 + PP2 + $V_{\text{ACC/DAT}}$. This yielded the sentences in (45). The critical DP1 was placed in the middle field because measuring ERPs on a sentence-initial determiner is suboptimal. For similar reasons, PPs were added in order to have sufficiently long spillover regions for the DP arguments. The presence of the PPs should not alter the integration of the preceding DPs.

The DP1 was either introduced by the accidentally syncretic and therefore ambiguous German strong determiner $der_{\text{NOM.M.SG/DAT.F.SG}}$ or introduced by the accidentally syncretic and therefore ambiguous German strong determiner $den_{\text{ACC.M.SG/DAT.PL}}$. The DP2 received disambiguating case marking given the requirements of the respective predicate. Accordingly, structure (45a) realizes a canonical subject-before-object order, while the conditions in (45b–45d) present a non-canonical object-before-subject sequence. These structures can be mapped onto the conditions from (33). Two subordinate Der and Den conditions are followed by four subordinate ${}_{\text{Der}}\text{Ner}$, ${}_{\text{Der}}\text{Nin}$, ${}_{\text{Den}}\text{Ner}$ and ${}_{\text{Den}}\text{Nern}$ conditions that constitute the four syntactic target structures: NOM.M.SG, DAT.F.SG, ACC.M.SG and DAT.PL.

(45) Experimental items:

a. NOM.M.SG:

Gestern	hat	der	Bäcker	aus	Mainz	den	Konditor	aus	Kassel
Yesterday	has	the	baker	from	Mainz	the	confectioner	from	Kassel
		Der	${}_{\text{Der}}\text{Ner}$						

ausgelacht.
laughed-at

"Yesterday, the baker from Mainz laughed at the confectioner from Kassel."

b. DAT.F.SG:
Gestern hat der Kundin aus Mainz der Konditor aus Kassel
Yesterday has the customer from Mainz the confectioner from Kassel
Der DerNin
zugeflüstert.
whisphered-at

"Yesterday, the confectioner from Kassel whispered at the customer from Mainz."

c. ACC.M.SG:
Gestern hat den Bäcker aus Mainz der Konditor aus Hürth
Yesterday has the baker from Mainz the confectioner from Hürth
Den DenNer
ausgelacht.
laughed-at

"Yesterday, the confectioner from Hürth laughed at the baker from Mainz."

d. DAT.PL:
Gestern hat den Bäckern aus Mainz der Konditor aus Hürth
Yesterday has the bakers from Mainz the confectioner from Hürth
Den DenNern
zugeflüstert.
whispered-at

"Yesterday, the confectioner from Hürth whispered at the bakers from Mainz."

All nouns in DP1 were matched for frequency according to Wortschatz Leipzig (mean = 12.96, sd = 2.85), length (mean = 6.63, sd = 1.45) and syllable structure (every noun was bisyllabic). As already mentioned in Section 4.1.2.2, masculine nouns in DP1 in the NOM.M.SG, ACC.M.SG and DAT.PL structures were without plural marking in their respective nominative case, while feminine nouns in the DAT.F.SG condition partially carried morphological marking for being a feminine entity. In this way, 40 lexical sets consisting of four sentences each were constructed, resulting in a total of 160 experimental items. The entirety of the critical material is listed in Appendix E.1.

In addition, 120 filler items of various types were included with the aim of varying the length. They consisted of 20 intransitive structures without PP1, 10 transitive subject-before-object structures with PP1 and without PP2, 10 transitive subject-before-object structures without PP1 and with PP2, 20 transitive object-before-subject structures without PP1 and without PP2, 10 transitive object-before-subject structures with PP1 and without PP2, 10 transitive object-before-subject structures without PP1 and with PP2, 10 transitive ungrammatical structures with PP1 and with PP2, 10 intransitive ungrammatical structures without PP1, 10 transitive ungrammatical structures with

PP1 and without PP1 and 10 transitive ungrammatical structures without PP1 and with PP2. (46) gives an overview of the filler items. With the sets of 160 experimental and 120 filler items, two pseudo-randomized lists were created.

(46) Filler items:

a. NOM.F.SG, intransitive:
Im Zoo hat die Löwin gedöst.
In the zoo has the lioness dozed
"The lioness dozed in the zoo."

b. NOM.F.SG, transitive with PP1 and without PP2:
Auf der Messe hat die Frau aus Dalberg den Aussteller befragt.
At the fair has the woman from Dalberg the exhibitor asked
"The woman from Dalberg asked the exhibitor at the fair."

c. NOM.F.SG, transitive without PP1 and with PP2:
Beim Arzt hat die Amme den Vater aus Halle beruhigt.
At the doctor has the wet nurse the father from Halle calmed-down
"The wet nurse calmed-down the father from Halle at the doctor's."

d. UNGRAMMATICAL:
Auf der Konferenz hat der *Podium gewackelt.
At the conference has the.M podium.N wobbled
"The podium wobbled at the conference."

7.4.3 Data acquisition

EEG data were recorded from thirty-two Ag-AgCL scalp electrodes which were mounted on the scalp via an elastic cap. The EEG was referenced online to the left mastoid electrode and re-referenced offline to linked mastoid electrodes. The EEG data were amplified by a BrainAmp amplifier with a sampling rate of 500 Hz while impedances were kept below 4kΩ. The ground electrode was placed at AFz. To control for artifacts from eye-movements, the recording also included a bipolar horizontal and vertical electrooculogram (EOG). Therefore, three electrodes were placed around the subject's right eye (above and below the eye and at its outer cantus) and one electrode at the outer cantus of the left eye.

7.4.4 Procedure

All participants were presented with written instructions and gave written consent about their participation. Subjects were comfortably seated in a soundproof, dimly lit booth. Each experimental session started with a practice run in which subjects read ten sentences of the same structure as the experimental items. The participants were asked to read attentively and to reply to the experimental task—a grammaticality judgment—as accurately as possible by pressing a "yes" or "no" button on a game controller. Two randomization lists were created with each list containing the entire material, namely

160 critical and 120 filler items; each list in itself consisted of six blocks and was pseudo-randomized in a way that a critical condition of each item was presented only once within a given block.

A trial sequence started off with a fixation star which was presented for 500 ms in the middle of the computer screen. After an inter-stimulus interval (ISI) of 150 ms, the experimental items were presented visually, word-by-word. Each word was presented in the center of the monitor for 400 ms. The ISI for the word-by-word presentation was 150 ms. The stimulus presentation was followed by an interval of 500 ms before three question marks appeared for 500 ms signalizing the participants to give a response within a response time of maximal 4000 ms. The trial ended with an inter-trial interval of 1000 ms before the next trial started.

7.4.5 Data analysis

EEG data were preprocessed in the following way: Instead of applying a baseline correction, the data were processed offline with a 0.3–20.0 Hz band-pass filter to avoid slow signal drifts (Maess et al., 2016). Average ERPs were calculated per condition, participant and electrode from the stimulus onset up to 1500 ms and then subjected to automatic (rejection criterion of EOG: >40 µV) and manual rejections. At the determiner position, 6.65 % of the trials for Der and 7.50 % of the trials for Den had to be excluded due to artifacts. Also due to artifacts, at the noun position, 6.02 % of the trials for the DerNer condition, 6.25 % of the trials for the DerNin condition, 7.50 % of the trials for the DenNer condition and 6.93 % of the trials for the DenNern condition had to be excluded.

The time windows for the statistical analyses of the ERP data were predefined by visual inspection: 350–450 ms and 550–700 ms for both the determiner and the noun positions. Using R and the *ez*-package (Lawrence, 2016), repeated-measures analyses of variance (henceforth ANOVA(s)) of the ERP data were calculated for the mean amplitude of the determiner position with the factor CONDITION (COND) (Der, Den) and the factor REGION OF INTEREST (ROI); data were collapsed over the two conditions with the respective determiner since they were identical up to the point of the determiner. ANOVAs at the noun position were analyzed with the factor COND (DerNer, DerNin, DenNer, DenNern) and ROI. ROI was computed separately for lateral and midline channels. Lateral electrode sites included the electrodes F7, F3, FC5, FC1 and T7 for the left anterior ROI, the electrodes F8, F4, FC6, FC2 and T8 for the right anterior ROI, the electrodes C3, P7, P3, CP5, CP1 for left posterior ROI and C4, P8, P4, CP6 and CP2 electrodes for the right posterior ROI. The midline channel included the following electrodes: anterior = Fz, FCz; central = Cz, CPz; posterior = Pz, POz. All trials of the grammaticality judgment entered the analysis. P-values for all effects with more than one degree of freedom were corrected by Huynh-Feldt correction (Huynh and Feldt, 1970). Furthermore, all noun effects of multiple pairwise comparisons were corrected to $p < 0.03$ by the Bonferroni-Keppel procedure (Keppel and Wickens, 1973). The significance level of determiners remained uncorrected at $p < 0.05$.

7.5 Results

Figure 7.1 illustrates the contrast between the determiner positions Der and Den time-locked to their onset. The ERPs at the determiner position revealed a negativity at around 400 ms for Den in comparison to Der. The expected subsequent positivity for Den did not emerge.

With regard to the noun position, Figure 7.2 shows the ERPs relative to noun onset. It demonstrates, as predicted, a graded negativity, albeit with a broader topographical distribution: The condition DerNin showed the largest amplitude, followed by DenNern and DerNer. Curiously, the noun of the DenNer condition also elicited a negativity at around 400 ms after stimulus onset in comparison to the condition DerNer. Regarding the positivity, the conditions DerNin and DenNern showed a more pronounced positivity at around 600 ms compared to DerNer, while DenNer compared to DerNer showed no difference.

In the following, the statistical analyses are presented separately for the positions of the determiner and the noun as well as the two relevant time windows.

7.5.1 Determiner position

350–450 ms latency window Lateral hemisphere sites showed a significant effect of COND ($F(1,21) = 6.61$, $p < 0.05$) and no interaction of COND and ROI ($F(3,63) = 0.75$, $p = 0.48$). Turning to the midline sites, ERPs showed a significant effect for COND ($F(1,21) = 8.11$, $p < 0.01$) and a significant interaction of COND and ROI ($F(2,42) = 5.92$, $p < 0.01$). Resolving this interaction by ROI revealed the most pronounced main effects for anterior electrodes (anterior: $F(1,21) = 12.07$, $p < 0.003$; central: $F(1,21) = 6.03$, $p < 0.05$; posterior: $F(1,21) = 4.84$, $p < 0.05$).

Lateral and midline electrode sites support the hypothesis independent of an SP_{NOM} insofar as a negatively deflected effect around 400 ms occurred for Den in comparison to Der. Both predictions for the determiner position in Sections 7.3.1.1 and 7.3.2.1 assumed an effect for Den.

550–700 ms latency window The analysis of the lateral electrode sites showed neither a significant effect of COND ($F(1,21) = 3.68$, $p > 0.06$) nor an interaction of COND and ROI ($F(3,63) = 0.43$, $p > 0.6$). With regard to the midline electrodes, analyses revealed neither a significant effect of COND ($F(1,21) = 1.00$, $p > 0.3$) nor an interaction of COND and ROI ($F(2,42) = 0.12$, $p > 0.7$).

Taking lateral and midline sites together, the absence of a late positively deflected ERP effect for Den suggests the hypothesis from Section 7.3.1.1 to be confirmed which assumed that a prior SP_{NOM} can be rejected, as a P600 should have occurred in this case. Therefore, the results are compatible with the hypothesis from Section 7.3.2.1 that the SP_{NOM} is not postulated by default.

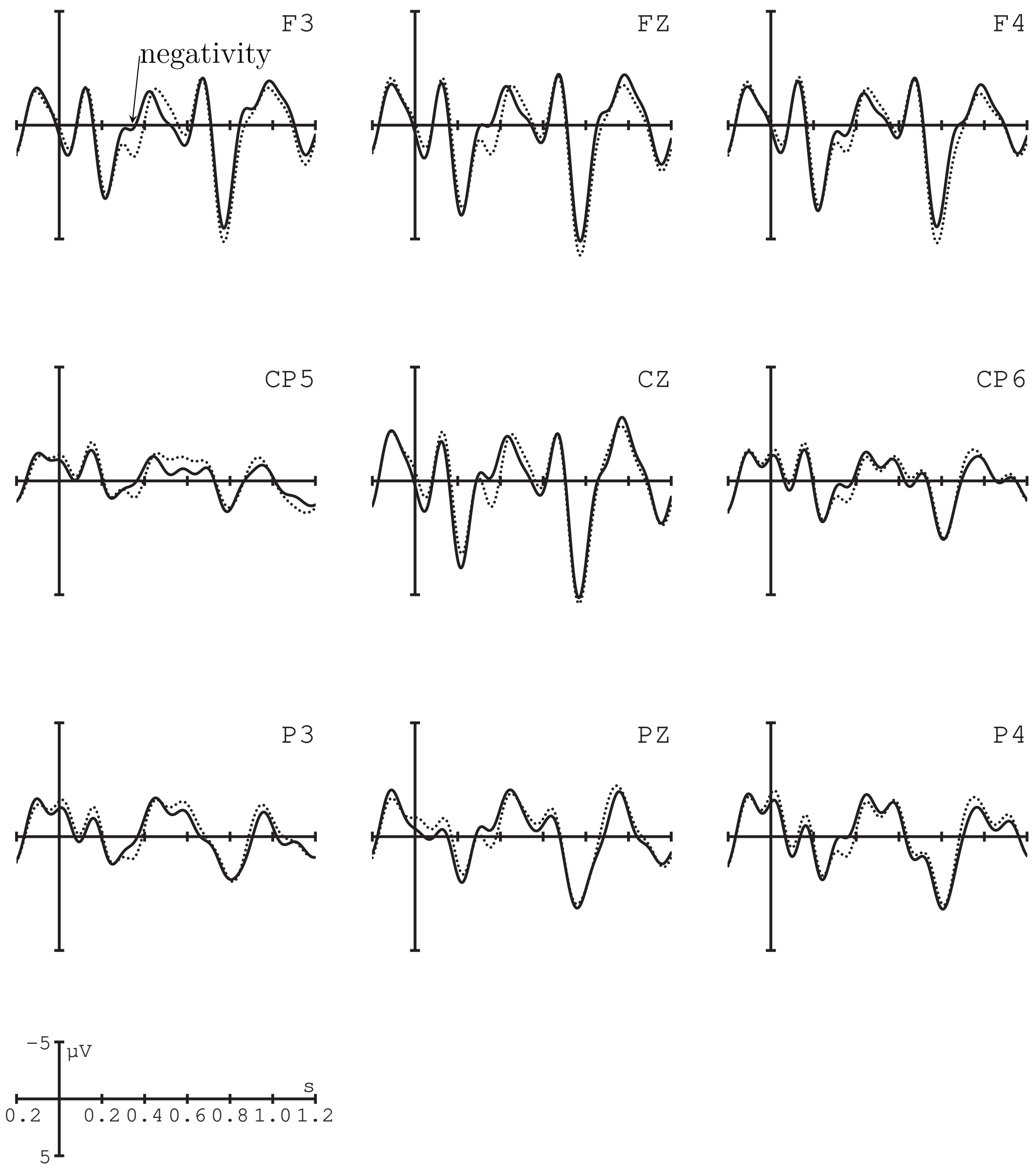


Figure 7.1: ERP effects (n=22) observed at the determiner position for Der (⋯⋯) and Den (——). The time window spans from 200 ms before determineronset to 1200 ms after (onset at vertical bar). Negativity is plotted upwards.

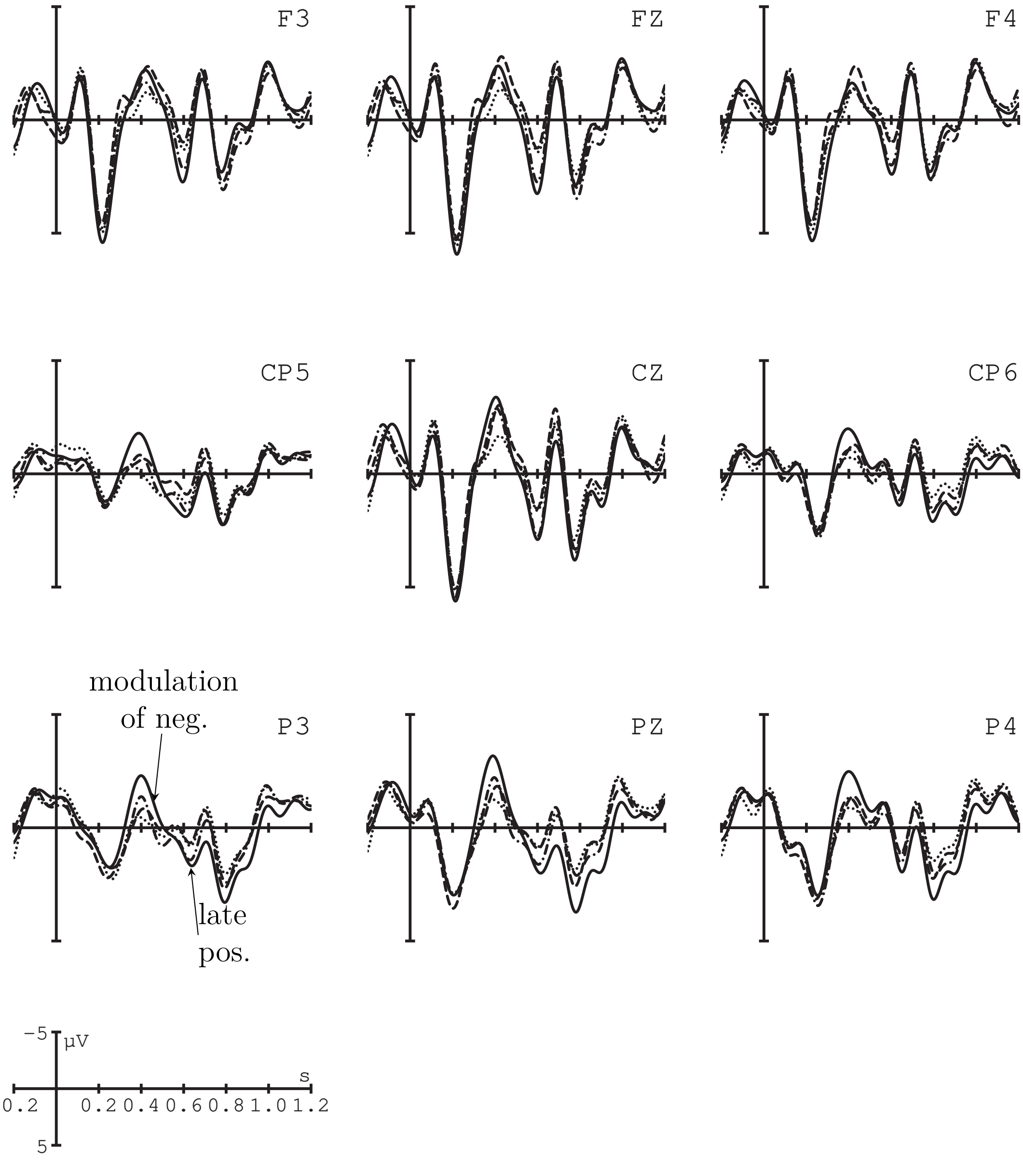


Figure 7.2: ERP effects (n=22) observed at the noun position for $_{\text{Der}}$Ner (⋯⋯), $_{\text{Der}}$Nin (——), $_{\text{Den}}$Ner (------) and $_{\text{Den}}$Nern (-·-·-·-). The time window spans from 200 ms before noun onset to 1200 ms after (onset at vertical bar). Negativity is plotted upwards.

7.5.2 Noun position

350–450 ms latency window The main analysis for lateral hemisphere sites showed a highly significant effect for COND ($F(3,63) = 8.32$, $p < 0.001$) and also a highly significant interaction of COND and ROI ($F(9,189) = 4.14$, $p < 0.001$). Resolving this interaction for ROI revealed the most pronounced effects for posterior electrode sites (left anterior $F(3,63) = 4.81$, $p < 0.01$; right anterior $F(3,63) = 2.19$, $p > 0.09$; left posterior $F(3,63) = 13.06$, $p < 0.001$; right posterior $F(3,63) = 9.34$, $p < 0.001$). Pairwise comparisons for lateral electrode sites are displayed in Table 7.1.

Table 7.1: Noun effects of ANOVAs for lateral sites of the 350–450 ms latency window.

comparison	effect	df	left ant.	right ant.	left post.	right post.
			F	*F*	*F*	*F*
DerNer vs. DerNin	COND	1,21	17.30***	–	45.75***	33.11***
DerNer vs. DenNer	COND	1,21	6.10*	–	5.98*	3.07 n.s.
DerNer vs. DenNern	COND	1,21	1.92 n.s.	–	9.67**	2.13 n.s.
DerNin vs. DenNern	COND	1,21	3.53(*)	–	8.24**	11.52**
DenNer vs. DenNern	COND	1,21	1.75 n.s.	–	0.30 n.s.	0.04 n.s.

Concerning midline sites, analyses revealed both a highly significant effect for COND ($F(3,63) = 9.48$, $p < 0.001$) and a significant interaction of COND and ROI ($F(6,126) = 5.20$, $p < 0.01$). Resolving this interaction by ROI revealed the most pronounced main effects for central sites while the anterior and posterior regions were also significant (anterior: $F(3,63) = 6.47$, $p < 0.001$; central: $F(3,63) = 9.81$, $p < 0.001$; posterior: $F(3,63) = 9.97$, $p < 0.001$). Pairwise comparisons for midline electrode sites are displayed in Table 7.2.

Table 7.2: Noun effects of ANOVAs for midline sites of the 350–450 ms latency window.

comparison	effect	df	ant.	cent.	post.
			F	*F*	*F*
DerNer vs. DerNin	COND	1,21	18.04***	33.46***.	26.68***
DerNer vs. DenNer	COND	1,21	13.37**	8.96**	0.48 n.s.
DerNer vs. DenNern	COND	1,21	6.36*	10.57*	2.92 n.s.
DerNin vs. DenNern	COND	1,21	1.37 n.s.	4.04(*)	10.02**
DenNer vs. DenNern	COND	1,21	1.81 n.s.	0.04 n.s.	1.18 n.s.

Since the preceding determiner position set the stage for an absent SP_{NOM}, the results of the noun position will thus only be checked against the SP_{NOM}-free hypothesis in Section 7.3.2.2. Summarizing lateral and midline sites, the data suggests that the most pronounced negatively deflected ERP effect occurred for DerNin and not as predicted for DenNern in comparison to DerNer. Furthermore, as hypothesized, DenNer elicited a negativity compared to DerNer. Thus, the reversed gradation of DerNin and DenNern has to be discussed below.

550–700 ms latency window The main analysis for lateral hemisphere sites showed a significant effect for COND ($F(3,63) = 6.32$, $p < 0.001$) but no significant interaction of COND and ROI ($F(9,189) = 0.27$, $p > 0.2$). Pairwise comparisons for lateral electrode sites are displayed in Table 7.3.

Table 7.3: Noun effects of ANOVAs for lateral sites of the 550–700 ms latency window.

comparison	effect	df	*F*
DerNer vs. DerNin	COND	1,21	6.89*
DerNer vs. DenNer	COND	1,21	0.23 n.s.
DerNer vs. DenNern	COND	1,21	9.4**
DerNin vs. DenNern	COND	1,21	1.85 n.s.
DenNer vs. DenNern	COND	1,21	14.62***

Respecting midline sites, analyses revealed a highly significant effect for COND ($F(3,63) = 9.22$, $p < 0.001$) but no significant interaction of COND and ROI ($F(6,126) = 1.36$, $p > 0.2$). Pairwise comparisons for midline electrode sites are displayed in Table 7.4.

Table 7.4: Noun effects of ANOVAs for midline sites of the 550–700 ms latency window.

comparison	effect	df	*F*
DerNer vs. DerNin	COND	1,21	10.77*
DerNer vs. DenNer	COND	1,21	0.40 n.s.
DerNer vs. DenNern	COND	1,21	12.22
DerNin vs. DenNern	COND	1,21	1.59 n.s.
DenNer vs. DenNern	COND	1,21	17.12***

Considering lateral and midline electrode sites under the assumption that an SP_{NOM} is not postulated by default, Section 7.3.2.2 generally predicted no occurrence of a late positive-going effect. However, it was hypothesized that both DerNin and DenNern carried features which may be categorically incompatible with the filter specification, thus eliciting a syntactic revision which would trigger a P600. The data suggest that this is the case as a late positivity occurred for DerNin and DenNern compared to DerNer. Also as predicted, a late positivity failed to appear for DenNer.

7.6 Discussion

In Experiment 1, DPs consisting of determiner and subsequent noun were visually presented word-by-word while electrophysiological data was recorded. The ERP results will allow to decide on which way the subsequent DP positions are processed and how different underspecification approaches and the presence or absence of an SP$_{\text{NOM}}$ influence the course of processing.

For the determiner position, a globally distributed negativity could be observed in the 350–450 ms latency window for conditions with Den in comparison to Der. However, a late positivity did not emerge for the former. At the subsequent noun position, graded negative-going ERP effects were obtained in the 350–450 ms time window that were also distributed rather globally. Nouns of ${}_{\text{Der}}$Nin produced the most pronounced effect in comparison to the ${}_{\text{Der}}$Ner position. Across all conditions, the gradation of ${}_{\text{Der}}$Ner < ${}_{\text{Den}}$Ner < ${}_{\text{Den}}$Nern < ${}_{\text{Der}}$Nin was found for the early negative effects. Turning to the 550 to 700 ms latency window, the noun position revealed positively deflected effects for ${}_{\text{Der}}$Nin and ${}_{\text{Den}}$Nern in comparison to ${}_{\text{Der}}$Ner.

In Section 7.2.2, it was explained why and how TMP's calculatory work with regard to *simplicity* or *complexity* due to lower or higher feature deviance was mapped onto expected morphosyntax-related ERP effects. Against this background, the following sections will explain the recorded ERP data for the determiner and the noun positions. It shall be addressed in which way one of the *der* alternatives in Der and one of *den* for Den was integrated. Crucially though, it will be discussed why exactly one of the alternatives is chosen and what the subsequent nouns in ${}_{\text{Der}}$Ner, ${}_{\text{Der}}$Nin, ${}_{\text{Den}}$Ner and ${}_{\text{Den}}$Nern reveal about the prior determiner.

7.6.1 Determiner position

The early ERP effect recorded for the determiner Den in comparison to Der revealed a more globally distributed negativity instead of the predicted LAN. As discussed in Sections 7.1.1 and 7.2.2, this particular effect was predicted since it has been shown to be sensitive to morphosyntactic violations. For the following reasons, the obtained effect shall not be interpreted as a LAN. Apart from the effect's topography, its deflection has to be discussed. The detected difference between Der and Den could be viewed as a P300 for the former relative to the latter. In Section 7.1.2, it was indicated, that this early positive-going ERP component can be measured in so-called oddball paradigms rendering the response as task-related. Across all experimental sentences, Der items were the only ones that appeared in a subject-before-object order where the initial DP realized a subject in nominative case. It could be feasible that this infrequent stimulus was expected along the more frequent object-before-subject ones. In this regard, 50 percent of the Der trials—structures with *der*$_{\text{NOM.M.SG}}$ to be precise—qualify for the detection of predictable stimuli. Admittedly, the P300 as an indicator of probability is by no means settled (Luck, 2014, p. 97). Thus, the effect for Der could also mirror the positive detection of the expected and probable top-ranked candidate *der*$_{\text{NOM.M.SG}}$, while the effect fails to appear for Den. This is in line with TMP's prediction across underspecification frameworks and irrespective of an SP$_{\text{NOM}}$ as Den would not be expected and probable since both *den*$_{\text{ACC.M.SG}}$ and *den*$_{\text{DAT.PL}}$ violate the SP$_{\text{NOM}}$ by contributing incompatible features. Furthermore, the P300 could be interpreted in line with Leminen and Clahsen (2014) from Section 2.5. Along their reasoning, Den would elicit an attenuated P300 response in comparison to a more pronounced Der. Thus, the effect for Der would mirror a processing facilitation compared to the more difficult Den that engendered a more pronounced P300. This justification could be attributed to *den*$_{\text{ACC.M.SG}}$'s lower rank.

On the other hand, Rösler et al. (1998, p. 162) reported a determiner contrast of *der* versus *den* (and *dem*) similar to the one detected in Experiment 1. The ERP response they obtained for the determiner *der* also showed a positive shift in comparison to *den* and *dem*.[30] They interpreted this as a negativity for the non-canonical *den* and *dem* in comparison to *der*. For these reasons, the ERP result that was obtained in the current investigation shall still be interpreted as a negativity for Den and not as a positivity for Der. While the effect was ruled out to be a LAN, it could be considered to be an N400. However, this effect exhibits a fronto-central or centro-parietal distribution while the obtained effect is globally distributed. Thus, the negative-going difference for Den in comparison to Der will be more cautiously interpreted as a rather topography-independent and more general negativity (NEG) from heron. This effect would not weaken the hypotheses for the determiner position: As it was mentioned in Section 7.1.1, several negative-going effects like the LAN and N400 could be viewed as representatives of a family of ERP components that are indicators of a more general cognitive principle, namely the violation of expectancy. Hence, this NEG will be added to this account. Turning to morphosyntax, O13's LAN results could thus be interpreted as reflecting a violation of expected morphosyntactic compatibility and specificity between two elements. Similarly, at the determiner position, the detected NEG for Den in comparison to Der can be attributed to the violation of expected features. This suggests that the natural language processing system integrates one of the determiners *der* in Der easier than one of the determiners *den* in Den. This modulation is mirrored by the determiner gradations irrespective of all underspecification approaches and with and without an SP$_{\text{NOM}}$ in (37) and (41) respectively. So far, this suggests that the experimental data supports TMP's claims: Across all underspecification approaches and independent of an SP$_{\text{NOM}}$, the determiner rankings in Tables 5.4 and 5.7 showed that *der* alternatives outranked *den* alternatives. Thus, apart from the deviant ERP effect, the hypotheses in (37) and (41) can be considered to be confirmed: TMP predicted more *complex* calculatory work for Den due to a higher feature deviance compared to Der's lower feature deviance. This was reflected by a more pronounced NEG effect for Den which suggests that structures with a DP-initial *den* determiner were morphosyntactically harder to process compared to *der*-initial DPs.

However, reconsider the former hypotheses in (37) that argued for a precursory SP$_{\text{NOM}}$ filter specification. The hypothesis in (37) was based on a preceding SP$_{\text{NOM}}$ that provided [−OBJ, −OBL]. In that case, Den introduced a [+OBJ] feature that would oppose the SP$_{\text{NOM}}$ specification, while Der would not provide such a conflicting feature. Taking the later ERP time window into account, this scenario should have elicited a late positively deflected ERP component. Since this effect should have occurred due to an incompatibility-induced reanalysis, it should be considered reflecting a P600. However,

[30] See Figure 3 in Rösler et al. (1998, p. 162).

as it turned out, the data did not reveal an effect at all for Den versus Der. This was predicted by the hypothesis in (41). In contrast to (37), the hypothesis in (41) neglected the prior SP$_{\text{NOM}}$. Correspondingly, Den's [+OBJ] cannot oppose any preceding features since there are none. As a result, both Der and Den would not reveal a P600. Therefore, the P600 data allows to discard the approach-independent hypothesis with an SP$_{\text{NOM}}$ in (37) while it corroborates the predictions without a prevalent SP$_{\text{NOM}}$ in (41). Summarizing these considerations yields the gradation in (47) which argues for an absent SP$_{\text{NOM}}$ and no difference with regard to the underspecification approaches. This is a first step to answer Question 3 on how the presence or absence of an assumed precursory SP$_{\text{NOM}}$ filter specification influenced the processing. The SP$_{\text{NOM}}$-related hypothesis of (37) can now be refused.

(47) Approach-independent hypotheses with no SP$_{\text{NOM}}$:
LAN: Der < Den
P600: Der = Den

ERP result:
NEG: Der < Den
P600: Der = Den

However, the data still does not allow to discern different underspecification approaches. It is also inconclusive with regard to an integration preference of the syncretic determiners: While TMP's claims in (27) and (29) contained minute gradations for different underspecification approaches and depending on a present or absent SP$_{\text{NOM}}$ for both *der* and *den* alternatives, the determiner data does not allow to disentangle *der*$_{\text{NOM.M.SG}}$ from *der*$_{\text{DAT.F.SG}}$ in Der and *den*$_{\text{ACC.M.SG}}$ from *den*$_{\text{DAT.PL}}$ in Den conditions. Recall from TMP's claims in (29) that both of Blevins' accounts predicted an integration of *der*$_{\text{DAT.F.SG}}$ and *den*$_{\text{DAT.PL}}$ over *der*$_{\text{NOM.M.SG}}$ and *den*$_{\text{ACC.M.SG}}$ for which, in contrast, Bierwisch, Wunderlich and Wiese claimed an easier integration. As yet, it can only be argued for an integration advantage of Der over Den without a preceding SP$_{\text{NOM}}$. For these reasons, Questions 1 and 2 have to remain undiscussed.

7.6.2 Noun position

In parallel to the determiner position, neither $_{\text{Der}}$Nin, $_{\text{Den}}$Ner nor $_{\text{Den}}$Nern elicited a left anterior negativity relative to $_{\text{Der}}$Ner. Thus, no LAN can be reported for these conditions. However, as it was the case with the preceding determiner, a more globally distributed NEG was detected for these conditions. In light of these findings, instead of the expected LAN, the measured NEG will again be interpreted as an expectancy violation related to morphosyntactic processing.

In order to tackle TMP's further claim of an integration of *der*$_{\text{NOM.M.SG}}$ over *der*$_{\text{DAT.F.SG}}$ in Der and of *den*$_{\text{ACC.M.SG}}$ over *den*$_{\text{DAT.PL}}$ in Den, the ERP effects of the subsequent noun position for both conditions have to be considered. Tables 7.1 and 7.2 showed that $_{\text{Der}}$Nin significantly differed from $_{\text{Der}}$Ner. As displayed in Figure 7.2, the former produced a more pronounced NEG than the latter. $_{\text{Den}}$Ner also produced a more pronounced NEG than DerNer. The difference between DerNer and DenNern was marginally significant. Furthermore, DerNin produced a significantly more pronounced NEG than DenNern. Dissecting this gradation shows that the transition from Der to DerNin was harder than from Der to DerNer. Similarly, after Den, DenNern was harder to integrate than DenNer. These binary clines are generally reflected by the hypotheses for a present SP_{NOM}. Irrespective of underspecification approach, it was always predicted that DerNer was easier than DerNin and that DenNern was easier than DenNer. However, the gradations' orders differed with respect to all four noun conditions resulting in four-way gradations that cannot be mapped onto any of the SP_{NOM}-related predictions. Thus, following the insights from the determiner position by neglecting SP_{NOM}-related hypotheses, turns out to be more revealing: The results in (48) almost exactly mirror Bierwisch's and Wunderlich's hypotheses in (43) for a lacking SP_{NOM}. Consequently, the data answers Question 2 on which of the underspecification approaches is more explanatorily adequate: Blevins' original and maximally underspecified as well as Wiese's approaches can be rejected. In addition to that, the observed NEG effects for the noun position concerned the remaining undiscussed Question 1. The observed NEG gradation suggests that a difference in featural transition from the determiner to the noun is mirrored by varyingly pronounced ERP effects. Recall from TMP's claims that the transitional *simplicity* or *complexity* hinged on the violation of the constraints. The appropriate overview of the noun rankings showed that the featural transition from Der to DerNer was indeed claimed to be easier than from Den to DenNer. However, the measured transition from Der to DerNin that was most effortful compared to other conditions was unexpected and not covered by any of TMP's original claims.

(48) Bierwisch's and Wunderlich's hypotheses with no SP_{NOM}:
LAN: DerNer < DenNer < DerNin < DenNern

ERP result:
NEG: DerNer < DenNer < DenNern < DerNin

With regard to the reversed order of DerNin and DenNern, it could be argued that the occurrence of a more pronounced NEG for DerNin was due to a stronger compatibility mismatch of the filter specifications [+M] and the noun's [+F] in comparison to DenNern's clash of [+PL] with gender features. Recall that it was predicted that DenNern would produce a more pronounced NEG than DerNin since the former was lower ranked due to its three non-retrievable features yielding a more *complex* calculation. This assumption would result in the claim that a violation of gender features is more severe than a number violation.[31] Feature hierarchies like that have been suggested by e.g. Lumsden (1987, 1992) and Noyer (1992) but also by Wiese's approach as introduced in Section 1.2.4. However, implementing the resolution of feature hierarchies would complicate TMP significantly. An additional mechanism would have to be assumed. That, in turn, would result in an additional feature checking constraint along incompatibility, non-retrievability and retrievability. While these original constraints

[31] Note that both DerNin and DenNern did not differ in the subsequent P600 effect, as both required a reanalysis of the preceding determiner.

are basically related to the presence of features, introducing hierarchy as another constraint would alter their ordering in no transparent way. Sections 10.2.2.1 and 10.2.3 will revisit this topic.

Apart from the NEG, the late positivity has to be considered too. Since the argument of a non-present SP_{NOM} is followed due to the preceding determiner integration, no occurrences of a P600 were predicted according to Section 7.3.2.2 since there were no incompatibilities. As can be seen in Tables 7.3 and 7.4, late positively deflected ERP effects were detected for DerNin and DenNern compared to DerNer. The results, therefore, match the predictions given that for both DerNin and DenNern the incompatibility route is taken and reanalysis entailed. Thus, the obtained effect can be considered to be a P600.

(49) Bierwisch's and Wunderlich's hypotheses with no SP_{NOM}:
P600: DerNer = DenNer < DerNin = DenNern

ERP result:
P600: DerNer = DenNer < DenNern = DerNin

Recall from the ranked candidates of *der* and *den* for a lacking SP_{NOM} in Tables 5.8 and 5.9 respectively that none of the nouns carried features that opposed the filter specification. However, it was assumed that DerNin's [+F] categorically opposed the filter specification's [+M] and that DenNern's [+PL] categorically opposed the filter specification's gender features. This reasoning traces back to Bierwisch's and Blevins' argument of prohibiting both any [+M, +F] combination as well as any plural with gender specification. Thus, the input of [+F] or [+PL] can be viewed as introducing opposing features that can trigger incompatibility which would entail reanalysis. To further strengthen this argument, consider a prior filter specification of the dismissed determiner alternatives. These scenarios would assume an integration of *der*$_{DAT.F.SG}$ instead of *der*$_{NOM.M.SG}$ and of *den*$_{DAT.PL}$ instead of *den*$_{ACC.M.SG}$. For the first *what-if scenario*, recall from Table 5.7 that, for Bierwisch, *der*$_{DAT.F.SG}$ would not carry a [+M] feature. Thus, the filter specification would not contain this feature before DerNin would enter. Accordingly, DerNin would not introduce any incompatible feature. Similarly, in the second *what-if scenario*, *den*$_{DAT.PL}$ would not carry any gender specification. Instead, it featured [+OBJ, +OBL, +PL]. In case of a subsequently incoming DenNern, the filter specification would be mirrored exactly on the input, resulting in total feature identity. This reasoning holds true for Wunderlich's features too. Thus, if the dismissed determiners were previously integrated, the subsequent nouns would not have introduced incompatibility. Therefore, no P600 would occur. Hence, the actual occurrence of a P600 effect for DerNin and DenNern suggests that Der was integrated as *der*$_{NOM.M.SG}$ and Den as *den*$_{ACC.M.SG}$ and that TMP's claims for other underspecification approaches can be disregarded.

On a second note, reconsider the SP_{NOM}-related hypotheses for the determiner and noun positions. According to (39), DenNer should have been the easiest to integrate across all approaches. Furthermore, DerNin for Bierwisch, Wunderlich, Wiese and Blevins' original on the one hand and DenNern for Blevins' maximally underspecified approach on the other hand should have been the hardest to integrate. This is crucial since, while TMP makes perfect predictions for some underspecification approaches, with other accounts, their claims are far from grammatical. Crucially, $_{\text{Der}}$Ner which turned out to be the easiest was ranked second or third depending on the underspecification approach. Thus, only the hypothesis that acted on the assumption of a lacking SP$_{\text{NOM}}$ can account for the obtained ERP results. Since the hypotheses were directly derived from TMP's claims, those that assumed a preceding SP$_{\text{NOM}}$ can equally be rejected.

On a final note, recall that all of the hypotheses are based on the *comparison* of TMP's individual position-dependent claims. While the comparative differences between individual integration may be different, it is crucial that TMP—as summarized in the comparative noun ranking in Table 5.13—still correctly and grammatically predicts *Bäcker*$_{\text{NOM.M.SG}}$ after *der*$_{\text{NOM.M.SG}}$ with which the system realizes the targeted NOM.M.SG context. Consequently, the mechanism disprefers *Kundin*$_{\text{DAT.F.SG}}$ after *der*$_{\text{NOM.M.SG}}$. With the input of this noun, it cannot build up a nominative context as it was the case with *Bäckern*$_{\text{NOM.M.SG}}$. In turn, it has to reanalyze the determiner in favor of the previously disregarded and lower ranked *der*$_{\text{DAT.F.SG}}$—hence the P600 on $_{\text{Der}}$Nin—in order to end up with the desired DAT.F.SG context. In a similar fashion, it can be upheld that TMP also correctly predicts *Bäcker*$_{\text{ACC.M.SG}}$ after *den*$_{\text{ACC.M.SG}}$ to eventually form the targeted ACC.M.SG DP. Therefore, the system disprefers *Bäckern*$_{\text{DAT.PL}}$. However, after its actual input, *den*$_{\text{ACC.M.SG}}$ has to be reanalyzed in favor of the originally dispreferred and lower ranked *den*$_{\text{DAT.PL}}$ alternative with which TMP can finally realize the targeted DAT.PL context which was reflected by the P600 on this very noun. While these analyses are compatible for both SP$_{\text{NOM}}$-related and SP$_{\text{NOM}}$-unrelated predictions, due to the determiner results that solely favor an absent SP$_{\text{NOM}}$, these claims can only be maintained for the likewise SP$_{\text{NOM}}$-free Bierwisch and Wunderlich approaches.

To summarize the noun position, it can be argued that TMP's predicted four-way cline of nouns was reflected by the obtained data. Along the hypothesized scale, TMP calculated a low featural deviance for $_{\text{Der}}$Ner and no overlap with $_{\text{Der}}$Nin. This resulted in a *simple* calculation for the former and a rather *complex* one for the latter. The other two nouns resided between these ends. The observed NEG modulation was in line with an adjusted noun gradation insofar as featurally highly deviant nouns elicited a more pronounced NEG than those that shared a common denominator with a previous integration. Overall, TMP correctly predicted higher processing load for more *complex* parsing calculations.

7.7 Interim Conclusion

To summarize both the determiner and the noun integration, since a P600 was actually elicited for $_{\text{Der}}$Nin and $_{\text{Den}}$Nern, it can be deduced that, at Der, the determiner was analyzed as *der*$_{\text{NOM.M.SG}}$ and not as *der*$_{\text{DAT.F.SG}}$. Furthermore, it can be inferred that, at Der, the determiner *den*$_{\text{ACC.M.SG}}$ was integrated instead of *den*$_{\text{DAT.PL}}$. Since *der*$_{\text{DAT.F.SG}}$ ranked higher than *den*$_{\text{ACC.M.SG}}$, the corresponding NEG associated with Synchronization was more pronounced for the former in comparison to the latter. The absence of a P600 at the determiner position leads to the conclusion that an SP$_{\text{NOM}}$ has not to be postulated as part of the filter specification. Following Der as $der_{\text{NOM.M.SG}}$, ${}_{\text{Der}}$Ner was predicted and effortlessly integrated. Depending on Der's $der_{\text{NOM.M.SG}}$ and Den's $den_{\text{ACC.M.SG}}$, ${}_{\text{Der}}$Nin, ${}_{\text{Den}}$Ner and ${}_{\text{Den}}$Nern occupy lower ranks than ${}_{\text{Der}}$Ner. However, the predictions of (48) were not met insofar as the ERP results suggest a reversed order of ${}_{\text{Der}}$Nin and ${}_{\text{Den}}$Nern. While a possible solution to this may be the introduction of feature hierarchies, a straightforward implementation into TMP is not apparent. The General Discussion will revisit this issue explicitly.

Answering Question 1, namely how the parses differ between elements of the subject-object ambiguities, the entirety of the obtained results suggests that a difference in featural transition from one word to another is mirrored by varyingly pronounced ERP effects for the resolution of the subject-object ambiguities. This conclusion is consistent with the predictions made from Bierwisch's and Wunderlich's features. This touches upon Question 2 on which of the underspecification approaches is explanatorily more adequate. Blevins' original and maximally underspecified and Wunderlich's approaches resulted in claims that would predict determiners and subsequent nouns which would not match the target structures. Concerning Question 3—the contribution of a present or absent SP_{NOM}—, all observations were compatible with hypotheses derived from TMP's SP_{NOM}-free claims only. For these reasons, further explorations with the attention on an absent SP_{NOM} will be confined to Bierwisch's and Wunderlich's approaches.

The present results lead to the conclusion that Experiment 1 provided the first evidence for the language processing system to pick up and use underspecified morphosyntactic information in the way predicted by TMP. While other accounts on the processing of ambiguous DP make similar claims, the present approach not only shows that any determiner is preferably predicted over the other but—crucially—also explains why one syncretic ambiguous determiner is predicted over another equally syncretic and ambiguous alternative. In case TMP encountered a featurally deviant specification that has little to nothing in common with a filter specification of a preceding analysis, the system predicted a more *complex* calculation. Conversely, a feature overlap yielded a rather *simple* calculation. Both scenarios were reflected by the obtained ERP results, suggesting higher processing load for *complex* calculations or deviant specifications and lower processing effort for *simpler* calculations due to encountering feature identity. Thus, it can be concluded that the supposed mapping of TMP's expenditure onto expected morphosyntax-related ERP effects in (50) is reasonable.

(50)		low	to	high feature deviance
		simple	to	*complex* calculatory work
	TMP:	$candidate_1$	<	$candidate_2$
		less	to	more processing effort
	NEG:	attenuated	<	pronounced

This reasoning entirely disregards abstract syntactic structures or hierarchies like they were entertained in Chapter 3 but rather makes use of the most low-level, incremental way conceivable.

8 Experiment 2: Processing of Grammatical Three-Element DPs

8.1 Introduction: More Points to Measure

Under the assumption of an absent SP_{NOM} filter specification, the first experiment revealed that Bierwisch's and Wunderlich's feature sets seemed to be more explanatorily adequate than both of Blevins' approaches or Wiese's framework. ERP data showed that using Bierwisch's and Wunderlich's specifications, TMP was able to predict correct DPs and approximated their processing difficulties. Blevins' original and maximally underspecified feature sets as well as Wiese's framework on the other hand entailed predictions that led not only to ungrammatical predictions, but were neither supported by the experimental data. Even though, the Questions 2 and 3 can be considered as set, Experiment 2 seeks to replicate the first experiment's results that favored Bierwisch's and Wunderlich's approaches and a lacking SP_{NOM}.

Question 1 on how the featural transition is shaped and whether the calculatory work between the contact points is represented by varying ERP data has to be further investigated. With the first experiment, important steps were made in order to come to the next level of examination. There is one measure that immediately allows to put TMP under further stress which is by elongating the structures under investigation. This will enable an additional measuring point in subsequent ERP experiments as well as allow for more feature comparisons over the course of the analysis. Adding a third position multiplies the eventual outcomes at the DP-final noun position. As will be detailed below, this gives a lot of room for false predictions. In order to keep the variables rather constant across experiments, the same DPs from the prior investigation shall be used. Even though there are several conceivable ways to prolong the first DP e.g. with a relative clause, for reasons of simplicity, the more intuitive way of expanding it is by an intermediate weak adjective. In German, a weak adjective inflects as depicted in Table 8.1.

Mirroring the previous investigation, the present and following sections will deal with the Parsing Prerequisites I to III. This means that Parsing Prerequisite I, that is the lexical material and Parsing Prerequisite II—the lexical material's features—have to be adjusted and compiled. The weak adjective from Table 8.1 resides between the strong preceding determiner and the DP-final noun, yielding the new and prolonged DPs in (51). The additional position will inevitably alter TMP's claims. While (25) and (33) respectively offered two positions where *something* morphosyntax-related could happen, (51) provides three subsequent elements that TMP has to take into consideration. Fig-

Table 8.1: Inflectional paradigm of the German weak adjective *klein* (“small”).

	SG			PL
	M	N	F	
NOM	*kleine*	*kleine*	*kleine*	*kleinen*
ACC	*kleinen*	*kleine*	*kleine*	*kleinen*
DAT	*kleinen*	*kleinen*	*kleinen*	*kleinen*
GEN	*kleinen*	*kleinen*	*kleinen*	*kleinen*

ure 8.1 visualizes the syncretic and ambiguous nature of (51)’s structures as well as their eventually disambiguating DP-final noun positions. The sequences of determiner, adjective and noun satisfy the aforementioned Parsing Prerequisite I with regard to the appropriate lexical material. The subsequent section will address Parsing Prerequisite II. Regarding Parsing Prerequisite III, the mechanism TMP will be maintained for obvious reasons.

(51) a. der kleine Bäcker
the.NOM.M, DAT.F small.NOM.M, NOM/ACC.N/F baker.NOM.M

b. der kleinen Kundin
the.NOM.M, DAT.F small.ACC.M, DAT, GEN, PL customer.DAT.F

c. den kleinen Bäcker
the.ACC.M, DAT.PL small.ACC.M, DAT, GEN, PL baker.ACC.M

d. den kleinen Bäckern
the.ACC.M, DAT.PL small.ACC.M, DAT, GEN, PL bakers.DAT.PL

8.1.1 Feature preparations

In order to comply with Parsing Prerequisite II and since the strong determiners and the nouns are identical to the ones used in Section 5.1, the present section will only be concerned with collecting features for the weak adjective. Since it turned out that Bierwisch’s and Wunderlich’s approaches are so similar in their ways to predict and integrate lexical elements, and since only these two of the four original frameworks provided empirically adequate specifications for TMP to make predictions, the remaining models by Blevins and Wiese will be neglected in the compilation of underspecified adjective features and only Bierwisch-related features will be compiled.

Since Bierwisch (1967, pp. 259–260) already formulated two rules to capture the German weak adjective, no new underspecified inventory has to be derived. Both rules are summarized in Table 8.2. Note that, just like his determiner inventory in Tables 1.6 and 5.2, Bierwisch’s adjective specifications also partially comprise disjunctions. In his inventory, *kleine* serves as the featureless elsewhere marker, while *kleinen* is the more specific alternative that disjunctively spans across four syntactic contexts of which two form a natural class: dative and genitive. Since these two are distinct from the other

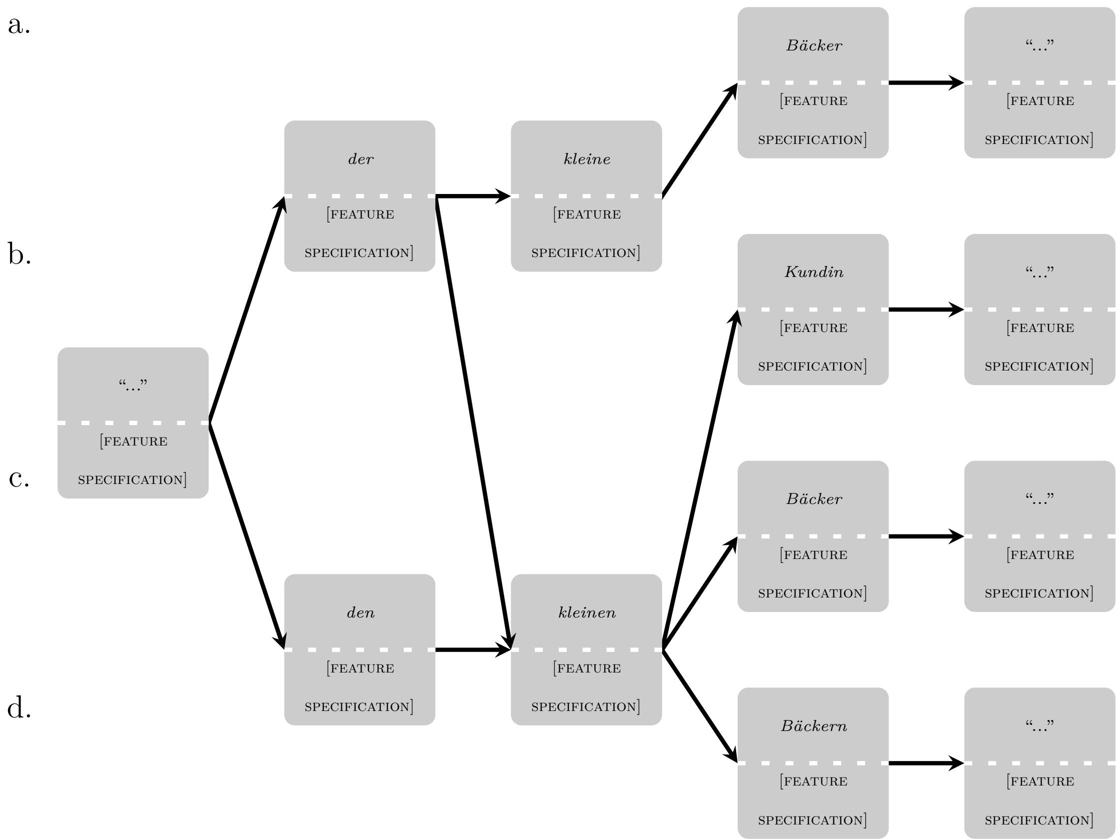


Figure 8.1: Visualization of (51a–51d).

two contexts—accusative masculine singular and plural—with regard to case, number and gender, he merges them across natural classes by means of a disjunction. The remaining underspecified inventories for the determiners *der* and *den* and the nouns *Bäcker*, *Kundin* and *Bäckern* from (51) can be found in Tables 5.2 to 5.3b. TMP can now combine the adjective's features with the ones of the preceding determiner and the subsequent noun.

Table 8.2: Bierwisch's inventory of the German weak adjective paradigm (Bierwisch, 1967, pp. 259–260).

determiner		feature specification
R_1 *kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$	$\leftrightarrow$	$[[+\text{OBJ}, +\text{M}] \vee +\text{OBL} \vee +\text{PL}]$
R_2 *kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	$\leftrightarrow$	$[\varnothing]$

8.1.2 TMP's calculations: Parsing using Bierwisch's features

As the aforementioned Parsing Prerequisites I to III are readily available, TMP can perform its calculations a second time. For reasons of readability and brevity, the four

DPs of (51) are investigated for Bierwisch' features without an assumed prior SP_{NOM} in Appendix C. The section will be restricted to the ranked candidates for determiners, adjectives and nouns. Crucially, the outcome of Appendix C will be concluded with TMP's claims in the subsequent Section 8.1.3 with regard to the expected calculatory *simplicity* or *complexity* for the determiner, adjective and noun integration. These comparisons will then allow for acute hypotheses that will be tested empirically afterwards.

8.1.3 TMP's claims

Parallel to previous claims in Section 5.3, this section will likewise formalize TMP's claims based on the outcomes of the three-element parsing calculations from Appendix C. But, in contrast to the previous two-element parses, the position-dependent comparisons will only be conducted within one framework. The reason for this is that Chapter 7 only identified Bierwisch's and Wunderlich's frameworks to be most fitting. Since both models revealed themselves as behaving in an identical matter, the subsequent investigations will revert to the feature set of Bierwisch only.

The following comparisons shall be carried out for (51)'s DPs: Both *der* determiners in (51a–51b) will be compared to both *den* determiners in (51c–51d). At the adjective position, *kleine* after *der* in (51a) will be compared to *kleinen* after *der* in (51b). Since *kleinen* after *den* in (51c) and *kleinen* after *den* in (51d) are identical, they will not be compared. Therefore, it suffices to compare *kleinen* after *der* in (51b) with *kleinen* after *den* in either (51c) or (51d). (51c) will be chosen for this comparison. Finally, at the noun position, *Bäcker* after *der kleine* in (51a) will be compared to *Kundin* after *der kleinen* in (51b). Furthermore, *Bäcker* after *den kleinen* in (51c) shall be compared to *Bäckern* after *den kleinen* in (51d).

8.1.3.1 Assuming no prior SP_{NOM}

Parallel cross-comparisons have to be collected for the parses without a prior SP_{NOM}. They will primarily refer to the derivation of ranked candidates but also include remarks towards the handling of incoming incompatible features.

8.1.3.1.1 Determiner position Since the structures' determiners of the current investigation are identical to those of TMP's initial parsing analyses, namely $der_{NOM.M.SG}$, $der_{DAT.F.SG}$, $den_{ACC.M.SG}$ and $den_{DAT.PL}$, the resulting claims are also the same as in Section 5.3.2.1. In order to derive hypotheses for the later Experiment 2, the gradation from (29) applies in the same way. Therefore, it is repeated in (52).

(52) Bierwisch:
$der_{NOM.M.SG} < den_{ACC.M.SG} = der_{DAT.F.SG} < den_{DAT.PL}$

With regard to incompatibility, the current case mirrors Section 5.2.2 insofar as, due to the lack of an SP_{NOM}, the features introduced by *den* again cannot oppose the filter specification. This results in incompatibility for $den_{ACC.M.SG}$.

8.1.3.1.2 Adjective position Turning to the adjective position, Table 8.3 gives an overview of the relevant rankings. It consists of two filter specifications, the top-ranked candidate and the alternatives of the targeted adjectives from (51). The overview amasses all the ranks and constraint violations directly from the rankings in Tables C.1 and C.2 for Bierwisch. Like before, it reads in the following way: For a filter specification of *der*$_{\text{NOM.M.SG}}$, *kleine* is the top-ranked candidate while it is *kleinen* for *den*$_{\text{ACC.M.SG}}$. This yields the following ranking: *kleinen* after *den*$_{\text{ACC.M.SG}}$ < *kleine* after *der*$_{\text{NOM.M.SG}}$ < *kleinen* after *der*$_{\text{NOM.M.SG}}$. For hypotheses derivation in Experiment 2, however, the gradation in (53) is relevant.

(53) Bierwisch:
kleinen$_{\text{ACC.M.SG, PL}}$ < *kleine*$_{\text{NOM.M.SG}}$ < *kleinen*$_{\text{DAT}}$

In respect of incompatibility, none of the adjectives introduces opposing features as they are all compatible with the prior determiners. Hence, this results in incompatibility neither for *kleine* nor for *kleinen*.

Table 8.3: Overview of all relevant ranked candidates for the adjective position.

rank	filter specification: [+M] (by current material's *der*$_{\text{NOM.M.SG}}$ from prior step)		⚡	⊖		⊕
	adjective	specification		⇒	⇐	
1.	*kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[∅]	0	1	0	0
2.	*kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$	[[+OBJ, +M] ∨ +OBL ∨ +PL]	0	3	3	1
	filter specification: [+OBJ, +M] (by current material's *den*$_{\text{ACC.M.SG}}$ from prior step)					
1.	*kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$	[[+OBJ, +M] ∨ +OBL ∨ +PL]	0	0	0	2
2.	*kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[∅]	0	2	0	0

8.1.3.1.3 Noun position With regard to the nouns, Table 8.4 gives an overview of the relevant rankings. It consists of three filter specifications, the top-ranked candidate and the alternatives of the targeted nouns from (51). The overview amasses all the ranks and constraint violations directly from the rankings in Tables C.3 to C.5 for Bierwisch. Like before, the summary reads in the following way: The top-ranked candidate both after a preceding filter specification of *der*$_{\text{NOM.M.SG}}$ *kleine* as well as *den*$_{\text{ACC.M.SG}}$ *kleinen* is *Bäcker*. In the latter case, it outranks *Bäckern*. Lastly, the top-ranked candidate for a preceding filter specification of *der*$_{\text{DAT.F.SG}}$ *kleinen* is *Kundin*. This yields the following ranking: *Bäcker* after *der kleine* < *Kundin* after *der kleinen* = *Bäcker* after *den kleinen* < *Bäckern* after *den kleinen*. However, the gradation in (54) turns out to be relevant for the second experiment's hypotheses.

(54) Bierwisch:
Bäcker$_{\text{NOM.M.SG}}$ < *Kundin*$_{\text{DAT.F.SG}}$ = *Bäcker*$_{\text{ACC.M.SG}}$ < *Bäckern*$_{\text{DAT.PL}}$

Turning to incompatibility, Table 8.4 shows that *Kundin* and *Bäckern* do not introduce incompatible features per se. However, recall again from previous analyses that both a compatible and an incompatible route were calculated. It still has to be decided which path is more feasible. For now, it has to be noted that both routes are plausible. Therefore, it is possible, that the input of either *Kundin* or *Bäckern* results in incompatibility.

Table 8.4: Overview of all relevant ranked candidates for the noun position.

rank	filter specification: [+M] (by current material's *der*$_{\text{NOM.M.SG}}$ + *kleine*$_{\text{NOM.M.SG}}$ from prior step)		⚡	🔍−		🔍+
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	0	0	1
	filter specification: [+OBL, +F] (by current material's *der*$_{\text{DAT.F.SG}}$ + *kleinen*$_{\text{DAT}}$ from prior step)					
1.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	1	0	1
	filter specification: [+OBJ, +M] (by current material's *den*$_{\text{ACC.M.SG}}$ + *kleinen*$_{\text{ACC.M.SG}}$ from prior step)					
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	0	1
2.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	1	2	1

8.1.3.2 Conclusion

The previous sections compared the different determiners, adjectives and nouns within Bierwisch's approach without a precursory SP$_{\text{NOM}}$. Under these conditions, *der* was predicted instead of *den* as the incoming determiner, yielding the scale of *der*$_{\text{NOM.M.SG}}$ < *den*$_{\text{ACC.M.SG}}$. For the subsequent adjective position, Bierwisch's framework predicted differences for the integration of *kleine* versus *kleinen* depending on the previous determiner integration. Likewise, various predictions could be derived for the DP-final noun. Its integration also depended on the preceding combinations of determiner and adjective.

8.2 From Claims to Hypotheses

Parallel to Experiment 1, the second experiment is equally concerned with the incremental processing of inflected elements. Section 8.1, however, established that adding a third position by means of an adjective is a way to further put TMP to the test. Therefore, three subsequent elements will be investigated in Experiment 2. As announced in (51) and repeated here in (55), the DPs comprise a strong determiner followed by a weak adjective and a concluding noun. Again, ERPs will be collected at each respective position within a DP in order to investigate the transition to the determiner and from thereon to the subsequent adjective and ultimately to the noun. Thus, both the derivation of hypotheses as well as the interpretation of obtained effects will happen in light of the position-dependent predictions from TMP's claims.

For the previous investigation, position-dependent designations that captured the ambiguity of the determiners and the disambiguating nature of the subsequent nouns were defined in Section 7.2.1. This has to be repeated for the DP-elements in (55) in order to set the stage for subsequent hypotheses. While it is again Der and Den for the determiner position as in Experiment 1, the new intermediate adjective position also needs descriptions. Appropriate designations are ${}_{\text{Der}}$Ae, ${}_{\text{Der}}$Aen and ${}_{\text{Den}}$Aen. Similar to the previous study, the noun positions are designated with ${}_{\text{DerAe}}$Ner, ${}_{\text{DerAen}}$Nin, ${}_{\text{DenAen}}$Ner and ${}_{\text{DenAen}}$Nern respectively. All positions successively constitute the same syntactic target contexts as in Experiment 1: NOM.M.SG, DAT.F.SG, ACC.M.SG and DAT.PL.

(55) a. NOM.M.SG:

der	kleine	Bäcker
the.NOM.M, DAT.F	small.NOM.M, NOM/ACC.N/F	baker.NOM.M
Der	${}_{\text{Der}}$Ae	${}_{\text{DerAe}}$Ner

b. DAT.F.SG:

der	kleinen	Kundin
the.NOM.M, DAT.F	small.ACC.M, DAT, GEN, PL	customer.DAT.F
Der	${}_{\text{Der}}$Aen	${}_{\text{DerAen}}$Nin

c. ACC.M.SG:

den	kleinen	Bäcker
the.ACC.M, DAT.PL	small.ACC.M, DAT, GEN, PL	baker.ACC.M
Den	${}_{\text{Den}}$Aen	${}_{\text{DenAen}}$Ner

d. DAT.PL:

den	kleinen	Bäckern
the.ACC.M, DAT.PL	small.ACC.M, DAT, GEN, PL	bakers.DAT.PL
Den	${}_{\text{Den}}$Aen	${}_{\text{DenAen}}$Nern

The three-element DPs in (55) contain, in contrast to (33), a two-way disambiguation: The determiner position is ambiguous between (55a) and (55b) for Der and between (55c) and (55d) for Den. The subsequent adjective position is the first stage of disambiguation as it at least resolves Der in (55a) and (55b) with ${}_{\text{Der}}$Ae and ${}_{\text{Der}}$Aen. However, ${}_{\text{Den}}$Aen does not disambiguate Den in (55c) and (55d). Eventually, it is the DP-final noun position as the second disambiguation stage that disambiguates the preceding determiner-adjective combination. In this way, the noun designation makes it transparent that both ${}_{\text{DerAe}}$Ner and ${}_{\text{DerAen}}$Nin in (55a) and (55b) respectively originate from ${}_{\text{Der}}$Ae and ${}_{\text{Der}}$Aen but both from Der, while ${}_{\text{DenAen}}$Ner and ${}_{\text{DenAen}}$Nern originate both from ${}_{\text{Den}}$Aen which is preceded by Den in (55c) and (55d) respectively.

Parallel to Experiment 1 in Section 7.3, TMP's claims from Section 8.1.3 can again be easily transformed into hypotheses by applying the two aforementioned ERP components in the way specified for the first study in Section 7.2.2. It has to be noted again that this procedure is potentially problematic, even more so in this experiment since there are three subsequent positions: Hypotheses of the DP-final noun are based on the predictions of the preceding adjective which, in turn, are again dependent on the hypotheses of the initial determiner.

8.3 Hypotheses

The current Experiment 2 has to show that in (55a), the language comprehender will eventually analyze Der as *der*$_{\text{NOM.M.SG}}$, ${}_{\text{Der}}\text{Ae}$ as *kleine*$_{\text{NOM.M.SG}}$ and ${}_{\text{DerAe}}\text{Ner}$ as *Bäcker*$_{\text{NOM.M.SG}}$ in order to realize the targeted NOM.M.SG context. Similarly, evidence must be found that in (55b), the comprehension system finally integrates Der as *der*$_{\text{DAT.F.SG}}$, ${}_{\text{Der}}\text{Aen}$ as *kleinen*$_{\text{DAT.F.SG}}$ and ${}_{\text{DerAen}}\text{Nin}$ as *Kundin*$_{\text{DAT.F.SG}}$ so that the analysis reaches the desired DAT.F.SG structure. For (55c), is must be proven that—in the end—Den will be analyzed as *den*$_{\text{ACC.M.SG}}$, ${}_{\text{Den}}\text{Aen}$ as *kleinen*$_{\text{ACC.M.SG}}$ and ${}_{\text{DenAen}}\text{Ner}$ as *Bäcker*$_{\text{ACC.M.SG}}$ in order to build up the targeted ACC.M.SG context while, in (55d), Den will be integrated as *den*$_{\text{DAT.PL}}$, ${}_{\text{Den}}\text{Aen}$ as *kleinen*$_{\text{DAT.PL}}$ and ${}_{\text{DenAen}}\text{Nern}$ as *Bäckern*$_{\text{DAT.PL}}$ in order to realize a DAT.PL context.

The predicted ranked candidates that are arranged along a gradation from left to right, that is from lower to higher feature deviance, can again simply be mapped onto the predicted ERP effect that is assumed to be associated with morphosyntactic processing. Lower and higher feature deviance correspond with TMP's *simpler* and more *complex* calculatory work and consequently with morphosyntax-related ERP effects reflecting lower and higher processing load. A LAN was predicted as the relevant effect in Experiment 1. However, a more broadly distributed NEG was found instead. Cautiously following the literature on this issue, instead of a LAN, this very NEG effect at around 400 ms shall be predicted for the current Experiment 2. The prediction of a P600 for encountering and resolving incompatibility remains unchanged.

Since the process to derive hypotheses from TMP's claims will be concerned with Bierwisch and the assumption of no prevalent SP$_{\text{NOM}}$ and is also identical to what was done for the first experiment in Section 7.3, the formulation of the second experiment's predictions can be abbreviated. Overview (56) collects the position- and ERP effect-dependent hypotheses for Bierwisch with regard to an absent SP$_{\text{NOM}}$ filter specification.

(56) a. Assuming no prior SP$_{\text{NOM}}$:
- i. Determiner position:
  NEG: $\text{Der} < \text{Den}$
  P600: $\text{Der} < \text{Den}$
- ii. Adjective position:
  NEG: ${}_{\text{Den}}\text{Aen} < {}_{\text{Der}}\text{Ae} < {}_{\text{Der}}\text{Aen}$
  P600: ${}_{\text{Der}}\text{Aen} < {}_{\text{Der}}\text{Ae} < {}_{\text{Den}}\text{Aen}$
- iii. Noun position:
  NEG: ${}_{\text{DerAe}}\text{Ner} < {}_{\text{DerAen}}\text{Nin} = {}_{\text{DenAen}}\text{Ner} < {}_{\text{DenAen}}\text{Nern}$
  P600: ${}_{\text{DerAe}}\text{Ner} = {}_{\text{DenAen}}\text{Ner} < {}_{\text{DerAen}}\text{Nin} = {}_{\text{DenAen}}\text{Nern}$

8.4 Method

The second and third experiment were carried out in conjunction. This means that participants, data acquisition, procedure and data analysis were largely kept the same across both studies. In case of any deviations, there will be explicit notes on that matter.

8.4.1 Participants

Similarly to the first experiment, twenty-four adults (15 females) recruited from the participant pool of the XLinC Lab at the University of Cologne (mean age: 22.58 years, range: 18-29 years) participated in the experiment. Five of the participants were excluded from the final data analysis due to excessive artifacts in their recordings. Therefore, 19 subjects entered the analysis (11 females, mean age: 22.36 years, range: 18-29 years). The remaining technical and practical aspects of the recruitment were identical to the previous experiment.

8.4.2 Materials

Parallel to Experiment 1, the experimental sentences of the second experiment shared the properties of those TMP dealt with in Section 8.1.2, while they were again expanded by PPs after the two DP arguments. Once more, this results in two subordinate Der and Den conditions, followed by three subordinate DerAe, DerAen and DenAen conditions that are concluded by four subordinate DerAeNer, DerAenNin, DenAenNer and DenAenNern conditions that constitute the same structures' syntactic target contexts as in the first experiment: NOM.M.SG, DAT.F.SG, ACC.M.SG and DAT.PL.

(57) Experimental items:

a. NOM.M.SG:

Gestern	hat	der	kleine	Bäcker	aus	Mainz	den	Konditor	aus
Yesterday	has	the	small	baker	from	Mainz	the	confectioner	from
		Der	DerAe	DerAeNer					

Kassel	ausgelacht.
Kassel	laughed-at

"Yesterday, the small baker from Mainz laughed at the confectioner from Kassel."

b. DAT.F.SG:

Gestern	hat	der	kleinen	Kundin	aus	Mainz	der	Konditor	aus
Yesterday	has	the	small	customer	from	Mainz	the	confectioner	from
		Der	DerAen	DerAenNin					

Kassel	zugeflüstert.
Kassel	whisphered-at

"Yesterday, the confectioner from Kassel whispered at the small customer from Mainz."

c. ACC.M.SG:

Gestern	hat	den	kleinen	Bäcker	aus	Mainz	der	Konditor	aus
Yesterday	has	the	small	baker	from	Mainz	the	confectioner	from
		Den	$_{\text{Den}}$Aen	$_{\text{DenAen}}$Ner					

Hürth ausgelacht.
Hürth laughed-at

"Yesterday, the confectioner from Hürth laughed at the small baker from Mainz."

d. DAT.PL:

Gestern	hat	den	kleinen	Bäckern	aus	Mainz	der	Konditor	aus
Yesterday	has	the	small	bakers	from	Mainz	the	confectioner	from
		Den	$_{\text{Den}}$Aen	$_{\text{DenAen}}$Nern					

Hürth zugeflüstert.
Hürth whispered-at

"Yesterday, the confectioner from Hürth whispered at the small bakers from Mainz."

Following (57), 40 lexical sets—with four sentences each resulting in a total of 160 experimental items—were constructed. The entirety of the critical material is listed in Appendix E.2. In addition, the 80 filler items from the first experiment were reused in the present study. Since Experiment 2 was carried out in conjunction with Experiment 3, the latter's 120 critical sentences served as filler items too. With the sets of 160 experimental and 200 filler items, two pseudo-randomized lists were created.

8.4.3 Data acquisition, procedure and data analysis

The data acquisition was carried out with the same technical parameters as in the first study. However, the rejection rates differed as follows: At the determiner position, 12.73 % of the trials for Der and 9.00 % of the trials for Den had to be excluded due to artifacts. Also due to artifacts, at the adjective position, 10.40 % of the $_{\text{Der}}$Ae, 10.53 % of the $_{\text{Der}}$Aen and 8.47 % of the trials for the $_{\text{Den}}$Aen condition had to be rejected. Similarly, at the noun position, 9.33 % of the trials for the $_{\text{DerAe}}$Ner condition, 10.13 % of the trials for the $_{\text{DerAen}}$Nin condition, 6.48 % of the trials for the $_{\text{DenAen}}$Ner condition and 9.07 % of the trials for the $_{\text{DenAen}}$Nern condition had to be excluded.

As it was the case for the first experiment, the time windows for the statistical analyses of the ERP data were again predefined by visual inspection: 300–400 ms and 450–600 ms for the determiner, 350–450 ms and 550–650 ms for the adjective as well as 300–500 ms and 550–650 ms for the noun positions. The remaining technicalities with regard to ERP data computation of the respective conditions and ROIs as well as the configuration of the electrodes were identical to Experiment 1. Similarly, again, all trials of the grammaticality judgment entered the analysis. P-values for all effects with more than one degree of freedom were corrected by Huynh-Feldt correction (Huynh and Feldt, 1970). Furthermore, all adjective and noun effects of multiple pairwise comparisons were corrected to $p < 0.03$ by the Bonferroni-Keppel procedure (Keppel and Wickens, 1973). The significance level of determiners remained uncorrected at $p < 0.05$.

8.5 Results

For the determiner position, Experiment 2 replicated the findings of the first experiment. The ERPs at the determiner position revealed a broadly distributed negativity at around 400 ms for Den compared to Der. Figure 8.2 shows the contrast between the determiner positions Der and Den time-locked to their onset. Just like in the previous experiment, the expected subsequent positivity for Den did not emerge.

Regarding the adjective position, Figure 8.3 displays the contrast of DerAe, DerAen and DenAen relative to the adjective onset. It illustrates a negativity for DerAen and DenAen in comparison to DerAe instead of the expected gradation. Furthermore, a positivity occurred for DerAen and DenAen in comparison to DerAe.

Figure 8.4 illustrates the ERPs relative to noun onset. Instead of the predicted gradation across conditions, only DerAenNin exhibited a reliable negativity. Regarding the positivity, only the conditions DenAenNern showed a more pronounced positivity at around 600 ms compared to DerAeNer and DenAenNer, while neither DerAenNin nor DenAenNer elicited this effect compared to DerAeNer.

8.5.1 Determiner position

300–400 ms latency window Lateral hemisphere sites showed a significant effect of COND ($F(1,18) = 8.23$, $p < 0.05$) and no interaction of COND and ROI ($F(3,52) = 0.75$, $p = 0.48$). Turning to midline sites, data neither showed a significant effect for COND ($F(1,18) = 3.92$, $p > 0.06$) nor a significant interaction of COND and ROI ($F(2,36) = 1.43$, $p > 0.25$).

Experiment 2 replicated the first experiment's findings for the determiner position insofar as lateral and midline electrode sites again confirmed the hypothesis of an absent SP_{NOM} insofar as a negatively deflected effect around 400 ms occurred for Den in comparison to Der. The predictions for the determiner position in (56a-i) assumed an effect for Den.

450–600 ms latency window Also just like in Experiment 1, the analysis of the lateral electrode sites showed neither a significant effect of COND ($F(1,18) = 1.27$, $p > 0.2$) nor an interaction of COND and ROI ($F(3,54) = 2.77$, $p > 0.07$). While the analysis of the midline electrodes did not reveal a significant effect of COND ($F(1,18) = 0.99$, $p > 0.3$) either, it revealed a significant interaction of COND and ROI ($F(2,36) = 3.9$, $p < 0.05$). However, resolving this interaction by ROI did not reveal any significant electrode sites (anterior: $F(1,18) = 2.73$, $p > 0.1$; central: $F(1,18) = 0.62$, $p > 0.4$; posterior: $F(1,18) = 0.09$, $p > 0.7$).

With regard to the later time window, the second experiment also replicated the first's findings. Lateral and midline sites do not show a late positivity for Den. In the case an SP_{NOM} was predicted, a P600 should have been elicited. Therefore, the results are

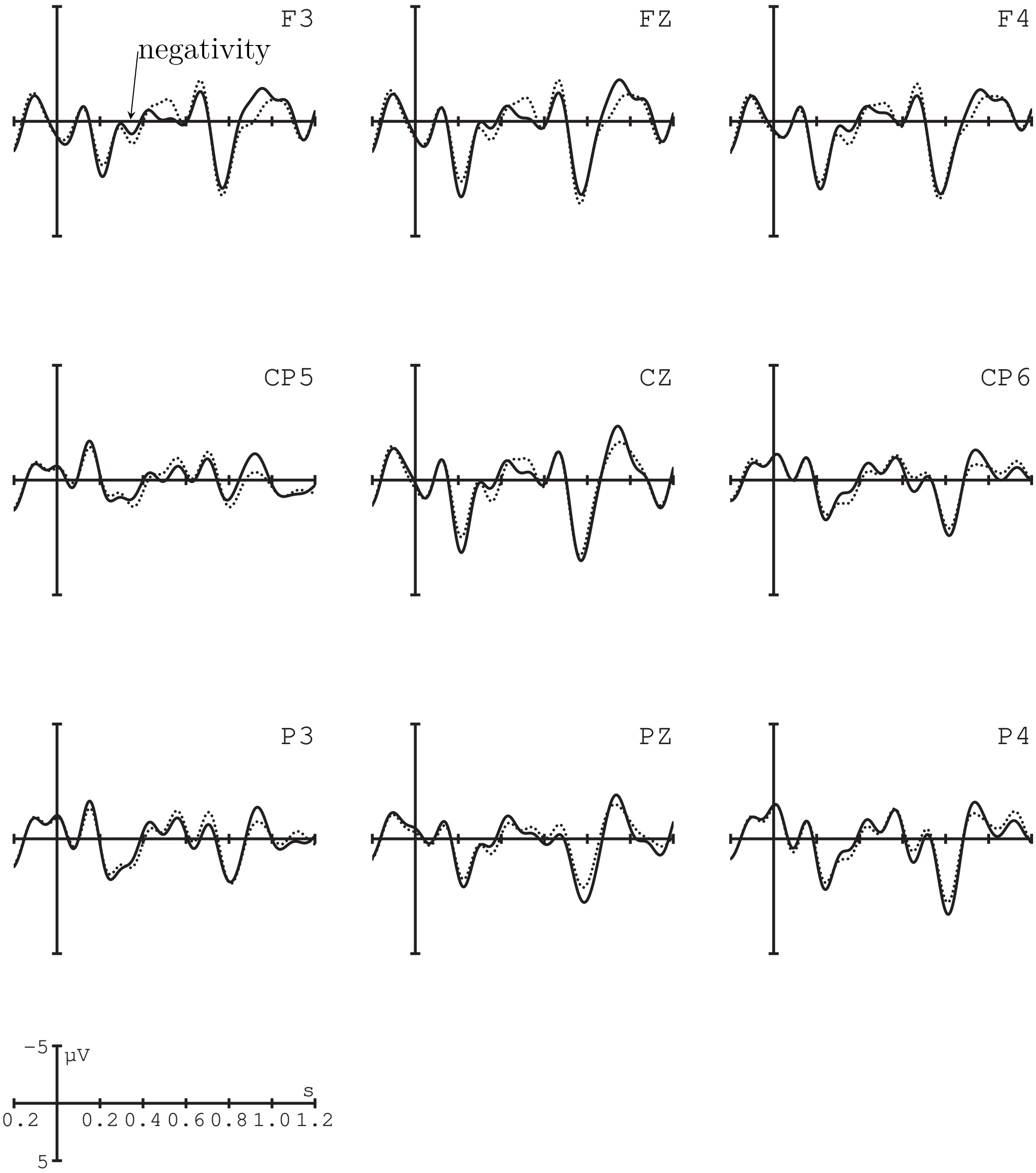


Figure 8.2: ERP effects (n=19) observed at the determiner position for Der (……) and Den (——). The time window spans from 200 ms before determiner onset to 1200 ms after (onset at vertical bar). Negativity is plotted upwards.

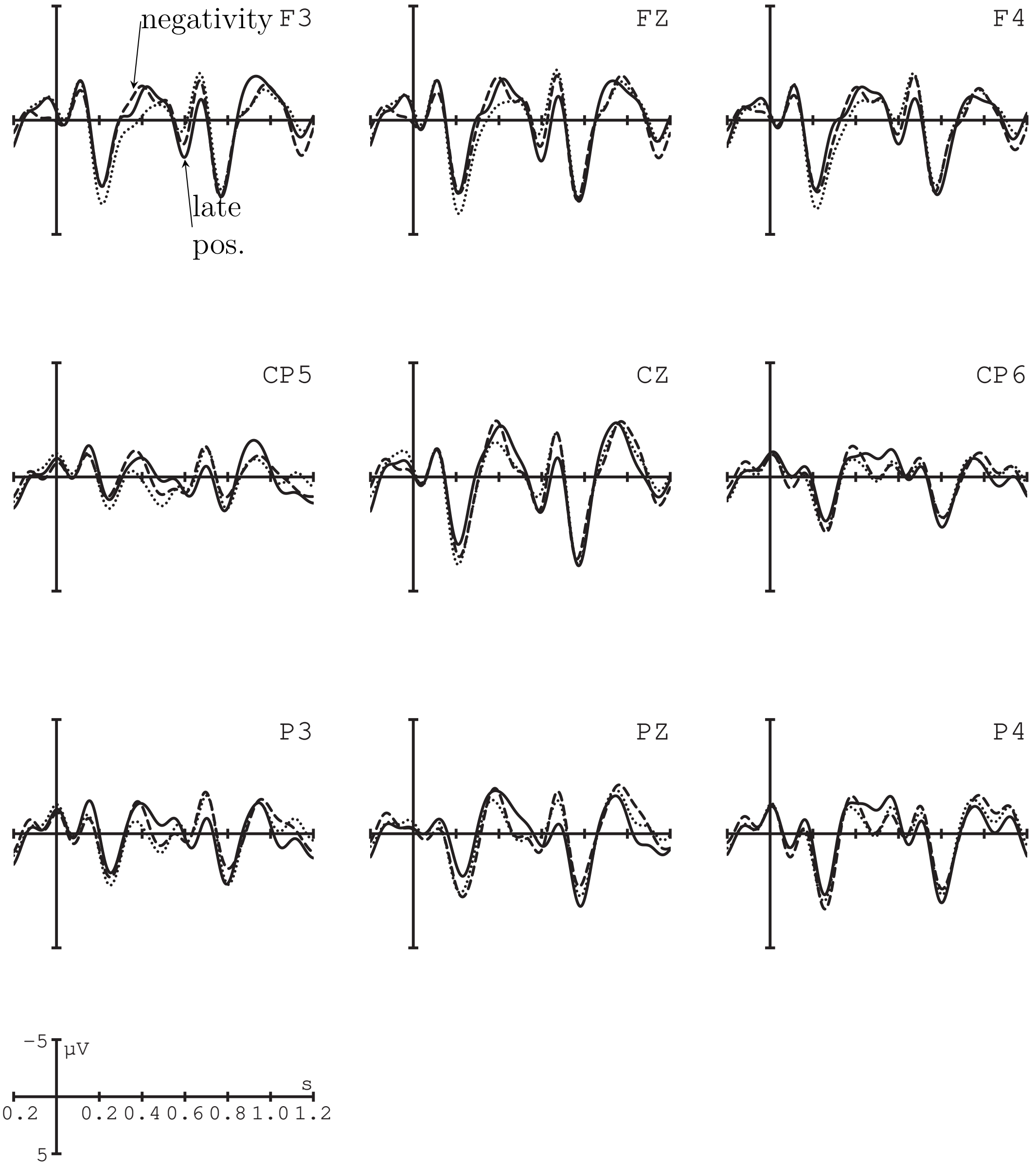


Figure 8.3: ERP effects (n=19) observed at the adjective position for DerAe (··············), DerAen (———) and DenAen (------). The time window spans from 200 ms before adjective onset to 1200 ms after (onset at vertical bar). Negativity is plotted upwards.

compatible with the hypothesis for a non-present SP_{NOM} as in (56a-i). For this reason, from hereon, only hypotheses that do not assume an SP_{NOM} will be considered when assessing the ERP data of subsequent adjective and noun positions.

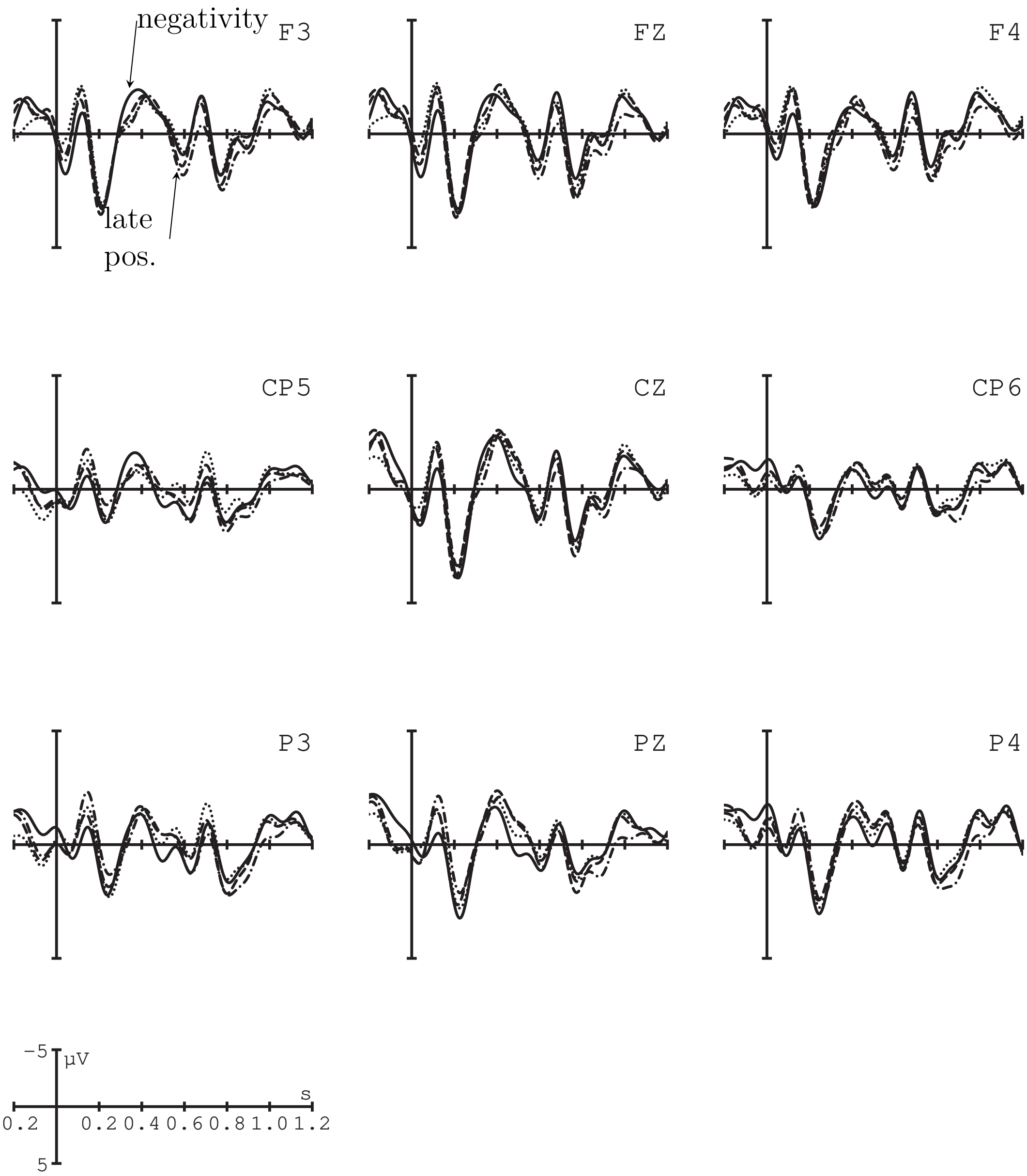


Figure 8.4: ERP effects (n=19) observed at the noun position for DerAeNer (··········), DerAenNin (———), DenAenNer (------) and DenAenNern (-·-·-·-). The time window spans from 200 ms before noun onset to 1200 ms after (onset at vertical bar). Negativity is plotted upwards.

8.5.2 Adjective position

350–450 ms latency window The main analysis for lateral hemisphere sites showed a highly significant effect for COND ($F(2,36) = 9.54$, $p < 0.001$) and a marginally significant interaction of COND and ROI ($F(6,108) = 2.57$, $p = 0.055$). Resolving this interaction for ROI revealed the most pronounced effects for left electrode sites (left anterior $F(2,36) = 11.58$, $p < 0.001$; right anterior $F(2,36) = 3.11$, $p = 0.057$; left posterior $F(2,36) = 12.12$, $p < 0.001$; right posterior $F(2,36) = 2.57$, $p > 0.09$). Pairwise comparisons for lateral electrode sites are displayed in Table 8.5.

Table 8.5: Adjective effects of ANOVAs for lateral sites of the 350–450 ms latency window.

comparison	effect	df	left ant.	right ant.	left post.	right post.
			F	*F*	*F*	*F*
DerAe vs. DerAen	COND	1,18	16.04***	–	28.7***	–
DerAe vs. DenAen	COND	1,18	16.79***	–	14.65**	–
DerAen vs. DenAen	COND	1,18	0.9 n.s.	–	0.15 n.s.	–

Concerning midline sites, the data revealed a significant effect for COND ($F(2,36) = 5.46$, $p < 0.01$) and only a marginally significant interaction of COND and ROI ($F(4,72) = 2.36$, $p = 0.08$). Resolving this interaction by ROI revealed the most pronounced main effects for anterior electrode sites (anterior: $F(2,36) = 7.28$, $p < 0.01$; central: $F(2,36) = 3.05$, $p < 0.08$; posterior: $F(2,36) = 4.25$, $p < 0.05$). Pairwise comparisons for midline electrode sites are displayed in Table 8.6.

Table 8.6: Adjective effects of ANOVAs for midline sites of the 350–450 ms latency window.

comparison	effect	df	ant.	cent.	post.
			F	*F*	*F*
DerAe vs. DerAen	COND	1,18	16.89***	–	6.21(*)
DerAe vs. DenAen	COND	1,18	9.98**	–	2.73 n.s.
DerAen vs. DenAen	COND	1,18	0.51 n.s.	–	2.48 n.s.

Both electrode sites reveal that, in the early time window, DerAen and DenAen elicit a negativity at around 400 ms in comparison to DerAe. Following the prior results that favor a non-present SP_{NOM}, the results are incompatible with the prediction in (56a-ii).

550–650 ms latency window The main analysis for lateral electrode sites showed no significant effect for COND ($F(2,36) = 1.13$, $p > 0.3$) but a highly significant interaction of COND and ROI ($F(6,108) = 6.41$, $p < 0.001$). Resolving this interaction for ROI revealed only an effect for left anterior electrode sites (left anterior $F(2,36) = 5.57$, $p = 0.01$; right anterior $F(2,36) = 1.67$, $p > 0.2$; left posterior $F(2,36) = 0.45$, $p > 0.6$; right posterior $F(2,36) = 0.49$, $p > 0.6$). Pairwise comparisons for lateral electrode sites are displayed in Table 8.7.

Turning to midline electrode sites revealed no significant effect for COND ($F(2,36) = 1.76$, $p > 0.1$) but a significant interaction of COND and ROI ($F(4,72) = 4.57$, $p < 0.01$). Resolving this interaction for ROI revealed the most pronounced effects for

Table 8.7: Adjective effects of ANOVAs for lateral sites of the 550–650 ms latency window.

comparison	effect	df	left ant.	right ant.	left post.	right post.
			F	*F*	*F*	*F*
DerAe vs. DerAen	COND	1,18	10.32**	–	–	–
DerAe vs. DenAen	COND	1,18	1.54 n.s.	–	–	–
DerAen vs. DenAen	COND	1,18	3.79(*)	–	–	–

anterior electrode sites (anterior: $F(2{,}36) = 3.90$, $p < 0.05$; central: $F(2{,}36) = 1.26$, $p > 0.2$; posterior: $F(2{,}36) = 0.46$, $p > 0.6$). Pairwise comparisons for midline electrode sites are displayed in Table 8.8.

Table 8.8: Adjective effects of ANOVAs for midline sites of the 550–650 ms latency window.

comparison	effect	df	*F*	ant.	cent.	post.
				F	*F*	*F*
DerAe vs. DerAen	COND	1,18		6.27*	–	–
DerAe vs. DenAen	COND	1,18		2.67 n.s.	–	–
DerAen vs. DenAen	COND	1,18		2.16 n.s.	–	–

Concerning the later time window, both electrode sites' data show that a reliable late positive-going effect occurred for DerAen compared to DerAe. Since the determiner still set the stage with a non-present SP_{NOM}, the presented data does not corroborate the respective hypothesis in (56a-ii) according to which no P600 should occur.

8.5.3 Noun position

300–500 ms latency window The main analysis for lateral hemisphere sites showed no significant effect for COND ($F(3{,}54) = 0.55$, $p > 0.6$) but a highly significant interaction of COND and ROI ($F(9{,}162) = 4.15$, $p < 0.001$). Resolving this interaction for ROI revealed only an effect for left anterior electrode sites (left anterior $F(3{,}54) = 2.81$, $p < 0.05$; right anterior $F(3{,}54) = 0.87$, $p > 0.4$; left posterior $F(3{,}54) = 0.53$, $p > 0.6$; right posterior $F(3{,}54) = 1.29$, $p > 0.9$). Pairwise comparisons for lateral electrode sites are displayed in Table 8.9. Midline sites revealed neither a significant effect for COND ($F(3{,}54) = 0.75$, $p > 0.5$) nor a significant interaction of COND and ROI ($F(6{,}108) = 1.85$, $p > 0.1$).

Again, the predicted positional gradation did not emerge. Only DerAenNin triggered a discernible effect compared to the other condition. All other nouns pattern together. While at least some kind of gradation was predicted irrespective of a present SP_{NOM}, no graded effects could be measured. This renders the hypothesis in (56a-iii) non-applicable.

Table 8.9: Noun effects of ANOVAs for lateral sites of the 300–500 ms latency window.

comparison	effect	df	left ant.	right ant.	left post.	right post.
			F	*F*	*F*	*F*
derAeNer vs. derAenNin	COND	1,18	11.71**	–	–	–
derAeNer vs. denAenNer	COND	1,18	0.85 n.s.	–	–	–
derAeNer vs. denAenNern	COND	1,18	1.28 n.s.	–	–	–
derAenNin vs. denAenNern	COND	1,18	2.66 n.s.	–	–	–
denAenNer vs. denAenNern	COND	1,18	2.52 n.s.	–	–	–

550–650 ms latency window The main analysis for lateral electrode sites showed no significant effect for COND ($F(3{,}54) = 1.83$, $p > 0.1$) but a significant interaction of COND and ROI ($F(9{,}162) = 3.65$, $p < 0.001$). Resolving this interaction for ROI revealed only an effect for left electrode sites (left anterior $F(3{,}54) = 4.55$, $p < 0.01$; right anterior $F(3{,}54) = 0.99$, $p > 0.4$; left posterior $F(3{,}54) = 3.23$, $p < 0.04$; right posterior $F(3{,}54) = 0.68$, $p > 0.5$). Pairwise comparisons for lateral electrode sites are displayed in Table 8.10.

Table 8.10: Noun effects of ANOVAs for lateral sites of the 550–650 ms latency window.

comparison	effect	df	left ant.	right ant.	left post.	right post.
			F	*F*	*F*	*F*
derAeNer vs. derAenNin	COND	1,18	0.31 n.s.	–	7.01*	–
derAeNer vs. denAenNer	COND	1,18	2.14 n.s.	–	4.64(*)	–
derAeNer vs. denAenNern	COND	1,18	7.59*	–	6.76*	–
derAenNin vs. denAenNern	COND	1,18	0.86 n.s.	–	1.77 n.s.	–
denAenNer vs. denAenNern	COND	1,18	6.49*	–	0.01 n.s.	–

The analysis of midline sites revealed no significant effect for COND ($F(3{,}54) = 0.70$, $p > 0.5$) but a significant interaction of COND and ROI ($F(6{,}108) = 4.17$, $p < 0.01$). However, resolving this interaction for ROI revealed no significant electrode sites (anterior: $F(3{,}54) = 1.85$, $p > 0.1$; central: $F(3{,}54) = 0.66$, $p > 0.2$; posterior: $F(3{,}54) = 1.06$, $p > 0.3$).

Both electrode sites for the later time window are similarly inconclusive. Assuming that both derAenNin and denAenNern should carry features that categorically opposed the feature specification, both should have elicited a late positivity. However, this was only the case for denAenNern compared to derAeNer but not for derAenNin. None of the predictions in (56a-iii) could be confirmed.

8.6 Discussion

In parallel to Experiment 1, no reliable left anterior but a global negativity could be observed in the 350–450 ms latency window for determiner conditions with Den compared to Der. Also mirroring the previous experiment, a late positivity did not emerge for Den. At the newly introduced, subsequent adjective position, no graded negativities across the three conditions were found in the 350–450 ms time window. Instead, $_{\text{Der}}$Aen and $_{\text{Den}}$Aen elicited a more pronounced negatively deflected effect in comparison to $_{\text{Der}}$Ae. In the subsequent latency window, both $_{\text{Der}}$Aen and $_{\text{Den}}$Aen evoked positive ERP effects compared to $_{\text{Der}}$Ae. At the DP-final noun position, in contrast to Experiment 1, no graded negativities were obtained between 300 and 500 ms. Instead, nouns of the $_{\text{DerAen}}$Nin condition produced the most pronounced negativity in comparison to $_{\text{DerAe}}$Ner, $_{\text{DenAen}}$Ner and $_{\text{DenAen}}$Nern. Turning to the 550–650 ms time window, the noun position revealed positively deflected effects for $_{\text{DerAen}}$Nin and $_{\text{DenAen}}$Nern in comparison to $_{\text{DerAe}}$Ner.

The subsequent sections will again address the obtained ERP results for the determiner, adjective and noun positions in light of TMP's *simple* or *complex* calculatory work that allegedly was reflected in attenuated or pronounced morphosyntax-related ERP effects. The discussion seeks to shed some light onto whether one of the *der* and *den* alternatives each were integrated at the respective Der and Den positions. In a similar fashion, for the adjective position, it will be interesting to see which analysis was entertained at $_{\text{Der}}$Ae, $_{\text{Der}}$Aen and both $_{\text{Den}}$Aen positions.

8.6.1 Determiner position

To describe the results of the determiner position, it can be concluded that Experiment 2 replicated prior findings from the first study. Again, a NEG was detected for Den versus Der. The occurrence of this effect can be explained by the violation of expected features. Considering the ERP data for the early time window alone, the results are compatible with the predictions that neglected a prior SP_{NOM} in (56a-i). Furthermore, since no late positivity was detected for Den in comparison to Der, the data suggests no preceding SP_{NOM}. Hence, no reanalysis-P600 was observed for Den. Paralleling Experiment 1, the ERP results favor the hypotheses that disregarded an SP_{NOM} filter specification. Therefore, these results again concern Question 3 on the role of the SP_{NOM} and allow to strengthen the previously given answer that hypotheses assuming a precursory SP_{NOM} can be rejected. Mirroring TMP's prediction of more *complex* calculatory work for Den compared to Der's rather overlapping bundle due to a higher feature deviance, the more pronounced NEG effect for Den suggests that structures with a DP-initial *den* determiner were morphosyntactically harder to process than *der*-initial DPs.

(58) Hypotheses with no SP_{NOM}:
NEG: Der < Den
P600: Der = Den

ERP result:
NEG: Der < Den
P600: Der = Den

The subsequent adjective position reveals a curious problem with regard to the obtained ERP results. After tackling this issue, it shall be discussed whether this very position will allow to disentangle *der*$_{\text{NOM.M.SG}}$ from *der*$_{\text{DAT.F.SG}}$ in Der and *den*$_{\text{ACC.M.SG}}$ from *den*$_{\text{DAT.PL}}$ in Den conditions. As yet, it can only be argued for an integration advantage of Der over Den without a preceding SP$_{\text{NOM}}$.

8.6.2 Adjective position

According to (56a-ii), $_{\text{Der}}$Ae and $_{\text{Der}}$Aen should have produced gradually stronger negatively deflected ERP effects in comparison to $_{\text{Den}}$Aen. The reasoning behind this prediction was that the appropriate TMP's claims in Paragraph 8.1.3.1.2 assumed an easier transition from Den as *den*$_{\text{ACC.M.SG}}$ to *kleinen* than from Der as *der*$_{\text{NOM.M.SG}}$ to *kleine* than from Der as *der*$_{\text{DAT.F.SG}}$ to *kleinen*. However, this was not reflected by the obtained ERP data. Rather, $_{\text{Der}}$Aen and $_{\text{Den}}$Aen elicited negativities in comparison to $_{\text{Der}}$Ae. Due to the absence of the predicted gradation of negative-going effects, the obtained data does not give further insights into Question 3 with regard to SP$_{\text{NOM}}$'s parsing contribution. (59) summarizes the hypotheses entertained so far and the currently deviating ERP results. The following sections nevertheless seek to present a possible explanation. Therefore, the obtained negativity shall again be interpreted as a NEG representing a violation of expected features. Similarly, the unexpected late positivity for $_{\text{Der}}$Aen and $_{\text{Den}}$Aen will be interpreted as P600 in a subsequent discussion.

(59) Hypotheses with no SP$_{\text{NOM}}$:
NEG: $_{\text{Den}}$Aen < $_{\text{Der}}$Ae < $_{\text{Der}}$Aen
P600: $_{\text{Der}}$Ae = $_{\text{Der}}$Aen = $_{\text{Den}}$Aen

ERP result:
NEG: $_{\text{Der}}$Ae < $_{\text{Der}}$Aen = $_{\text{Den}}$Aen
P600: $_{\text{Der}}$Ae < $_{\text{Der}}$Aen = $_{\text{Den}}$Aen

8.6.2.1 Disjunctive feature specifications

Admittedly, at first glance, it appears that either TMP's mechanism failed as a prediction-generating machine or that the employed feature specifications were incapable of capturing the occurring transitions from determiner to adjective. In a worst case scenario, both cases could be indiscernibly applicable. However, it is possible to account for the present adjective results without abandoning TMP and its predictions. Two approaches are conceivable.

First, recall from Section 8.1.1 that Bierwisch's adjective inventory made use of disjunctive feature specifications. In particular, the more specific *kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$ was specified for [[+OBJ, +M] ∨ +OBL ∨ +PL]. Table 8.11 repeats the ranked candidates for the adjective without a prior SP$_{\text{NOM}}$ for convenience. Taking both preceding determiner integrations—*der*$_{\text{NOM.M.SG}}$ on the one hand and *den*$_{\text{ACC.M.SG}}$ on the other—into account, the top-ranked targeted *kleinen* after *den* clearly represents the integration with the lowest calculatory work, followed by *kleine* after *der* which, in turn, is followed by *kleinen* after *der*. This motivated the ranking and hypothesis that was repeated in (59): $_{\text{Den}}\mathsf{Aen} < {}_{\text{Der}}\mathsf{Ae} < {}_{\text{Der}}\mathsf{Aen}$.

Table 8.11: Overview of all relevant ranked candidates for the adjective position.

rank	filter specification: [+M] (by current material's *der*$_{\text{NOM.M.SG}}$ from prior step)		⚡	🔍−		🔍+
	adjective	specification		⇒	⇐	
1.	*kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[∅]	0	1	0	0
2.	*kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$	[[+OBJ, +M] ∨ +OBL ∨ +PL]	0	3	3	1
	filter specification: [+OBJ, +M] (by current material's *den*$_{\text{ACC.M.SG}}$ from prior step)					
1.	*kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$	[[+OBJ, +M] ∨ +OBL ∨ +PL]	0	0	0	2
2.	*kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[∅]	0	2	0	0

So far, *kleinen*'s disjunctive specification was simply treated as if it was a conjunctive feature bundle. This was done in order to get around additionally complicating TMP's mode of operation. No secondary mechanism was postulated that could have resolved the disjunction. Rather, it was assumed that TMP would simply pick the "right" alternative from the three disjuncts. For $_{\text{Der}}\mathsf{Aen}$, it was *kleinen* after *der*$_{\text{NOM.M.SG}}$ that should be selected. Therefore, the featural disjunct of [+OBL] would be selected which, in turn, should trigger the reanalysis of the determiner *der* to *der*$_{\text{DAT.F.SG}}$ in order to form the first DP of the structure (57b). In the case of $_{\text{Den}}\mathsf{Aen}$, it was *kleinen* after *den*$_{\text{ACC.M.SG}}$ that should be selected. Consequently, the featural disjunct of [+OBJ, +M] should be picked in order to form the first DP of either the structure (57c) or (57d). This argument was not thought through consequently: Recall from the prior experiment that the results supported Bierwisch's assumption about the opposition of gender and plural specifications. If *kleinen*'s specification is treated as a whole before picking the right disjunct alternative, in both cases—$_{\text{Der}}\mathsf{Aen}$ and $_{\text{Den}}\mathsf{Aen}$—*kleinen* introduces a categorical conflicting [+PL] feature that opposed *der*'s and *den*'s [+M]. This would demote *kleinen* after *den* in Table 8.11 to the second rank. This would result in a stronger ERP effect compared to *kleine* in $_{\text{Der}}\mathsf{Ae}$. Furthermore, both *kleinen* alternatives after *der* and *den* would introduce incompatibility which, in turn, would reveal the detected late positivity as reanalysis-P600. Crucially, the presented explanation seeks to make $_{\text{Der}}\mathsf{Aen}$ and $_{\text{Den}}\mathsf{Aen}$ equally more *complex* to calculate for TMP in comparison to the rather *simple* $_{\text{Der}}\mathsf{Ae}$. Under these assumptions, the ERP results can be accounted for by attributing the higher featural deviance to $_{\text{Der}}\mathsf{Aen}$ and $_{\text{Den}}\mathsf{Aen}$ which entailed more *complex* calculatory work.

However, there might be a second reason for non-converging hypotheses: Expanding on the prior explanation with regard to the disjunctive specification, it is still unsolved how the "right" alternative along the three disjuncts should be picked. Initially noted for the first exemplification of TMP's Step 2, it was frequently stressed that an additional mechanism handling disjunctive features shall not be assumed in order to avoid complicating TMP. Referring back to this abandoned idea of a secondary mechanism, it might actually be necessary to postulate an additional operation to appropriately process the individual disjuncts. Hence, this idea will be revisited in the General Discussion.

Apart from that, disjunctive feature specifications could not pose comparable problems for the preceding determiner position since TMP's selection of target determiners had not to rely on candidates with these kinds of feature bundles. Until this point, ERP results have suggested that the Der position becomes integrated as *der*$_{\text{NOM.M.SG}}$, which was specified for [+M], and Den was integrated as *den*$_{\text{ACC.M.SG}}$ which carried [+OBJ, +M]. However, in case *der* had to be revised, categorically opposing feature had to be introduced nevertheless. Either way, the aforementioned scenario that posed a problem at the adjective is rendered inapplicable for the preceding determiner position.

As the subsequent Experiment 3 also deals with adjective integration, the topic of disjunctive features will be revisited more prominently in the General Discussion.

8.6.2.2 Inferences about the preceding determiner position

The question arises if the adjective position can give additional insights into the integration of the preceding determiner position as it was the case with the noun position in Experiment 1. In the first study, it was assumed that the integration of the previously disregarded determiner alternatives of *der*$_{\text{DAT.F.SG}}$ and *den*$_{\text{DAT.PL}}$ should have resulted in absent P600 effects on the subsequent noun position for *Kundin* and *Bäckern*. This argument is not employable for the adjective position in this experiment. If, again, an integration of the abandoned determiners *der*$_{\text{DAT.F.SG}}$ and *den*$_{\text{DAT.PL}}$ is assumed, the subsequent target adjective *kleinen* would consist of the disjunctive feature specification. This bundle would at least have made it necessary to be restored into individual forms which would cause processing cost but more crucially it would provide features that are incompatible with *der*$_{\text{DAT.F.SG}}$ and *den*$_{\text{DAT.PL}}$. In the former case, *kleinen*'s disjunct [+PL] would categorically oppose *der*$_{\text{DAT.F.SG}}$'s [+F] while the adjective's disjunct [+M] would be categorically incompatible with *den*$_{\text{DAT.PL}}$'s [+PL]. Regardless of the integration of Der as the preferred and higher ranked *der*$_{\text{NOM.M.SG}}$ or the lower ranked dispreferred *der*$_{\text{DAT.F.SG}}$ or Den as the preferred and higher ranked *den*$_{\text{ACC.M.SG}}$ or the lower ranked dispreferred *den*$_{\text{DAT.PL}}$, P600 effects should occur due to the introduction of incompatible features. Thus, no inferences can be drawn about the adjective position from the preceding determiner integration.

However, recall that all hypotheses are based on the comparisons of TMP's claims. As the previous experiment showed, some underspecification approaches can be rejected as they make illicit predictions for the noun position. Depending on whether an SP$_{\text{NOM}}$ was assumed, select accounts predict determiners that would not allow for nominative or accusative DPs. Consequently, their subsequent noun integration is similarly ungrammatical as they favor dative feminine or dative plural DPs notwithstanding that the structure targets the aforementioned contexts. Even though the featural comparison across conditions may be deviating due to the aforementioned reasons of disjunctive specifications or categorically incompatible features, recall from the comparative adjective rankings in Table 8.3 that TMP still predicts the correct adjective after *der*$_{\text{NOM.M.SG}}$, namely *kleine*, while it disprefers *kleinen*. Similarly, TMP still predicts *kleinen* after *den*$_{\text{ACC.M.SG}}$. To sum up these remarks on the adjective position, the collected data suggests that DerAe was integrated as *kleine*$_{\text{NOM.M.SG}}$, DerAen as *kleinen*$_{\text{DAT.F.SG}}$ and DenAen as *kleinen*$_{\text{ACC.M.SG}}$.

8.6.3 Noun position

After the intricate preceding DP position, addressing the present noun position turns out to be equally challenging since prior hypotheses are no longer applicable. If consistency in the line of argument was still to be maintained, the predictions that assumed no prior SP$_{\text{NOM}}$ should be the crucial hypotheses. In particular, it was hypothesized in (56a-iii) that, at the noun position, gradually more pronounced NEGs should arise for DerAenNin, DenAenNern and DerAeNer in comparison to DenAenNer. This effect should have been followed by a P600 for DerAenNin's and DenAenNern's incompatibility route.

(60) Hypotheses with no SP$_{\text{NOM}}$:
NEG: DerAeNer < DerAenNin = DenAenNer < DenAenNern
P600: DerAeNer = DenAenNer < DerAenNin = DenAenNern

ERP result:
NEG: DerAeNer = DenAenNer = DenAenNern < DerAenNin
P600: DerAeNer = DenAenNer[32] < DerAenNin = DenAenNern

The noun effects mirror the first experiment's insofar, as DenAenNer and DenAenNern again deviate from the predictions with a reversed order of effect strengths. It could again be argued that a compatibility violation that involved a [+F] feature was more severe than one that concerned a [+PL] feature. At this point, the discussion about a feature hierarchy will also be postponed to Sections 10.2.2.1 and 10.2.3. Apart from that, the results mirror the hypotheses insofar that DerAeNer was the easiest noun to integrate. However, it was not predicted that it would pattern with DenAenNer and DenAenNern. The only common ground is the gradation between DerAeNer and DerAenNin even though it was not predicted that both are located at the endpoints of the gradation. Therefore, as with the adjective position, the noun data does not allow either to further discuss Question 3 on what the contribution of an SP$_{\text{NOM}}$ is. The occurrence of the P600 effect again suggests categorically opposing features for DenNern and DenAenNer by introducing [+F] and [+PL] features respectively that were incompatible with the feature specification's [+M].The assumption of incompatibility is only informative insofar as it can explain the pronounced NEG effect for DerAenNin but not the absence of such an effect for DenAenNern. In both cases, the introduction of an incompatible feature should have demoted the respective nouns in their rankings. For now, a rationale for the noun

[32] Also marginally for DenAenNer.

position has to be postponed to the General Discussion as no concise answer for the observed ERP differences can be given at this point.

While the deviating results of the preceding DP position would suggest that the noun results could not be interpreted against the background of the original hypotheses since they were based on the preceding adjective hypotheses, it has to be reprised that TMP still correctly and grammatically predicted the appropriate nouns: According to the mechanism's comparative noun rankings in Table 8.4, *Bäcker*$_{\text{NOM.M.SG}}$ is predicted after *der*$_{\text{NOM.M.SG}}$ followed by *kleine*$_{\text{NOM.M.SG}}$ since the structure is sufficiently disambiguated after the adjective to the eventually targeted NOM.M.SG context. Similarly, after *der*$_{\text{DAT.F.SG}}$ and *kleinen*$_{\text{DAT.F.SG}}$, TMP preferably predicts *Kundin*$_{\text{DAT.F.SG}}$ as the adjective made the DP distinct enough. Therefore, the system can build up the targeted DAT.F.SG structure after the adjective position already, as indicated by its P600 elicitation. However, after *den*$_{\text{ACC.M.SG}}$ and *kleinen*$_{\text{ACC.M.SG}}$, the system predicts *Bäcker*$_{\text{ACC.M.SG}}$ in order to realize the desired ACC.M.SG DP. In contrast to that, *Bäckern*$_{\text{DAT.PL}}$ is dispreferred which, in turn, is mirrored by the P600, indicating a reanalysis of the previously prevalent ACC.M.SG interpretation towards the targeted DAT.PL context. For these reasons, the original hypotheses from (56a-iii) can still be upheld against which the ERP results are compared in (60).

8.7 Interim Conclusion

Summarizing the determiner, adjective and noun effects, it has to be accepted that the obtained ERP data are not coherent under the current assumptions since they cannot be entirely mapped onto TMP's hypotheses. However, for the determiner position, it can be concluded that, as in Experiment 1, the data suggests that Der was integrated as *der*$_{\text{NOM.M.SG}}$ and Den as *den*$_{\text{ACC.M.SG}}$. For the adjective position, the results were not as conclusive. While, according to TMP's original rankings, *kleine* after *der*$_{\text{NOM.M.SG}}$ and *kleinen* after *den*$_{\text{ACC.M.SG}}$ were still assumed to be preferred, DenAen was not easier with regard to integration in comparison to DerAe. However, this was the prediction. The data suggested the opposite gradation: DerAe < DenAen. Yet, this issue was addressed by acknowledging the adjective's disjunctive feature bundles. It was speculated that additional processing was necessary to resolve the disjunction of *kleinen* and to restore its original forms. This posed a disadvantage for said adjective and made the integration of DerAe measurably easier. It produced an attenuated NEG in comparison to both DerAen and DenAen. In case of DerAen, this resulted in a reanalysis of the determiner *der*$_{\text{NOM.M.SG}}$ in favor of the previously disregarded *der*$_{\text{DAT.F.SG}}$. With regard to the subsequent noun position, the picture became even more obscure. Only part of the hypothesized scale of (56a-iii) was mirrored by the results. It was predicted that DerAeNer would produce a smaller NEG than DerAenNin. This was actually the case and could be accounted for by the categorically opposing feature [+F] provided by the noun. The assumption was corroborated by the subsequent P600 for this very noun. However, it also produced the most pronounced NEG of all nouns, deviating entirely from the predicted gradation. The General Discussion will address this issue.

The evidence available further strengthens TMP's explanatory adequacy insofar that the determiners' results from Experiment 1 could be replicated. In parallel to the previous study, TMP adequately predicted not only that one element was preferably predicted and integrated over another but also presented reasons why this may be the case. However, the crux of minuscule, innumerable features at incrementally available positions becomes obvious. These are two sides of the same coin: While, on the one hand, the multitude of features that meet may lead to an exponentially growing number of parses, this fact, on the other hand, reveals the present approach also as a powerful means to explore sentence processing on an unprecedented fine-grained level.

9 Experiment 3: Processing of Ungrammatical Three-Element DPs

9.1 Introduction: Ungrammaticality

Experiment 1 suggested that, except for Bierwisch's and Wunderlich's accounts, the other underspecification frameworks yielded not only noun gradations irrespective of a present or absent SP_{NOM}, that were not reflected by the obtained ERP results, but more importantly ungrammatical predictions. To be precise, Blevins' original and maximally underspecified feature sets as well as Wiese's framework entailed illicit claims and predicted ungrammatical DPs as detailed in Appendices B.2.2.1, B.2.2.2 and B.2.2.4. However, ungrammaticality is a measure to further increase the complicacy of featural transition between DP positions. Hence, it can serve as yet another way to investigate Question 3 on how the processing of the positions' contact points manifest itself in ERP effects. Specifically, it will be interesting to see whether a certain type of features—positive or negative—triggers ungrammaticality. It seems also conceivable that particular contact points of featural incompatibility are responsible for strong ungrammaticality cues. Furthermore, it is possible that crossing a threshold along the predicted ranked candidates causes ungrammaticality. The deeper the access of a candidate within the list, the higher the possibility of ungrammaticality. Therefore, the aspect of illicit structures shall be investigated in a more controlled way.

Again, mirroring the previous investigations, the Parsing Prerequisites I to III have to be satisfied. With regard to Parsing Prerequisite I, as already mentioned in Section 8.4.2, the four elongated DPs from the previous investigation will be reused and repurposed. In order to receive ungrammatical structures, the sequence of (61a)'s determiner, adjective and noun—namely *der kleine Bäcker*—will be used with its original grammatical but also with an ungrammatical *den* and *dem*. In effect, all three determiners *der*, *den* and *dem* are followed by the adjective *kleine*. Thus, in the case of *den* and *dem*, *kleine* introduces an ungrammaticality since *kleinen* would be the correctly inflected form. This yields the DPs in (61). Figure 9.1 visualizes the parses the language processor has to go through in order to analyze the structures of (61). Regarding the lexical material, Parsing Prerequisite I can be considered as set. Moreover, no separate feature preparations are necessary, since the three determiners *der*, *den* and *dem*, the adjective *klein* and the noun *Bäcker* were already specified for the previous investigations. Thus, Parsing Prerequisite II is also satisfied. Unsurprisingly, the TMP's deployment as the parsing mechanism of choice sets the remaining Parsing Prerequisite III.

(61)	a.	der	kleine	Bäcker
		the.NOM.M, DAT.F	small.NOM.M, NOM/ACC.N/F	baker.NOM.M
	b.	den	*kleine	Bäcker
		the.ACC.M, DAT.PL	small.ACC.M, DAT, GEN, PL	baker.NOM.M
	c.	dem	*kleine	Bäcker
		the.DAT.M/N.SG	small.ACC.M, DAT, GEN, PL	baker.NOM.M

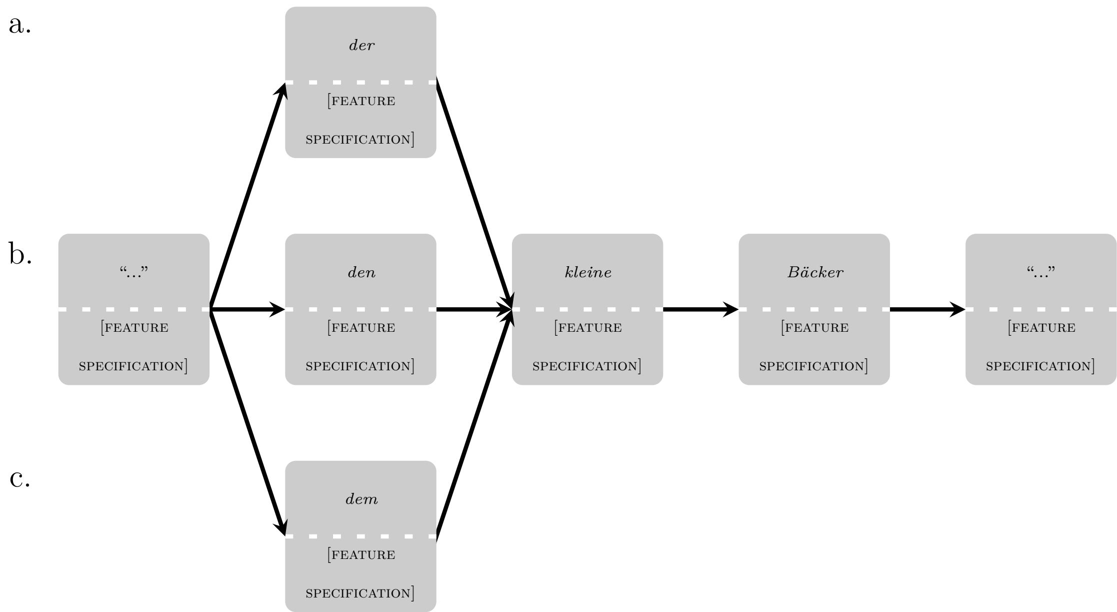


Figure 9.1: Visualization of (61a–61c).

9.1.1 TMP's calculations: Parsing using Bierwisch's features

Since the Parsing Prerequisites I to III are again readily available, TMP can perform its calculations a third time. For reasons of readability and brevity, the three DPs of (61) are investigated for Bierwisch's features without an assumed a priori SP_{NOM} in Appendix D. This section will be restricted to the ranked candidates for determiners and adjectives. Since (61b) and (61c) are ungrammatical after the adjective position, no noun analyses shall be made as no clear claims can be derived from these illicit structures. Recall from Experiment 2 that, at the noun position, claims would be based on the preceding adjective and, in turn, their integration again on determiner claims. This potentiation is prone to unpredictable misconceptions. Thus, the DP-final position will be omitted from the investigation. Crucially, the outcome of Appendix D will be concluded with TMP's claims in the subsequent Section 9.1.2 with regard to the expected calculatory *simplicity* or *complexity* for the determiner, adjective and noun integration. These comparisons will then allow for acute hypotheses that will be empirically tested afterwards.

9.1.2 TMP's claims

Parallel to previous claims in Sections 5.3 and 8.1.3, this section will likewise formalize TMP's claims based on the outcomes of the three-element parsing calculations from Appendix D. As in Section 8.1.3, the determiner- and noun-dependent comparisons will be done for Bierwisch only.

The following comparisons shall be carried out for (61)'s DPs: At the determiner position, *der* in (61a) shall be compared to *den* in (61b) as well as with *dem* in (61c) and *den* in (61b) shall be compared to *dem* in (61c). Similarly, at the adjective position, *kleine* after *der* in (61a) shall be compared to **kleine* after *den* in (61b) as well as after *dem* in (61c). Furthermore, **kleine* after *den* in (61b) shall be compared to **kleine* after *dem* in (61c). Since (61b) and (61c) are ungrammatical after the adjective position, no noun analyses were made. Thus, no claims will be made for the noun position.

9.1.2.1 Assuming no prior SP_{NOM}

Parallel cross-comparisons have to be collected for the parses without a preceding SP_{NOM}. Again, they will mainly refer to the derivation of ranked candidates but also include comments towards the processing of incoming incompatible features.

9.1.2.1.1 Determiner position Parallel to Paragraph 9.1.2.1.1, no comparative overview of the approaches' determiner rankings is necessary since Bierwisch is the underspecification framework that remains for further investigation. The determiner rankings are thus confined to Table D.1. Again, the top-ranked candidate after no preceding SP_{NOM} filter specification is $das_{NOM/ACC.N.SG}$. There are five lower ranked target determiners for *der* in (61a), *den* in (61b) and *dem* in (61c): The determiner *der* in the $der_{NOM.M.SG}$ alternative outranks $der_{DAT.F.SG}$. The former occupies the second while the latter occupies the third rank. With regard to *den*, the candidate in the $den_{ACC.M.SG}$ alternative ranks above $den_{DAT.PL}$ with the former at the third and the latter at the fourth rank. The third targeted determiner $dem_{DAT.M/N.SG}$ occupies rank three. This yields the following ranking: $der_{NOM.M.SG} < den_{ACC.M.SG} = dem_{DAT.M/N.SG} = der_{DAT/GEN.F.SG;\ GEN.PL} < den_{DAT.PL}$. However, at the determiner position, the targeted candidates of $der_{NOM.M.SG}$ and $der_{DAT.F.SG}$ both appear to TMP as *der* while $den_{ACC.M.SG}$ and $den_{DAT.PL}$ appear indistinguishably as *den*. The higher ranking alternative of either *der* or *den* will be integrated. Therefore, for the integration at the determiner position, only the comparison of $der_{NOM.M.SG}$ versus $den_{ACC.M.SG}$ versus $dem_{DAT.M/N.SG}$ is relevant. Since the first outranks the other two, TMP predicts the following gradation under the assumption of an absent SP_{NOM} and Bierwisch's features: $der_{NOM.M.SG} < den_{ACC.M.SG} = dem_{DAT.M/N.SG}$. However, in order to derive hypotheses for the later Experiment 3, the gradation (62) can be isolated.

(62) Bierwisch:
$der_{NOM.M.SG} < den_{ACC.M.SG} = dem_{DAT.M/N.SG} = der_{DAT.F.SG} < den_{DAT.PL}$

Turning to incompatibility, the current scenario mirrors Section 5.2.2 insofar as, due to the lack of an SP_{NOM}, the features introduced by *den* or *dem* again cannot oppose the filter specification. Therefore, this does not result in incompatibility either for *den*$_{\text{ACC.M.SG}}$ or for *dem*$_{\text{DAT.M.SG}}$.

9.1.2.1.2 Adjective position Turning to the adjective position, Table 9.1 gives an overview of the relevant rankings. It consists of three filter specifications, the top-ranked candidate and the alternatives of the targeted adjectives from (61). The overview amasses all the ranks and constraint violations directly from the rankings in Tables D.2 to D.4 for Bierwisch. Like the summary for the determiner above, it reads in the following way: For a filter specification of *der*$_{\text{NOM.M.SG}}$, *kleine* is the top-ranked candidate while it is *kleinen* for *den*$_{\text{ACC.M.SG}}$ and *dem*$_{\text{DAT.M/N.SG}}$. This yields the following ranking: *kleinen* after *den*$_{\text{ACC.M.SG}}$ < *kleine* after *der*$_{\text{NOM.M.SG}}$ < **kleine* after *den*$_{\text{ACC.M.SG}}$ = **kleine* after *dem*$_{\text{DAT.M/N.SG}}$ < *kleinen* after *der*$_{\text{NOM.M.SG}}$. For the hypotheses' derivation in Experiment 3, however, the gradation in (53) is relevant.

(63) Bierwisch:
kleine$_{\text{NOM.M.SG}}$ < **kleine* = **kleine*

Regarding to incompatibility, Table 9.1 shows that *kleine* does not introduce opposing features. Hence, there is no incompatibility for *kleine*.

Table 9.1: Overview of all relevant ranked candidates for the adjective position.

rank	adjective	specification	↯	🔍− ⇒	🔍− ⇐	🔍+
	filter specification: [+M] (by current material's *der*$_{\text{NOM.M.SG}}$ from prior step)					
1.	*kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[Ø]	0	1	0	0
2.	*kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$	[[+OBJ, +M] ∨ +OBL ∨ +PL]	0	3	3	1
	filter specification: [+OBJ, +M] (by current material's *den*$_{\text{ACC.M.SG}}$ from prior step)					
1.	*kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$	[[+OBJ, +M] ∨ +OBL ∨ +PL]	0	0	0	2
2.	*kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[Ø]	0	2	0	0
	filter specification: [+OBJ, +OBL] (by current material's *dem*$_{\text{DAT.M/N.SG}}$ from prior step)					
1.	*kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$	[[+OBJ, +M] ∨ +OBL ∨ +PL]	0	1	0	1
2.	*kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[Ø]	0	2	0	0

9.1.2.2 Conclusion

The previous sections compared the different determiners and adjectives within Bierwisch's approach without a prevalent SP$_{\text{NOM}}$. Under these conditions, *der* was predicted instead of *den* and both determiners before *dem* as the incoming determiner, yielding the scale of *der*$_{\text{NOM.M.SG}}$ < *den*$_{\text{ACC.M.SG}}$ = *dem*$_{\text{DAT.M/N.SG}}$. For the subsequent adjective position, Bierwisch's framework predicted differences for the integration of *kleine* versus *kleinen* depending on the previous determiner integration. No claims were derived for the noun position as two of the three structures were rendered ungrammatical after the adjective position.

9.2 From Claims to Hypotheses

The final experiment is technically again concerned with the incremental processing of three sequentially available inflected word forms. Section 9.1 raised the issue of ungrammaticality being an additional means to further test TMP's behavior at the transition from one to another position. Therefore, the structures from the second experiment in (55)—here repeated in (64)—will be altered at the adjective position in order to construct ungrammatical DPs. However, as it was pointed out in Section 9.1.1, only two of the three available positions will be investigated: the determiner and the subsequent adjective while the latter introduces an ungrammaticality. This is due to the multitude of prediction-related conjectures across positions leading to unpredictable subsequent assumptions after the ungrammaticality was processed.

As it was done for Experiments 1 and 2 in Sections 7.2.1 and 8.2 respectively, the structures in (64) have to be denoted with position-dependent labels for ambiguous and subsequent disambiguating elements in order to set the stage for subsequent hypotheses. Again, Der and Den represent the determiner position. Even though the *dem* determiner in question is, due to the space of hypotheses, not as ambiguous in the way that *der* and *den* are, a similar designation is chosen for this position: Dem. For the intermediate adjectives, ${}_{\text{Der}}\text{Ae}$, ${}_{\text{Den}}\text{Ae}$ and ${}_{\text{Dem}}\text{Ae}$ are the designations of choice. The three positions realize a NOM.M.SG context as well as ungrammatical ACC and DAT structures respectively:

(64) a. NOM.M.SG:

der	kleine	Bäcker
the.NOM.M, DAT.F	small.NOM.M, NOM/ACC.N/F	baker.NOM.M
Der	${}_{\text{Der}}\text{Ae}$	

b. ACC UNGR.:

den	*kleine	Bäcker
the.ACC.M, DAT.PL	small.ACC.M, DAT, GEN, PL	baker.NOM.M
Den	${}_{\text{Den}}\text{Ae}$	

c. DAT UNGR.:

dem	*kleine	Bäcker
the.DAT.M/N.SG	small.ACC.M, DAT, GEN, PL	baker.NOM.M
Dem	${}_{\text{Dem}}\text{Ae}$	

In contrast to (55), (64) does not reveal the two-way disambiguating nature of the DPs for several reasons. The adjective position does not need to disambiguate the preceding determiner since the DP-inital position is not ambiguous. Since the same adjective is employed in all three structures, it already renders the DPs ungrammatical in (64b) and (64c). The DP-final noun is identical across all three structures. This results in a still grammatical DP in (64a), while the ungrammaticality in (64b–64c) will not be altered.

As it was done for the first and second experiment in Sections 7.3 and 8.3 respectively, TMP's claims from Section 9.1.2 can again be easily transformed into hypotheses by applying the two aforementioned ERP components in the way specified for the first study in Section 7.2.2. It must be noted again that this procedure is potentially problematic as the hypotheses of the adjective are dependent on the hypotheses of the initial determiner. For this very reason, as previously pointed out, the DP-final noun will not be part of the hypotheses.

9.3 Hypotheses

In parallel to Experiments 1 and 2, it has to be shown that in (64a), the processing system will ultimately analyze Der as *der*$_{\text{NOM.M.SG}}$, ${}_{\text{Der}}$Ae as *kleine*$_{\text{NOM.M.SG}}$ and ${}_{\text{DerAe}}$Ner as *Bäcker*$_{\text{NOM.M.SG}}$ in order to realize the targeted NOM.M.SG context. In contrast to that, while evidence must be found that, in (64b), the comprehension system finally integrates Den as *den*$_{\text{ACC.M.SG}}$, the analysis should discover the ungrammaticality at ${}_{\text{Den}}$Ae unable to fulfill a grammatical accusative context. Similarly, for (64c), it must be proven that—in the end—Dem will be analyzed as *dem*$_{\text{DAT.M/N.SG}}$ until the language comprehender encounters the ungrammaticality at ${}_{\text{Dem}}$Ae, incapable to build up a grammatical dative context.

The predicted ranked candidates that are arranged along a gradation from left to right, that is from lower to higher feature deviance, can again simply be mapped onto the predicted NEG. As before, lower and higher feature deviance correspond with TMP's *simpler* and more *complex* calculatory work and consequently with ERP effects reflecting less and more processing load. A P600 is expected for encountering and resolving incompatibility.

(65) a. Assuming no prior SP$_{\text{NOM}}$:
  i. Determiner position:
   NEG: Der < Den = Dem
   P600: Der = Den = Dem
  ii. Adjective position:
   NEG: ${}_{\text{Der}}$Ae < ${}_{\text{Den}}$Ae = ${}_{\text{Dem}}$Ae
   P600: ${}_{\text{Der}}$Ae = ${}_{\text{Den}}$Ae = ${}_{\text{Dem}}$Ae

9.4 Method

As already mentioned in Section 8.4, this study was carried out in conjunction with Experiment 2. This means that participants, data acquisition, procedure and data analysis were kept the same across both experiments. In case of deviation from this statement, there will be explicit notes on that matter.

9.4.1 Participants

Since the data for Experiment 3 was collected in conjunction with the second experiment, participant properties were identical to Experiment 2.

9.4.2 Materials

Like before for the first and second study, the experimental sentences of the third experiment shared the properties of those TMP dealt with in Section 9.1.1, again expanded by PPs after the two DP arguments. Thus, apart from the first two experiments, the third investigation will test structures that become ungrammatical as soon as the adjective becomes available. Again, this results in the subordinate Der, Den and Dem conditions, followed by three subordinate DerAe, DenAe and DemAe conditions that constitute the three syntactic target structures, namely NOM.M.SG, ACC ungr. and DAT ungr..

(66) Experimental items:

a. NOM.M.SG:

In der Pause hat der schwere Boxer aus Nippes den Trainer aus
In the break has the heavy boxer from Nippes the coach from
Der DerAe
Zollstock angeschrien.
Zollstock shouted-at

"During the break, the heavy boxer from Nippes shouted at the coach from Zollstock."

b. ACC ungr.:

In der Pause hat den *schwere Boxer aus Nippes den Trainer aus
In the break has the *heavy boxer from Nippes the coach from
Den DenAe
Zollstock angeschrien.
Zollstock shouted-at

c. DAT ungr.:

In der Pause hat dem *schwere Boxer aus Nippes den Trainer aus
In the break has the *heavy boxer from Nippes the coach from
Dem DemAe
Zollstock angeschrien.
Zollstock shouted-at

Following (66), 40 lexical sets—with three sentences each resulting in a total of 120 experimental items—were constructed. The entirety of the critical material is listed in Appendix E.3. Since Experiments 2 and 3 were carried out in conjunction, not only the 80 filler items that were discussed for the second study will be used in the present investigation too, but also second experiment's 160 critical sentences will serve as filler items. Self-evidently, the 120 critical and 240 filler items were part of the same two pseudo-randomized lists as in Experiment 2.

9.4.3 Data acquisition, procedure and data analysis

The present study was carried out in conjunction with Experiment 2. Thus, it held the same technical parameters for the data acquisition. The experiment's procedure, the technical details of the stimulus presentation as well as the data analysis were also identical to the previous Experiment 2. However, the rejection rates differed as follows: At the determiner position, 10.53 % of the trials for Der, 9.87 % of the trials for Den and 10.53 % of those of Dem had to be excluded due to artifacts. Also due to artifacts, at the adjective position, 10.80 % of the $_{Der}$Ae, 11.33 % of the $_{Den}$Ae and 10.00 % of the trials of the $_{Dem}$Ae conditions had to be rejected.

Since Experiment 3 was carried out in conjunction with the second study, the selected time windows are the same for both investigations: 300–400 ms and 450–600 ms for the determiner and 350–450 ms and 550–650 ms for the adjective position. Furthermore, the remaining technicalities with regard to ERP data computation of the respective conditions and ROIs as well as the configuration of the electrodes were also identical to Experiment 2. Furthermore, again, all trials of the grammaticality judgment entered the analysis. In parallel to the preceding investigation, P-values for all effects with more than one degree of freedom were corrected by Huynh-Feldt correction (Huynh and Feldt, 1970). The significance level of determiners and adjectives remained uncorrected at $p < 0.05$.

9.5 Results

Figure 9.2 illustrates the determiners Der, Den and Dem time-locked to their onset. The ERPs at the determiner position revealed a broadly distributed negativity at around 400 ms for Den compared to Der and a slightly attenuated effect for Dem in contrast to Der. Figure 9.2 shows the gradation between the determiner positions Der, Den and Dem time-locked to their onset. Unlike in the previous two experiments, a positivity emerged for both Den and Dem in comparison to Der.

Figure 9.3 plots the contrast of $_{Der}$Ae, $_{Den}$Ae and $_{Dem}$Ae relative to the onset of the adjective. It illustrates both negativity and a positivity for $_{Den}$Ae and $_{Dem}$Ae in comparison to $_{Der}$Ae.

In the following, the statistical analyses are presented separately for the position of the determiner and the adjective for two relevant time windows.[33] No analysis will be conducted for the noun position as it is assumed that no concise hypothesis can be derived from an ungrammatical structure-final element.

[33] As mentioned above, all effects of multiple pairwise comparisons were corrected by the Bonferroni-Keppel procedure (Keppel and Wickens, 1973). Abbreviations for Bonferroni-corrected p-values: (*) = $p < 0.08$, * = $p < 0.03$, ** = $p < 0.01$, *** = $p < 0.001$, n.s. = not significant.

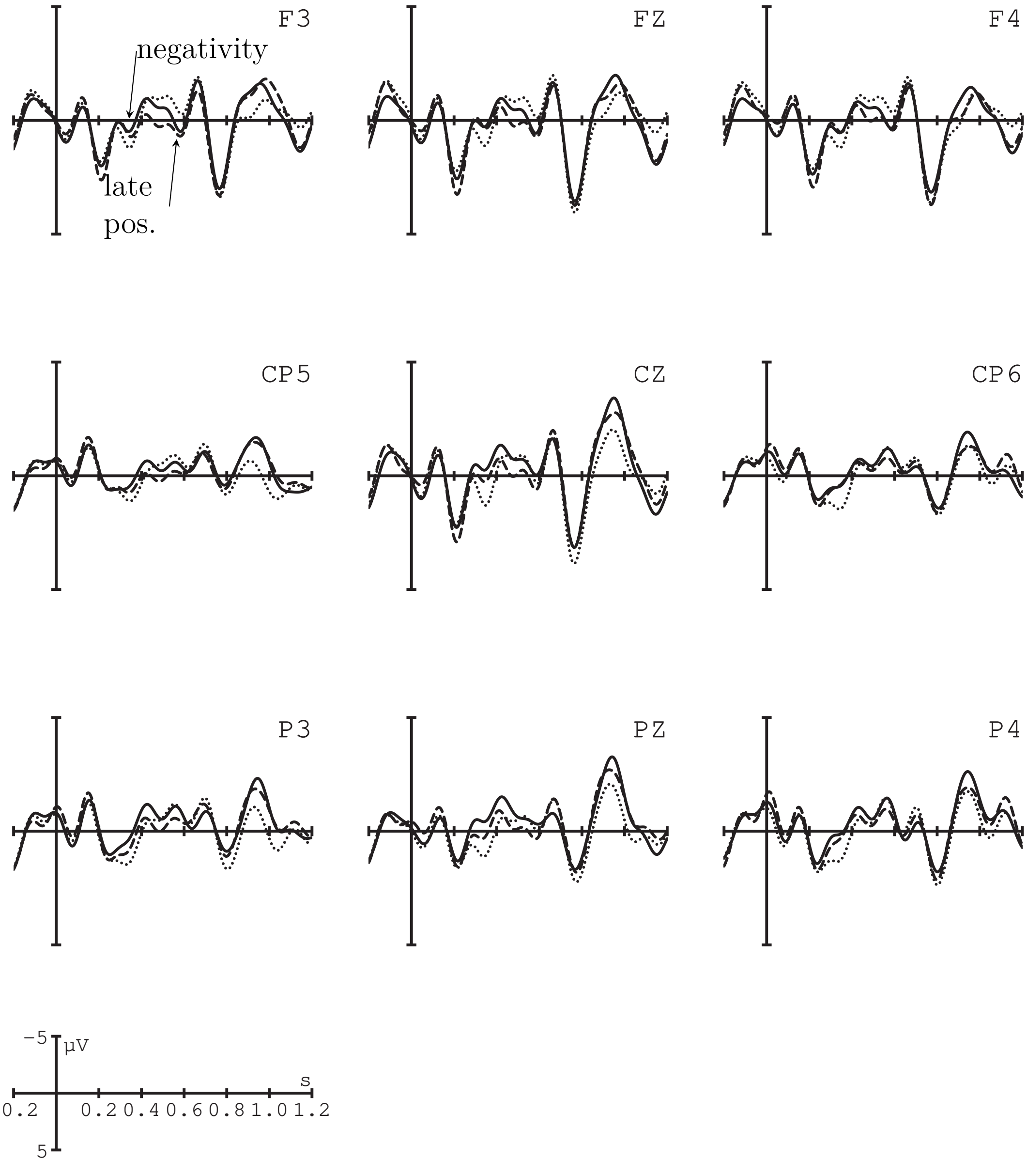


Figure 9.2: ERP effects (n=19) observed at the determiner position for Der (··············), Den (———) and Dem (------). The time window spans from 200 ms before determiner onset to 1200 ms after (onset at vertical bar). Negativity is plotted upwards.

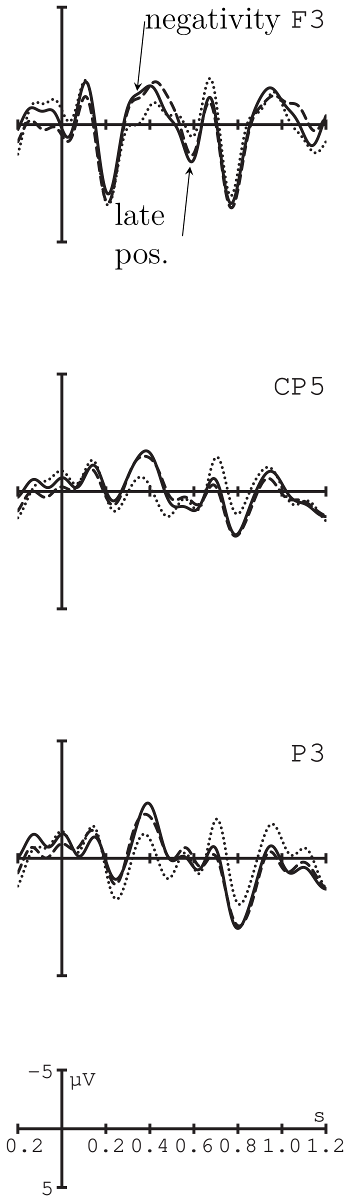


Figure 9.3: ERP effects (n=19) observed at the adjective position for DerAe (··········), DenAe (———) and DemAe (------). The time window spans from 200 ms before noun onset to 1200 ms after (onset at vertical bar). Negativity is plotted upwards.

9.5.1 Determiner position

300–400 ms latency window Lateral hemisphere sites showed a significant effect of COND ($F(2,36) = 5.59$, $p < 0.01$) and no interaction of COND and ROI ($F(6,108) = 1.77$, $p > 0.1$). Pairwise comparisons for lateral electrode sites are displayed in Table 9.2.

In a similar fashion, midline electrode sites showed a significant effect for COND ($F(2,36) = 6.15$, $p < 0.01$) but no significant interaction of COND and ROI ($F(4,72)$

Table 9.2: Determiner effects of ANOVAs for lateral sites of the 300–400 ms latency window.

comparison	effect	df	F
DER vs. DEN	COND	1,18	14.33***
DER vs. DEM	COND	1,18	4.81(*)
DEN vs. DEM	COND	1,18	0.48 n.s.

$= 0.91$, $p > 0.4$). Pairwise comparisons for midline electrode sites are displayed in Table 9.3.

Table 9.3: Determiner effects of ANOVAs for midline sites of the 300–400 ms latency window.

comparison	effect	df	F
DER vs. DEN	COND	1,18	26.08***
DER vs. DEM	COND	1,18	3.60 n.s.
DEN vs. DEM	COND	1,18	1.28 n.s.

Experiment 3 replicated Experiments 1 and 2 insofar as for DEN a negativity emerged in comparison to DER. Furthermore, a negativity was elicited by DEM which did not differ from DEN. This is the pattern that was predicted by the hypothesis without an SP_{NOM} in (65a-i). For this reason, from hereon, only hypotheses that do not assume an SP_{NOM} will be considered when assessing the ERP data of subsequent adjective positions.

450–600 ms latency window Experiment 3 did not replicate the prior two experiments insofar as the analysis of the lateral electrode sites showed a significant effect of COND ($F(2,36) = 5.15$, $p = 0.01$) and also a significant interaction of COND and ROI ($F(6,108) = 4.47$, $p = 0.001$). Resolving this interaction for ROI revealed the most pronounced effects for left anterior electrode sites (left anterior $F(2,36) = 9.76$, $p < 0.001$; right anterior $F(2,36) = 3.52$, $p < 0.05$; left posterior $F(2,36) = 3.97$, $p < 0.03$; right posterior $F(2,36) = 1.84$, $p > 0.1$). Pairwise comparisons for lateral electrode sites are displayed in Table 9.4.

Table 9.4: Determiner effects of ANOVAs for lateral sites of the 450–600 ms latency window.

comparison	effect	df	left ant.	right ant.	left post.	right post.
			F	F	F	F
DER vs. DEN	COND	1,18	5.67*	2.28(*)	0.30 n.s.	–
DER vs. DEM	COND	1,18	18.81***	10.62*	7.05*	–
DEN vs. DEM	COND	1,18	4.12 n.s.	0.61 n.s.	4.88(*)	–

The analysis of the midline electrodes revealed a significant effect of COND ($F(2,36) = 3.46$, $p < 0.05$) and a significant interaction of COND and ROI ($F(4,72) = 3.00$, $p < 0.05$). Resolving this interaction by ROI revealed the most pronounced main effects for anterior electrode sites (anterior: $F(2,36) = 4.54$, $p < 0.03$; central: $F(2,36) = 2.55$, $p > 0.09$; posterior: $F(2,36) = 2.53$, $p > 0.09$). Pairwise comparisons for midline electrode sites are displayed in Table 9.5.

Table 9.5: Determiner effects of ANOVAs for midline sites of the 450–600 ms latency window.

comparison	effect	df	ant.	cent.	post.
			F	F	F
Der vs. Den	COND	1,18	1.74 n.s.	–	–
Der vs. Dem	COND	1,18	10.20*	–	–
Den vs. Dem	COND	1,18	2.86 n.s.	–	–

Unexpectedly, lateral and midline sites reveal a positive ERP effect for Den in contrast to Der. The same effect was marginally present for Dem compared to Der. Den and Dem seemed to not differ. The occurrence of a late positivity as a P600 was not predicted by the appropriate hypothesis in (65a-i).

9.5.2 Adjective position

350–450 ms latency window The main analysis for lateral hemisphere sites showed a significant effect for COND ($F(2,36) = 7.78$, $p < 0.01$) and a significant interaction of COND and ROI ($F(6,108) = 6.78$, $p < 0.001$). Resolving this interaction for ROI revealed the most pronounced effects for left posterior electrode sites (left anterior $F(2,36) = 9.71$, $p < 0.001$; right anterior $F(2,36) = 1.37$, $p > 0.2$; left posterior $F(2,36) = 11.44$, $p < 0.001$; right posterior $F(2,36) = 3.67$, $p < 0.05$). Pairwise comparisons for lateral electrode sites are displayed in Table 9.6.

Table 9.6: Adjective effects of ANOVAs for lateral sites of the 350–450 ms latency window.

comparison	effect	df	left ant.	right ant.	left post.	right post.
			F	F	F	F
DerAe vs. DenAe	COND	1,18	10.95***	–	17.65***	5.64*
DerAe vs. DemAe	COND	1,18	14.11***	–	12.53**	0.98 n.s.
DenAe vs. DemAe	COND	1,18	0.29 n.s.	–	0.87 n.s.	3.30 n.s.

Midline sites revealed a significant effect for COND ($F(2,36) = 7.56$, $p < 0.01$) but no significant interaction of COND and ROI ($F(4,72) = 0.27$, $p > 0.7$). Pairwise comparisons for midline electrode sites are displayed in Table 9.7.

Table 9.7: Adjective effects of ANOVAs for midline sites of the 350–450 ms latency window.

comparison	effect	df	F
DerAe vs. DenAe	COND	1,18	15.35***
DerAe vs. DemAe	COND	1,18	7.06**
DenAe vs. DemAe	COND	1,18	1.51 n.s.

The present data is mirrored by the hypothesis in (65a-ii) that assumed no SP_{NOM}. The data supports this prediction insofar as DenAe and DemAe produced a similar negativity compared to DerAe.

550–650 ms latency window The main analysis for lateral hemisphere sites showed no significant effect for COND ($F(2{,}36) = 2.27$, $p > 0.1$) but a significant interaction of COND and ROI ($F(6{,}108) = 4.30$, $p < 0.002$). Resolving this interaction for ROI revealed effects for anterior electrode sites (left anterior $F(2{,}36) = 3.24$, $p = 0.05$; right anterior $F(2{,}36) = 8.68$, $p < 0.001$; left posterior $F(2{,}36) = 0.45$, $p > 0.6$; right posterior $F(2{,}36) = 1.48$, $p > 0.2$). Pairwise comparisons for lateral electrode sites are displayed in Table 9.8.

Table 9.8: Adjective effects of ANOVAs for lateral sites of the 550–650 ms latency window.

comparison	effect	df	left ant.	right ant.	left post.	right post.
			F	F	F	F
DerAe vs. DenAe	COND	1,18	5.49*	12.50*	–	–
DerAe vs. DemAe	COND	1,18	3.97(*)	7.79*	–	–
DenAe vs. DemAe	COND	1,18	0.12 n.s.	2.55 n.s.	–	–

Midline electrode sites revealed no significant effect for COND ($F(2{,}36) = 1.96$, $p > 0.1$) but a significant interaction of COND and ROI ($F(4{,}72) = 6.91$, $p < 0.01$). Resolving this interaction for ROI revealed the most pronounced effects for anterior electrode sites (anterior: $F(2{,}36) = 6.49$, $p < 0.01$; central: $F(2{,}36) = 1.73$, $p > 0.1$; posterior: $F(2{,}36) = 0.31$, $p > 0.7$). Pairwise comparisons for midline electrode sites are displayed in Table 9.9.

As with the determiner position, no P600 should occur at the adjective position if no SP_{NOM} is assumed. However, lateral sites show that, similar to the preceding position, a late positivity occurred for DenAe and DemAe compared to DerAe. Due to this, the data does not corroborate any hypothesis for this position.

Table 9.9: Adjective effects of ANOVAs for midline sites of the 550–650 ms latency window.

comparison	effect	df	ant.	cent.	post.
			F	*F*	*F*
DerAe vs. DenAe	COND	1,18	12.98**	–	–
DerAe vs. DemAe	COND	1,18	7.43*	–	–
DenAe vs. DemAe	COND	1,18	0.39 n.s.	–	–

9.6 Discussion

Replicating the previous investigations, Experiment 3 showed a negativity for Den in comparison to Der between 300 and 400 ms. This effect was also present for the Dem condition. The 450–600 ms latency window departed from Experiments 1 and 2 insofar as a late positivity was observed for both Den and Dem compared to Der. At the subsequent adjective position, DenAe and DemAe elicited a more pronounced negativity in comparison to DerAe. In the 550–650 ms time window, both DenAe and DemAe evoked positive ERP effects compared to DerAe.

The following sections seek to assess the obtained ERP effects for the determiner and the adjective positions insofar as they will address whether one of the *der* and *den* alternatives—*der*$_{\text{NOM.M.SG}}$ or *der*$_{\text{DAT.F.SG}}$ and *den*$_{\text{ACC.M.SG}}$ or *den*$_{\text{DAT.PL}}$ respectively—was integrated at Der and Den. In a similar fashion, for the adjective position, it will be interesting to see which analyses were entertained at DerAe, DenAe and both DemAe positions.

9.6.1 Determiner position

At first glance, the determiner results again seem to exactly mirror the hypotheses based on Bierwisch's framework without a preceding SP$_{\text{NOM}}$ filter specification. For this experiment, it was predicted that both Den and Dem would produce a more pronounced NEG effect in comparison to Den. The hypotheses argued for this very pattern as TMP's respective SP$_{\text{NOM}}$-less claims from Paragraph 9.1.2.1.1 were based on the determiner ranking in Table D.1. There, *der*$_{\text{NOM.M.SG}}$ outranked the equally ranked *den*$_{\text{ACC.M.SG}}$ and *dem*$_{\text{DAT.M/N.SG}}$. The mapping of the hypotheses from (65a-i) onto the NEG results is given in (67). The results exactly mirror TMP's prediction of more *complex* calculatory work for Den and Dem due to their higher compared to Der's lower feature deviance. The more pronounced NEG effects for both Den and Dem suggest that structures with a DP-initial *den* or *dem* determiner were morphosyntactically harder to process than DPs introduced by *der*.

(67) Hypotheses with no SP$_{\text{NOM}}$:
NEG: Der < Den = Dem
P600: Der = Den = Dem

ERP result:
NEG: Der < Den = Dem
P600: Der < Den = Dem

With regard to Question 3 on how the featural transition is mirrored by ERP effects, the present experiment supports the idea that equally complex contact points are represented by clustering ERP results. Recall from TMP's claims that the overview for the adjectives showed that both $_{\text{Den}}$Ae's and $_{\text{Dem}}$Ae's *kleine* lacked two features in a forward-directed search while all other constraints were zero. Thus, both adjectives had identical transitional feature properties irrespective of a preceding *den* or *dem*. This was mirrored by two indiscernible NEG effects. In contrast to that, $_{\text{Der}}$Ae only had one non-retrievable feature due to which its NEG was less pronounced than for the other two adjectives.

In the previous two experiments, no P600 emerged for non-Der determiners which supported SP_{NOM}-free hypotheses. In contrast to that, the present study produced this unexpected effect for Den and Dem. This result was not predicted by the hypotheses that neglected a precursory SP_{NOM} filter specification. Although previously obtained data led to the rejection of a precursory SP_{NOM} filter specification and thus to a corroboration of SP_{NOM}-free analyses and hypotheses, this agreement shall be suspended for a brief explanation with a preceding SP_{NOM}.

> If an SP_{NOM} filter specification is assumed for the structures in (61) instead, rankings, claims and hypotheses other than the current ones that lacked an SP_{NOM} entail. As a first step, the appropriated ranked predicted candidates have to be derived as given in Table 9.10.

Table 9.10: Ranked determiner candidates after an SP_{NOM}.

rank	filter specification: [−OBJ, −OBL, −PL] (by current material's SP_{NOM} + *hat*)		ϟ	🔍−		🔍+
	determiner	specification		⇒	⇐	
1.	$das_{\text{NOM/ACC.N.SG}}$	[Ø]	0	3	0	0
2.	$der_{\text{NOM.M.SG}}$	[+M]	0	3	1	0
3.	$die_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[+PL ∨ +F]	1	3	1	0
	$des_{\text{GEN.M/N.SG}}$	[+OBL]	1	3	1	0
4.	$den_{\text{ACC.M.SG}}$	[+OBJ, +M]	1	3	2	0
5.	$dem_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL]	2	3	2	0
	$der_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL, [+PL ∨ +F]]	2	3	2	0
6.	$den_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	3	3	3	0

> With this ranking, TMP predicts the following gradation under the assumption of a present SP_{NOM} and Bierwisch's features: $der_{\text{NOM.M.SG}}$ < $den_{\text{ACC.M.SG}}$

< $dem_{\text{DAT.M/N.SG}}$. However, in order to derive a new SP_{NOM}-based hypotheses, the following gradation (68) can be isolated. This claimed gradation can be easily transformed into the hypotheses in (69) by applying NEG and P600 components in the way specified Section 7.2.2.

(68) Bierwisch:
$der_{\text{NOM.M.SG}} < den_{\text{ACC.M.SG}} < dem_{\text{DAT.M/N.SG}} = der_{\text{DAT.F.SG}} < den_{\text{DAT.PL}}$

(69) Assuming a prior SP_{NOM} for the determiner position:
NEG: DER < DEN < DEM
P600: DER < DEN = DEM

Interestingly, the SP_{NOM}-related predictions from (69) hypothesized the occurrence of two clustering P600 effects for DEN and DEM in comparison to DER. This hypothesis was mirrored exactly by the experimental data. Unfortunately, this approach not only contradicts the previous findings that suggested the absence of an SP_{NOM} filter specification, it can also not explain the NEG effects: According to (69), a graded NEG with DER < DEN < DEM would have been predicted if there was a precursory SP_{NOM}. However, the results showed the gradation of DER < DEN = DEM which was actually mirrored by the obtained determiner data. Taking both approaches together, the results are inconclusive insofar as the NEG effects clearly favor hypotheses without an SP_{NOM} filter specification while the P600 effects, in contrast, would corroborate the hypotheses that assumed a precursory SP_{NOM} filter specification. Since two preceding experiments allowed to reject SP_{NOM}-based hypotheses, this line of argument shall be followed for this study too. Therefore, the deviating P600 effects have to be explained differently.

The sole difference between Experiments 1 to 2 and Experiment 3 at the determiner position is the additional *dem*. Therefore, the difference in the P600 pattern has to be attributed to its presence. Looking back at the experiment's critical items, the distribution of *dem* stands out. Since Experiment 3 was carried out in conjunction with the second experiment, *dem* occurred three times less often compared to *der* and *den* and two times less often in comparison to the fillers' *die*. This reveals the determiner *dem* to be very salient in contrast to the other determiners. It is possible that both *dem*'s non-frequent salience as well as its visual distinctness triggered a more thorough and deeper analysis by the language comprehenders thus allowing for a strategy due to which non-canonical structures—that is both DPs introduced by *den* and *dem*—received more processing attention. If this was the case, the observed P600 effects for DEN and DEM may not be related to morphosyntactically triggered processes. Rather, they have to be attributed to an unbalanced item design.

9.6.2 Adjective position

The adjective position continues the same ERP patterns that were already observed on the preceding determiner position. With regard to the NEG effect, the results represent the hypotheses that assumed no a priori SP_{NOM} perfectly. In Paragraph 9.1.2.1.2, TMP claimed that the ungrammatical $_{\mathrm{Den}}$Ae and $_{\mathrm{Dem}}$Ae adjectives were harder to integrate than $_{\mathrm{Der}}$Ae. This was mirrored by the results as summarized in (70).

(70) Hypotheses with no $\mathrm{SP_{NOM}}$:
NEG: $_{\mathrm{Der}}$Ae < $_{\mathrm{Den}}$Ae = $_{\mathrm{Dem}}$Ae
P600: $_{\mathrm{Der}}$Ae = $_{\mathrm{Den}}$Ae = $_{\mathrm{Dem}}$Ae

ERP result:
NEG: $_{\mathrm{Der}}$Ae < $_{\mathrm{Den}}$Ae = $_{\mathrm{Dem}}$Ae
P600: $_{\mathrm{Der}}$Ae < $_{\mathrm{Den}}$Ae = $_{\mathrm{Dem}}$Ae

The P600 effects, however, deviated from the predictions in the same manner as they did at the determiner position. Thus, they have to be addressed in a different way. The respective hypotheses assumed no occurrence of a P600 effect since there was no incompatible feature that the radically underspecified *kleine* could have introduced. Since P600 effects for $_{\mathrm{Den}}$Ae and $_{\mathrm{Dem}}$Ae appeared nonetheless, ungrammaticality cannot be linked to the introduction of incompatible features, if the comparative overview of the adjective ranking from Table 9.1 is reconsidered. The overview clearly shows that *kleine* is not able to trigger incompatibility at any point. However, it may be possible that the insights on disjunctive features from the adjective position of the second experiment can be helpful, even though the idea is not fully applicable here as *kleine* was assumed to be entirely featureless. As a consequence, it might be feasible to assume that Bierwisch's adjective specification is not adequate. Recall from the weak adjective's paradigm in Table 8.1 that, in fact, *kleinen* is the most frequent form neutralizing not only case but also gender and number. This form occupies eleven slots within the paradigm. In contrast to that, *kleine* only neutralizes gender as well as nominative and accusative case which leads to it occurring in only five cells. This generates to the impression that *kleine* is more special as it is less frequent and that *kleinen* is rather the frequent default form.

However, Bierwisch proposed the exact opposite attribution of adjectives and distributional characteristics. The inevitable consequence from that is to depart from Bierwisch's way of underspecifying the weak adjective paradigm and come up with a new inventory. By adhering to the opposite distributional characteristics, *kleine* would be associated with one disjunctive form: It could be specified for [[−OBJ, −OBL, +M] ∨ −OBL, −M]. The first disjunct would capture the nominative masculine singular form while the latter would span across both structural cases in neuter and feminine gender. In contrast to that, *kleinen* would be radically underspecified with [∅]. Since this turning point would affect both adjectives, a new specification would also have implications for the preceding Experiment 2. As indicated above, this argument and its ramifications will be revisited in the General Discussion.

Irrespective of the deviating ERP results and the attempt to explain them, it has to be remembered that TMP did *not* claim ungrammatical but correct adjectives after the determiners in Paragraph 9.1.2.1.2. Consequently, this means that the system integrated Der as $der_{\mathrm{NOM.M.SG}}$ and subsequently $_{\mathrm{Der}}$Ae in order to realize a NOM.M.SG context. This analysis was then corroborated by the DP-final noun. In contrast to that, the fact that

TMP did not predict the ungrammatical $_{\text{Den}}$Ae and $_{\text{Dem}}$Ae as adjective continuations of the preceding determiners Den and Dem is mirrored by their respective P600 effects.

9.7 Interim Conclusion

Even though the ERP results are somewhat inconclusive, it has to be reiterated that TMP still claimed a prediction of an easier integration of Der in comparison to Den and Dem. This was perfectly reflected by the NEG results. However, the deviating P600 data could not be accounted for in a straightforward way. These results were attributed to unbalanced material which revealed the determiner *dem* to stand out. From the current point of view, the unexpected P600s for Den and Dem remain uninterpretable. In a similar fashion, the adjective's predictions about the feature transition were also mirrored by the NEG results. As with the determiner position, the adjective elicited unexpected P600 effects that have to be touched upon again in the General Discussion.

What was previously indicated by the second study was substantiated by the present Experiment 3. There is mounting evidence that successively complicating the featural transitions is accompanied by increasingly fuzzy predictions for these successions. However, inconclusive results cannot be viewed as a refutation of the proposed model. Rather, this makes clear that TMP's predictions have to be confined to a narrower space.

10 General Discussion

The present thesis seeks to show that German provides morphosyntactic features and that a linguistic parser makes use of these in order to build up an analysis. In the Theoretical Part I, the appropriate mechanism—TMP—claimed varying integration efforts for the transition from word to word. These contact points were crossed with assumptions from different underspecification approaches and the idea of a present or absent SP_{NOM}. This resulted in a multitude of parsing calculations and analyses. Their comparison allowed for claims concerning the following questions.

> Question 1: How do the parses differ between the elements of the subject-object ambiguities?
>
> Question 2: Which one of the underspecification approaches by Bierwisch, Blevins, Wunderlich and Wiese is explanatorily more adequate?
>
> Question 3: Does the presence or absence of an SP_{NOM} filter specification contribute to TMP's predictions?

Answering the Questions 1 to 3 shall settle whether or not TMP is a suitable prediction-generating machine. However, they could not be answered thoroughly until the previously derived claims were molded into experimental hypotheses in order to empirically assess the mechanism's claims. Consequently, the Experimental Part II put TMP to the test in three experiments that gradually increased the word transitions' featural complexities. Before the experimental data can finally be discussed in its entirety, the obtained results will be recapitulated in Section 10.1. Subsequently, Section 10.2 will address the experiments' unexpected results and TMP's descriptive limitations. Section 10.3 will transform these shortcomings into opportunities for fruitful and extensive future research. Eventually, Section 10.4 will provide answers to Questions 1 to 3 with regard to TMP's explanatory adequacy.

10.1 Summary of the Experiments

Table 10.1 summarizes the findings of the Experiments 1 to 3. This overview already acknowledges the occurrence of a more broadly distributed NEG instead of the predicted LAN effect. In addition, it also lists just those predictions that were corroborated by an absent SP_{NOM} filter specification and assumed Bierwisch's features. Experimental data deviating from the hypotheses are in boldface. All results corroborating the predictions are in regular type.

Table 10.1: Summary of the experiments' results compared to their respective hypotheses.

			determiner position	adjective position	noun position
Exp. 1	hypotheses	NEG	Der < Den	position not available[1]	$_{\text{Der}}$Ner < $_{\text{Den}}$Ner < $_{\text{Der}}$Nin < $_{\text{Den}}$Nern
		P600	Der = Den		$_{\text{Der}}$Ner = $_{\text{Den}}$Ner < $_{\text{Der}}$Nin = $_{\text{Den}}$Nern
	results	NEG	Der < Den		**$_{\text{Der}}$Ner < $_{\text{Den}}$Ner < $_{\text{Den}}$Nern < $_{\text{Der}}$Nin**
		P600	Der = Den		$_{\text{Der}}$Ner = $_{\text{Den}}$Ner < $_{\text{Der}}$Nin = $_{\text{Den}}$Nern
Exp. 2	hypotheses	NEG	Der < Den	$_{\text{Den}}$Aen < $_{\text{Der}}$Ae < $_{\text{Der}}$Aen	$_{\text{DerAe}}$Ner < $_{\text{DerAen}}$Nin = $_{\text{DenAen}}$Ner < $_{\text{DenAen}}$Nern
		P600	Der = Den	$_{\text{Der}}$Ae = $_{\text{Der}}$Aen = $_{\text{Den}}$Aen	$_{\text{DerAe}}$Ner = $_{\text{DenAen}}$Ner < $_{\text{DerAen}}$Nin = $_{\text{DenAen}}$Nern
	results	NEG	Der < Den	**$_{\text{Der}}$Ae < $_{\text{Der}}$Aen = $_{\text{Den}}$Aen**	**$_{\text{DerAe}}$Ner = $_{\text{DenAen}}$Ner = $_{\text{DenAen}}$Nern < $_{\text{DerAen}}$Nin**
		P600	Der = Den	**$_{\text{Der}}$Ae < $_{\text{Der}}$Aen = $_{\text{Den}}$Aen**	$_{\text{DerAe}}$Ner = $_{\text{DenAen}}$Ner < $_{\text{DerAen}}$Nin = $_{\text{DenAen}}$Nern[2]
Exp. 3	hypotheses	NEG	Der < Den = Dem	$_{\text{Der}}$Ae < $_{\text{Den}}$Ae = $_{\text{Dem}}$Ae	position not available[3]
		P600	Der = Den = Dem	$_{\text{Der}}$Ae = $_{\text{Der}}$Aen = $_{\text{Den}}$Aen	
	results	NEG	Der < Den = Dem	$_{\text{Der}}$Ae < $_{\text{Den}}$Ae = $_{\text{Dem}}$Ae	
		P600	**Der < Den = Dem**	**$_{\text{Der}}$Ae < $_{\text{Den}}$Ae = $_{\text{Dem}}$Ae**	

[1]Experiment 1 did not have an adjective position.
[2]Also marginally for $_{\text{DenAen}}$Ner.
[3]Experiment 3's ungrammatical DP-final noun position was not investigated.

Experiment 1 investigated two transitions: from an analysis of whatever kind (present or absent SP_{NOM}) to a strong determiner and from there to a subsequent noun. The first transition's peculiarities were presumably measurable on the two different determiners. One of four nouns disambiguated two preceding determiners. Thus, what happened during this transition, was assumed to be settled and detectable on the noun. In Section 5.3.2.1, at the determiner position, TMP claimed for parses that utilized Bierwisch's features and were not calculated with a precursory SP_{NOM} that, of the four target determiners, *der*$_{NOM.M.SG}$ would result in the least calculatory work followed by *den*$_{ACC.M.SG}$. From this, the experimental hypothesis that Den should elicit a stronger NEG effect in comparison to Der could be derived. No P600 was predicted as there should not have been an SP_{NOM} to which any incoming features would be incompatible. Both predictions were represented by the experimental data. With regard to the noun position, the obtained results are shown in boldface in Table 10.1. A modulation of NEGs with $_{\text{Der}}$Ner to be the easiest and $_{\text{Den}}$Nern to be the hardest was expected. Both nouns that eventually realize a dative context, $_{\text{Der}}$Nin and $_{\text{Den}}$Nern, should have also elicited a P600 effect. While the latter hypothesis was confirmed by the data, the effects in the earlier time window showed a different modulation for the nouns.

Experiment 2 added an intermediate weak adjective between the strong determiner and the DP-final noun. Therefore, three featural transitions could be investigated: from an analysis of whatever kind (absent SP_{NOM}) to the determiner, from there to the adjective and from there to the noun. Subsequently, two adjectives disambiguated two determiners. Therefore, the properties of the transition from either of the determiners to one of the adjectives were assumed to find their measurable expression in the adjective position. The adjectives, in turn, were again disambiguated by the DP-final noun. What happens on the contact point between adjective and noun, was presumably detectable at the noun position. The determiner data replicated the findings from Experiment 1. The obtained adjective data deviated from the original hypotheses. With the initial predictions, the most effortful integration was expected for $_{\text{Der}}$Aen and the easiest for $_{\text{Den}}$Aen in comparison to $_{\text{Der}}$Ae. Furthermore, no P600 was predicted. The seemingly deviating results can be easily accounted for by modifying the expected gradations: It was argued that, due to *kleinen*'s disjunctive specification which introduced incompatible features in both cases of $_{\text{Der}}$Aen and $_{\text{Den}}$Aen, these positions should have been more effortful in equal measures compared to $_{\text{Der}}$Ae which, both, would have demoted them in the ranking and thus elicited a NEG but also triggered a P600 due to their incompatibility. A more elaborate explanation will be presented in the subsequent discussion. Table 10.1 also shows a boldfaced noun position as it behaved the same as in Experiment 1. While the P600 results still hold true, the early effects presented a different modulation in comparison to the hypothesized gradation. No straightforward morphosyntax-related explanation could be presented yet.

Experiment 3 took a slightly different approach by introducing ungrammaticality. Again, a sequence of determiner, adjective and noun would allow for three featural transitions. However, in this experiment, the adjective was inflected incorrectly which led to ungrammaticality. Therefore, the final transition from the adjective to the noun position was not investigated. No NEG gradation between Der, Den and Dem was predicted.

Instead, Den and Dem should have clustered in comparison to Der. These hypotheses were supported by the collected data. Parallel to the previous experiments, a P600 was predicted neither for Den nor for Dem. However, as Table 10.1 shows, the boldfaced results deviated from these predictions. No precise explanation has been found yet. Similarly, the adjective position's P600 effects deviated in the same way as the determiner position differed from the predictions. A P600 occurred even though none was predicted. The NEG effects, however, supported the hypotheses of $_{\text{Dem}}$Ae being harder to integrate than both $_{\text{Der}}$Ae and $_{\text{Den}}$Ae.

Taking the three experiments together, Table 10.1 reveals four out of 28 occasions in which TMP's claims and therefore the derived experimental hypotheses deviated from the obtained results. Two of these four deviations were concerned with the important morphosyntax-related Synchronization process which was associated with a NEG effect. The other two anomalies were related to the secondary mechanism of reanalysis and its associated P600 effect. Returning to the Questions 1 to 3 which asked how well TMP performed as a prediction-generating machine, it can be concluded for Question 3 that the results are only compatible with claims that neglect a precursory SP_{NOM} filter specification. Regarding Question 2, the data is solely consistent with Bierwisch's underspecification approach. More importantly, all other possible combinations of a present or absent SP_{NOM} with any other underspecification approach have to be rejected as the experimental outcomes cannot be mapped onto TMP's claims or the derived hypotheses respectively. The remaining Question 1 will be addressed in the remainder of the thesis.

10.2 Explanatory Inadequacy

The thesis' entire structure hinged on linking the experimental results to the theoretical claims in order to decide on TMP's explanatory adequacy. If this link cannot be established, the model's explanatory inadequacy has to be admitted and discussed. The deviating boldfaced results in Table 10.1 make it unapologetically clear that not all predictions were represented by the experimental data. Therefore, the remaining Question 1 on the specifics of the words' transitions cannot be considered as settled yet. To do so, reasons for these non-converging hypotheses have to be found. This will also allow to finally decide on TMP's explanatory adequacy. These reasons must be related to the way the hypotheses came about: Recall that every experimental prediction was rooted in TMP's parsing claims. All of the model's calculations and analyses in Sections 5.2, 8.1.2 and 9.1.1 were preceded by setting the Parsing Prerequisites I to III: Concerning Parsing Prerequisite I, the lexical material was initially construed in Section 4.1.2 and subsequently altered for the respective investigations. Turning to Parsing Prerequisite II, the lexical material's features were individually compiled for and provided by the different underspecification approaches. With regard to Parsing Prerequisite III, TMP was identified as the mechanism to work with. The interplay of all three prerequisites facilitated the parsing calculations in the first place. Therefore, inappropriate hypotheses ultimately have to be attributed to either one or a combination of not appropriately satisfied parsing prerequisites:

Parsing Prerequisite I: lexical material

Parsing Prerequisite II: features

Parsing Prerequisite III: mechanism

The subsequent sections will address the potentially flawed Parsing Prerequisites I to III. Recall from Sections 4.1.2 and 4.1.3 that the attempt was made to confine TMP to a narrow area of operation. This included the construction of the lexical material under investigation. Consequently, the first reconciliation in Section 10.2.1 will focus on the first precondition and will thus be less concerned with TMP as a prediction-generating machine itself. In particular, this section will acknowledge lexical frequency as a factor contributing to unpredictable parsing behavior. The second and third acknowledgements will be more closely related to TMP as a mechanism as they deal with the lexical material's features and TMP itself. Addressing the second prerequisite, Section 10.2.2 will be concerned with the notion of possibly unsuitable features. Finally, the last settlement will be directly concerned with the third aforementioned premise and thus with TMP's mechanism to derive processing claims. Section 10.2.3 will deal with the possible objection that TMP can also be defective.

10.2.1 Frequency of lexical material

10.2.1.1 Extra-paradigmatic

The first reconciliation is concerned with Parsing Prerequisite I. Thus, it addresses potential shortcomings of the lexical material that has been used to demonstrate TMP's calculatory and predictive capabilities. With regard to the experimental results, this section primarily discusses the two deviating NEG modulations for the noun position in Experiments 1 and 2. Most strikingly, the DP positions that elicited the most pronounced NEG were the feminine nouns DerNin in the first and DerAenNin in the second study that made up the DAT.F.SG and DAT.PL contexts. Advocates of frequency-based accounts of language processing might interject that the results concerning this matter are inconclusive and might be confounded if not entirely attributed to the frequency of the DPs and their elements in question.

Kempen and Harbusch (2003) argued that word order-related processing difficulties were supposedly not due to structural reasons but had to be attributed to the constructions' infrequencies. In particular, their reply to Bornkessel et al. (2002) objected that clause-initial dative and accusative constructions did not simply pattern together in comparison to nominative-initial clauses. They observed that *den* could either be accusative or dative. Following this reasoning, a stronger NEG result for the non-canonical DAT.F.SG or DAT.PL nouns should be attributed to their lower frequency in comparison to the more frequent NOM.M.SG structure. This effect would find its measurable expression on the DerNin and DerAenNin nouns as well as on DenNern and DenAenNern respectively, both in comparison to DerNer and DerAeNer.

However, three counterarguments may be put forward here. First, if both dative contexts—that is DAT.F.SG and DAT.PL in Experiments 1 and 2—should considerably differ from a nominative context, while they both cluster, these differences and similarities should be reflected by the ERP data. To be precise, Kempen and Harbusch's (2003) observation should be translatable into a modulation akin to NOM.M.SG < DAT.F.SG = DAT.PL. Consequently, this could be adapted leading to $_{\text{Der}}$Ner < $_{\text{Der}}$Nin = $_{\text{Den}}$Nern for the first or $_{\text{DerAe}}$Ner < $_{\text{DerAen}}$Nin = $_{\text{DenAen}}$Nern for the second study respectively. However, the recorded ERP data does not show clustering datives. To the contrary, the results show a gradation between $_{\text{Den}}$Nern, $_{\text{DenAen}}$Nern and $_{\text{Der}}$Nin, $_{\text{DerAen}}$Nin, while the nouns that comprise a DAT.F.SG context produce a more pronounced NEG effect than the nouns that build up a DAT.PL structure. Seemingly, Kempen and Harbusch's (2003) frequency account cannot attribute for the present data. As a consequence, the line of argument will revert back to feature-driven explanations. The difference between the more pronounced DAT.F.SG context and the attenuated DAT.PL must be due to the $_{\text{Der}}$Nin's and $_{\text{DerAen}}$Nin's [+F] compared to $_{\text{Den}}$Nern's and $_{\text{DenAen}}$Nern [+PL] feature. Whether gender features hold a special status will be revisited in Section 10.2.2.1.

The second counterargument is concerned with the detection of (in)frequency: How is it possible to decide whether a particular construction is frequent or infrequent? The obvious question at issue here is how to determine what is frequent or infrequent. Is the criterion deciding on which linguistic element should be scrutinized a purely shape-based, physical property referring to the sequence of phonemes or graphemes? Or is it a relational characteristic, for example the co-occurrence of a determiner and a noun? The argument put forward here aims at separating the notions of what constitutes frequency. While it is recognized that dative case is less frequent in the input than nominative or accusative case, it shall be argued that the human language processing system has to access morphosyntactic information in order to determine a word or construction as being frequent or infrequent. As it was put forward when designing TMP in Chapter 4, encountering the plain determiner *der* does not entail that it is followed by a feminine noun to realize an infrequent DAT.F.SG context or by a masculine noun to build up a frequent NOM.M.SG context per se. It is also not plausible to assume that the frequency of *den Bäckern* or *der Kundin* is determined as a whole. Therefore, morphosyntactic information *is* available on the input and *has* to be accessed in order to determine an element's frequency. Retrieving *Kundin*'s [+F] feature after *der*$_{\text{NOM.M.SG}}$ is not only revealed to be infrequent but also ungrammatical.

A third counterargument comes from the findings by Bornkessel et al. (2002, 2003a). The authors argued that the processing differences between scrambled argument DPs could not be attributed to a difference in structural frequency. In an ERP experiment, they found that different negativities for nominative-, accusative- and dative-initial structures were incompatible with a frequency-based account insofar as this account would predict a similar behavior of accusative- and dative-initial objects. In contrast to that, the results showed that dative-initial constructions rather clustered with unmarked nominative initial sentences with respect to their processing. Bornkessel et al. (2002) concluded that processing differences could not be attributed to varying structure frequency but were rather in line with a structural account that argued for fine-grained differences during argument processing. In line with this are the findings by Clahsen et al. (2001) who did not find a frequency effect for different inflectional markers but a specificity effect for more specific over less specific affixes.

10.2.1.2 Inter-paradigmatic

However, frequency simply cannot be rejected as an influencing factor as it is in itself directly related to the configuration of a paradigm. The distribution of forms across syntactic contexts determines the paradigmatic opposition which, in turn, defines the specification of the exponents.[34] Therefore, recall the strong determiner paradigm from Table 1.3 that encircled the syncretism fields. If the distribution changed towards less phonologically different forms occupying more cells, the syncretism fields would grow by virtue of that. This very process can be observed synchronically in a particular register of German: Among others Schäfer and Sayatz (2014), Stefanowitsch (2010), and Vogel (2006) have pointed out that the cliticized or end-short form of the German weak determiner *ein* ("a") is affected by an internal redistribution. In colloquial spoken or chat-based written German, the regular paradigm in Table 10.2a shifts towards the more reduced and syncretic alternative in Table 10.2b. This development reduces the instances of the short form *n* to zero while it increases the frequency of *nen* to four occasions. The corresponding inventories for the paradigms show that the new alternative not only requires less rules to be derived in some cases—five in Table 10.3b instead of six in Table 10.3a—it also requires less features per exponent.

Table 10.2: Paradigms of the regular and alternative short form of the German weak determiner.

(a) Regular short forms.

	SG		
	M	N	F
NOM	*n*	*n*	*ne*
ACC	*nen*	*n*	*ne*
DAT	*nem*	*nem*	*ner*
GEN	*?nes*	*?nes*	*?ner*

(b) "New" alternative.

	SG		
	M	N	F
NOM	*nen*	*nen*	*ne*
ACC	*nen*	*nen*	*ne*
DAT	*nem*	*nem*	*ner*
GEN	*?nes*	*?nes*	*?ner*

These insights still yield no conclusive picture of whether or not frequency contributes to the obtained effects. However, it has to be concluded that the specification of a lexical element is a function of the element's frequency itself within its paradigm. Even if this circumstance is synchronically not as visible as in Table 10.2, it also holds true for the paradigm of the German strong determiner from Table 1.1 repeated here in Table 10.4.

Interestingly, in this paradigm, the inter-paradigmatic frequency can be correlated with the extra-paradigmatic frequency that was addressed in the preceding section. A

[34]In fact, Blevins's (1995) underspecification approach hinged on and is in fact named after this finding: "Syncretism and Paradigmatic Opposition."

Table 10.3: Inventories of the regular and alternative short form of the German weak determiner paradigms.

(a) Inventory for Table 10.2a.

determiner		feature specification
R_1 *nem*$_{\text{DAT.M/N.SG}}$	↔	[+OBJ, +OBL, −F]
R_2 *nen*$_{\text{ACC.M.SG}}$	↔	[+OBJ, +M]
R_3 *ner*$_{\text{DAT/GEN.F.SG}}$	↔	[+OBL, +F]
R_4 *nes*$_{\text{GEN.M/N.SG}}$	↔	[+OBL]
R_5 *ne*$_{\text{NOM/ACC.F.SG}}$	↔	[+F]
R_6 *n*$_{\text{NOM.M.SG, NOM/ACC.N.SG}}$	↔	[Ø]

(b) Inventory for Table 10.2b.

determiner		feature specification
R_1 *nem*$_{\text{DAT.M/N.SG}}$	↔	[+OBJ, +OBL, −F]
R_2 *ner*$_{\text{DAT/GEN.F.SG}}$	↔	[+OBL, +F]
R_3 *nes*$_{\text{GEN.M/N.SG}}$	↔	[+OBL]
R_4 *ne*$_{\text{NOM/ACC.F.SG}}$	↔	[+F]
R_5 *nen*$_{\text{NOM/ACC.M/N.SG}}$	↔	[Ø]

quick glance into the Leipzig Corpora Collection (2018)[35] reveals that determiner forms that are frequent within their paradigms in Table 10.4 also have more frequent token equivalents while rather infrequent paradigmatic forms have less frequent tokens: According to the corpus, the most frequent forms are *der* and *die*. The former is contained in frequency class 1 and sits at rank 0, while the latter resides in frequency class 2 and occupies rank 0. These two forms are in fact also the most frequent determiners in the paradigm in Table 10.4 with six and eight occasions respectively. In contrast to that, *dem* and *des* are the types with the lowest frequencies. Both are contained in frequency class 2 but with *dem* on rank 18 and *des* on rank 19. These two forms with two occasions each have also the lowest frequencies within the paradigm in Table 10.4.

Undoubtedly, linguistic dynamics outside of inflectional paradigms based in phonology, frequency and semantics may have, in turn, an influence on the internal structure of a paradigm. By virtue of that, paradigm-external frequent or infrequent usage of forms will eventually affect the feature specifications of the very forms. This may also be true for the noun paradigms of *Bäcker* and *Kundin* from Tables 5.3a and 5.3b. If this can be acknowledged, frequency inevitably has an influence on the processing of *Kundin* versus *Bäcker*. Consequently, TMP's workspace that was discussed in Section 4.1.2 was not

[35]German news corpus based on material crawled in 2018. Sentences: 46,843,422. Types: 8,487,717. Tokens: 720,421,868. Token frequencies: *der* = 20,958,085; *die* = 19,680,358; *den* = 8,007,265; *das* = 6,265,729; *dem* = 4,382,140; *des* = 4,321,881.

Table 10.4: Inflectional paradigm of the German strong determiner.

	SG			PL		
	M	N	F	M	N	F
NOM	*der*	*das*	*die*	*die*	*die*	*die*
ACC	*den*	*das*	*die*	*die*	*die*	*die*
DAT	*dem*	*dem*	*der*	*den*	*den*	*den*
GEN	*des*	*des*	*der*	*der*	*der*	*der*

defined narrowly enough. This, eventually, resulted in failing the Parsing Prerequisite I.

Thus, as a possible countermeasure for future research, the parser's space of hypotheses would have to be limited to an even narrower field of operation. This would entail additionally controlling for the lexical material. In order to avoid frequency negatively affecting the processing of said material, co-occurrence analyses for individual lexical elements have to be carried out. In case of the present studies' two- or three-element DPs, this measure should prevent the rather unpredicted behaviors of DerNin and DerAenNin.

10.2.2 Inappropriate features

Addressing the second of TMP's potential shortfalls is related to not complying with Parsing Prerequisite II. Thus, it is concerned with the parsing mechanism itself rather than with the previously discussed Parsing Prerequisite I. The following discussion is about the interface between the lexical material and TMP: It could be the case that possibly incorrect morphosyntactic features that were processed by TMP led to wrong hypotheses. There are several reasons conceivable for why the chosen morphosyntactic specifications could be viewed as deficient. Recall that, for all of TMP's investigations, appropriate features were compiled for each underspecification approach in Section 5.1 and—after Bierwisch's features turned out to be explanatorily adequate—for this very framework in Section 8.1.1. This should have dispelled the possibility of omitting a certain underspecification approach. Therefore, it can be ruled out that an inappropriate framework was used from the get-go although an appropriate one was available. Within Bierwisch's approach, other reasons have to be considered that may be feature-related or concern features in a more general way. The following two sections will address these possibilities.

10.2.2.1 Feature hierarchy

The discussion for the first and second experiments' noun positions already indicated one conceivable reason for deviating hypotheses: feature hierarchies. The related idea is that some features outweigh others. Wiese's (1999, p. 14) hierarchy of [+M] > [+OBL] > [+F] > [+OBJ] assumed that features on the scale's left side were more specific than those on the right side. Noyer (1992) and others also argued for basing the specificity principle on a hierarchy of features. In particular, Lumsden's (1987, pp. 100, 106) investigations on Old English revealed the hierarchy of [±PL] > [±F] > [±GENITIVE] > [±INHERENT] > [±NEUTER] > [±ACC] which he assumed to be universal. In Lumsden (1992), this hierarchy and its notion of universality were refined towards the precedence of [±PL] over [±F]. Without going into the specifics of deriving such hierarchies, it shall be noted that both hierarchies of Wiese (1999) and Lumsden (1987, 1992) rank a [±F] specification beneath a [+OBL] or [±PL] feature. Interestingly, the hierarchy [+OBL] / [±PL] > [±F] can be mapped onto the first and second experiments' noun effects that showed a reversed order of the prediction: In both studies, the feminine nouns in ${}_{\text{Der}}$Nin and ${}_{\text{DerAen}}$Nin produced more pronounced NEG effects than the oblique dative plural nouns in ${}_{\text{Den}}$Nern and ${}_{\text{DenAen}}$Nern. However, the opposite pattern was predicted. TMP was conceived as a parsing mechanism that is based on preferably encountering minimal feature deviances. This means that the input should differ as little as possible from the already analyzed material. A noun could be considered as typically completing a DP. In consequence, there should be a previous analysis available that is most likely not devoid of morphosyntactic features. The DP-final noun has to be integrated into this feature. In order to maintain minimal feature deviance, an incoming noun with as many features as available from the preceding input is desired. If "specificity" is understood as satisfying TMP's bias for minimal feature deviance, it could be argued that the inputs of ${}_{\text{Der}}$Nin and ${}_{\text{DerAen}}$Nin, which carried a [+F], were comparably less specific and thus violated TMP's feature deviance more severely than the dative plural forms ${}_{\text{Den}}$Nern and ${}_{\text{DenAen}}$Nern, which had a specification of [+OBL, +PL]. This, in turn, would have increased the work for TMP rendering ${}_{\text{Der}}$Nin and ${}_{\text{DerAen}}$Nin to be calculatory more *complex* than ${}_{\text{Den}}$Nern and ${}_{\text{DenAen}}$Nern. If this can be concluded, Wiese's (1999) and Lumsden's (1987, 1992) hierarchies can be mapped onto TMP's expected calculatory work under consideration of the predicted varying NEG effects. In this way, the boldfaced results for the first two studies' noun positions in Table 10.1 can be accounted for.

(71)		low	to	high feature deviance
		simple	to	*complex* calculatory work
		[+OBL, +PL]'s more	to	[+F]'s less hierarchical specificity
	TMP:	${}_{\text{Den}}$Nern, ${}_{\text{DenAen}}$Nern	$<$	${}_{\text{Der}}$Nin, ${}_{\text{DerAen}}$Nin
		less	to	more processing effort
	NEG:	attenuated	$<$	pronounced

However, the different proposed hierarchies are a matter of an empirical question. While the noun results could be explained with Wiese's (1999) and Lumsden's (1987, 1992) hierarchies, it is possible that other effect modulations are not attributable to some features outweighing others.

10.2.2.2 Disjunctive feature specifications

The second possible reason that may have contributed to the falsity of the features has been implied in the second experiment's discussion of the adjective results: disjunctive feature specification. Recall from Sections 1.2.1 and 8.1.1 that Bierwisch's approach introduced disjunctive specifications for $der_{\text{DAT/GEN.F.SG, GEN.PL}}$ and $die_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$

as well as for *kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$ (Bierwisch, 1967, p. 260). While Experiment 1 involved neither of these elements, Experiment 2 made use of the aforementioned adjective with its disjunctive specification. For this study, it was already indicated in the experiment's discussion that the disjunction seemed to pose a problem insofar as it was treated as an entire conjunctive feature bundle.

However, there might be another way to look at the second experiment's adjective results. In order to do so, *kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$'s disjunctive feature specification has to be examined more closely. With its feature bundle of [[+OBJ, +M] ∨ +OBL ∨ +PL], it spans across four syntactic contexts of which only two constitute a natural class: dative and genitive. The first disjunct, [+OBJ, +M], captures the context of accusative masculine singular, the second, [+OBL], the entire dative and genitive and the last disjunct, [+PL], all plural forms. At first glance, it seems that Bierwisch interfuses things that do not belong together. For this reason, Blevins refuses the notion of disjunctions altogether:

> [D]isjunctive feature specifications, like disjunctive extensions generally, do not support a distinction between linguistically significant generalizations, neutralizations in this case, from random assemblages of feature specifications. [...] Contrasts and convergences are effectively stipulated, albeit somewhat concisely, on a case by case basis. (Blevins, 1995, p. 125)

Experiments 1 and 2 settled the Questions 2 and 3 in favor of Bierwisch's approach and an absent SP$_{\text{NOM}}$. The second study, however, revealed the adjective position to be problematic under this given feature configuration. The experimental hypotheses for the adjective position were not met insofar as modulated NEG effects for $_{\text{Den}}$Aen < $_{\text{Der}}$Ae < $_{\text{Der}}$Aen were predicted but the gradation of $_{\text{Der}}$Ae < $_{\text{Der}}$Aen = $_{\text{Den}}$Aen was measured instead. So how can both the disjunctive specifications as well as the deviant hypotheses be reconciled while maintaining SP$_{\text{NOM}}$-less Bierwisch features? The only way is to avoid disjunctive feature specifications altogether as Blevins suggested. Without switching to another underspecification approach, this, in turn, would mean for Bierwisch's specification of *kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$ that, instead of this single form specified for [[+OBJ, +M] ∨ +OBL ∨ +PL], three separate forms have to be assumed: *kleinen* in accusative masculine singular with [+OBJ, +M], *kleinen* in dative and genitive with [+OBL] and *kleinen* in plural with [+PL]. Similar to Blevins (1995, p. 125), Müller correspondingly objected that "nothing is won" (2002, p. 345, fn. 16, own translation) if a disjunctive feature specification like *kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$'s was split up into three discrete forms.

Maybe Müller's demur only applies to a theoretical side of the argument if the only goal to make use of disjunctions is to capture syncretism as elegantly as possible simply for the sake of it. If, on the other hand, the supposed representational redundancy is capable of appropriately explaining the deviating adjective hypotheses of Experiment 2, then something is actually won; then the redundancy is the price to pay on both sides, theoretically and empirically; then evidence was found for the impracticality of mapping theoretical assumptions of underspecification onto the mentally represented equivalent.

Eventually, both hierarchically ordered features as well as disjunctive feature specifications or rather their avoidance necessitate an adjustment of TMP. The subsequent section will primarily address how TMP could handle the latter kind of feature bundles more appropriately.

10.2.3 A defective mechanism

Mainly due to the preceding section, it becomes clear that the remaining factor contributing to false parsing claims, and ultimately to incorrect hypotheses, is the parser itself. Therefore, this section is concerned with Parsing Prerequisite III: TMP and its design. The aforementioned reasons for deviating hypotheses—frequency but even more so feature hierarchies and disjunctive specifications—can only result in the adjustment of TMP's inner workings. In the discussion of Experiment 2's adjective position, it was indicated that the previously neglected idea of a secondary mechanism processing disjunctive features might actually be necessary in order to appropriately process the individual disjuncts. Similarly, it might be necessary to postulate an additional means for featural hierarchy information. Thus, in this section, the implementation of additional constraints for disjunctive specifications and hierarchically ordered features shall be discussed. These constraints would complement TMP's existing ordering mechanism.

In Section 4.2.3, TMP's very mode of operation was laid out. Apart from the transition from current to incoming material, the mechanism's design crucially hinged on the bias for minimal feature deviance that allowed the derivation of the predicted ranked candidates. The candidates engaged in the ranking were ordered from least to most deviant in comparison to a prior existing filter specification. As a result, the least deviant candidate was preferably predicted. If it was the actual input, calculatory work was assumed to be *simple* in case of its integration. The ranking itself materialized due to four constraints that ordered the candidates. Feature incompatibility was viewed as a major calculatory disturbance. Thus, this constraint had precedence over the others. A second constraint assumed that features that were not present on the input in comparison to the filter specification also demoted the candidate in question. The third constraint was less severe as it checked feature non-retrievability in the opposite direction, namely from the input to the filter specification. Lastly, a possibly beneficiary constraint—retrievability—checked for overlapping features. While this constraint actually directly ensured minimal feature deviance, the other constraints penalized feature deviance and thus demoted the candidate in question.

10.2.3.1 Implementing feature hierarchy information

However, next to these constraints, the notions of feature hierarchies and disjunctive specifications have to be implemented too. Besides the previously existing restrictions, the two additional constraints would also contribute to guaranteeing minimal feature deviance relative to a filter specification. Conversely, violating the ranking constraints entails subsequent more *complex* calculations as discussed for DerNiN and DerAenNiN and demonstrated in (71).

With regard to the feature hierarchies, this kind of information has to be present and processable at TMP's parsing Step 2. Since the hierarchy's properties immediately entail a ranking, its information does not have to be calculated as it was the case with the other constraints. Thus, it is cogitable to position a feature hierarchy constraint before incompatibility, non-retrievability and retrievability constraints. However, it could be objected that such a ranking constraint could counteract the established restrictions insofar that the rankings would cancel out one another. This could be the case when a ranked candidate carries both a hierarchically higher ranked feature that has an alleged processability advantage but also an incompatible feature which would demote this candidate in its ranking.

10.2.3.2 Implementing disjunctive feature specifications

With regard to the disjunctive features, recall from the previous section that Bierwisch's determiner and adjective inventories, that were originally introduced in Tables 1.6 and 8.2 respectively, allowed for the assumption of a single lexical form with one disjunctive specification or as many disjuncts as there are in the respective specification. There are three possibilities of how to avoid or cope with a disjunctive specification. The first option would be to refute disjunctions altogether and assume three discrete representations of *kleinen* instead of one as already indicated in the preceding section. This solution would be less concerned with TMP itself but rather with an adjustment of Bierwisch's underspecification approach that was supported all along. The discrete forms could then be ordered like in the revised overview in Table 10.5. Three separately represented or restored candidates would occupy individual ranks. However, these rankings would illicitly predict *kleinen*$_{\text{ACC.M.SG}}$ as a continuation of *der*$_{\text{NOM.M.SG}}$.

Table 10.5: Revised overview of all relevant ranked candidates for the adjective position with individual ranks.

rank	filter specification: [+M] (by current material's *der*$_{\text{NOM.M.SG}}$ from prior step) adjective	specification	⚡	⊖ ⇒	⊖ ⇐	⊕
1.	*kleinen*$_{\text{ACC.M.SG}}$	[+OBJ, +M]	0	0	1	1
2.	*kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[Ø]	0	1	0	0
3.	*kleinen*$_{\text{DAT/GEN}}$	[+OBL]	0	1	1	0
4.	*kleinen*$_{\text{PL}}$	[+PL]	1	1	1	0
	filter specification: [+OBJ, +M] (by current material's *den*$_{\text{ACC.M.SG}}$ from prior step)					
1.	*kleinen*$_{\text{ACC.M.SG}}$	[+OBJ, +M]	0	0	0	2
2.	*kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[Ø]	0	2	0	0
3.	*kleinen*$_{\text{DAT/GEN}}$	[+OBL]	0	2	1	1
4.	*kleinen*$_{\text{PL}}$	[+PL]	1	2	1	0

In contrast to that, the other two scenarios still assume a disjunctive mental representation according to Bierwisch's approach. In case of an incoming material that is part of a disjunctive syncretism, TMP would need to “restore” individual syncretic forms. In case of *kleinen*, it would be the accusative masculine singular, dative and genitive, and plural forms, each with their specifications of [+OBJ, +M], [+OBL] and [+PL] respectively. This would have to take place before the integration process. In particular, it would have to happen somewhere around TMP’s Step 2 so that the forms could be ranked as predicted candidates. Therefore, Step 2 of TMP’s mechanism would have to be modified insofar that it allowed for restoring or separating forms with possibly disjunctive feature specifications in order to appropriately represent the space of hypotheses in which predicted ranked candidates could be derived. The question arises whether the restoring would occur before or after ranking the predicted candidates. Thus, a second conceivable scenario would assume the restoring to take place before the ranking. This would result in three individual forms of *kleinen* being part of the ranking immediately. In essence, this would entail the same illicit result as the first possibility with discretely stored forms.

A third possibility could thus assume that restoring disjunct forms takes place after ranking predicted candidates. This could mean that, at first, the ranking would engage with the entire disjunctive feature specification. Previous experimental data suggested that categorically opposing features entailed incompatibility. As shown in Table 10.6, *kleinen* after both *der* and *den* is ranked second due to its [+PL] feature that categorically opposes *der*’s and *den*’s [+M] specification. After that initial ranking, TMP would have to restore the disjunctive form within the rank it is occupying. This would result in the individually ranked candidates occupying the second rank’s (a–c) of Table 10.6.

Table 10.6: Revised overview of all relevant ranked candidates for the adjective position with original ranks.

rank	adjective	specification	↯	🔍− ⇒	🔍− ⇐	🔍+
	filter specification: [+M] (by current material’s *der*$_{\text{NOM.M.SG}}$ from prior step)					
1.	*kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[∅]	0	1	0	0
2.	*kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$	[[+OBJ, +M] ∨ +OBL ∨ +PL]				
	a. *kleinen*$_{\text{ACC.M.SG}}$	[+OBJ, +M]	0	0	1	1
	b. *kleinen*$_{\text{DAT/GEN}}$	[+OBL]	0	1	1	0
	c. *kleinen*$_{\text{PL}}$	[+PL]	1	1	1	0
	filter specification: [+OBJ, +M] (by current material’s *den*$_{\text{ACC.M.SG}}$ from prior step)					
1.	*kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[∅]	0	2	0	0
2.	*kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$	[[+OBJ, +M] ∨ +OBL ∨ +PL]				
	a. *kleinen*$_{\text{ACC.M.SG}}$	[+OBJ, +M]	0	0	0	2
	b. *kleinen*$_{\text{DAT/GEN}}$	[+OBL]	0	2	1	1
	c. *kleinen*$_{\text{PL}}$	[+PL]	1	2	1	0

Crucially, the modified ranking in Table 10.6 allows altering the prior comparison of expected gradations and ERP results to the revision in (72).

(72) Revised gradations with no SP_{NOM}:
NEG: $_{\text{Der}}\text{Ae} < {}_{\text{Der}}\text{Aen} = {}_{\text{Den}}\text{Aen}$
P600: for $_{\text{Der}}\text{Aen}$ and $_{\text{Den}}\text{Aen}$

ERP result:
NEG: $_{\text{Der}}\text{Ae} < {}_{\text{Der}}\text{Aen} = {}_{\text{Den}}\text{Aen}$
P600: for $_{\text{Der}}\text{Aen}$ and $_{\text{Den}}\text{Aen}$

In this way, the experimental effects can be accounted for by acknowledging that the disjunction imposed by Bierwisch had to be resolved. The predicted, eventually false gradation could be adjusted towards $_{\text{Der}}\text{Ae} < {}_{\text{Der}}\text{Aen} = {}_{\text{Den}}\text{Aen}$. Thus, this would mirror the experimental results, since it was assumed in Section 8.6.2.1 that *kleinen*'s disjunctive feature bundle as a whole introduced features incompatible with the prior specifications of $\textit{der}_{\text{DAT.F.SG}}$ or $\textit{den}_{\text{ACC.M.SG}}$. Resolving *kleinen*'s disjunction into individual subforms resulted in a demotion of the respective *kleinen* alternatives to lower ranks in comparison to *kleine* after *der*. In this way, the gradation of $_{\text{Der}}\text{Ae} < {}_{\text{Der}}\text{Aen} = {}_{\text{Den}}\text{Aen}$ could be motivated.

The present explanation is even dependent on Bierwisch's disjunctions in order to explain the obtained results from which the hypotheses deviated. The disjunction allows to attribute the NEG and P600 effects to the constant introduction of incompatible features by the originally intact disjunctive specification. In addition to that, distinguishing and separating [[+OBJ, +M] ∨ +OBL ∨ +PL] into [+OBJ, +M] for *kleinen* in accusative masculine singular, into *kleinen* with [+OBL] in dative and genitive and into *kleinen* for plural with [+PL] could also result in more *complex* calculatory effort and thus measurably add to processing effort. If this approach was in fact applicable, it would be evidence for a disparity between capturing syncretism theoretically and how the phenomenon manifests itself in the mental lexicon practically.

However, elaborating on this discrepancy, the first possibility of handling disjunctive features has to be revisited. It could also be the case that the mental lexicon not only stores separated forms that Bierwisch summarized by means of disjunction but rather multiple entries in general. The syncretisms of morphologically rich paradigms—like the one of the strong determiner—could, for all intents and purposes, still be captured by means of underspecification in order to optimize memory load. However, consider the paradigm of the weak adjective that contains only two distinct forms, for example *kleine* and *kleinen*. For these morphologically less varying paradigms, underspecifying and capturing a few forms only may not be feasible. Therefore, in either way—whether there are disjunctive feature specifications that may have to be resolved into discrete disjuncts or whether there are three redundant or more forms right from the beginning—both alternatives still use underspecification even though to a lesser extent. If Bierwisch's $\textit{kleinen}_{\text{ACC.M.SG, DAT/GEN, PL}}$ with its three-part specification of [[+OBJ, +M] ∨ +OBL ∨ +PL] is to be separated, there are still just three alternatives of *kleinen*. In contrast to that, the denial of underspecification altogether would result in memory-costly eleven or even 19 different forms if gender was not collapsed in plural. Thus, it could be argued that underspecification is used when required. Returning to possibly flawed feature specifications, this inevitably leads to a departure from any previously entertained underspecification approach necessitating new specifications of the lexical elements under investigation.

10.2.3.3 Further limitations of TMP's mode of operation

Addressing the Parsing Prerequisites I to III as the main culprits for wrongly derived hypotheses exposed TMP as being highly susceptible to both small changes in morphosyntactic specifications it is fed with and the very way it operates. However, additional options for adjustment directly related to TMP's mode of operation or the way morphosyntactic features are made available to it can be identified.

In fact, the properties of TMP's original ranking constraints—incompatibility, non-retrievability and retrievability—are also still up for debate: For example, it could be possible to implement the primary constraint of incompatibility as an instance of non-retrievability of the respective feature with an opposing value. This would alter the predicted ranked candidates immensely, eventually yielding different, probably ungrammatical parses. Crucially, if the measure to encounter and recognize incompatibility was cut from TMP, the argument to reason for the occurrence of reanalysis during the Integration process is also taken away. As a replacement for incompatibility, a threshold for predicted ranked candidates may be a viable measure to motivate reanalysis. On a related note, TMP's retrievability constraint could also entail different rankings. So far, this constraint was treated very conservatively as it was the last measure to decide on a predicted candidate's rank. It did not contribute to the ranking at all. It is still unsolved whether this constraint's power could also cancel out an established ranking.

Turning away from TMP's ranking constraints, the implementation of feature hierarchies introduced the idea of features having different qualities. However, features could also vary with regard to their "origin". They could differ with respect to whether they are inherent to a lexical element or whether they are imposed. Features can have lexico-semantically motivated origins. While these features could differ with regard to their processability, they could also differ from those that were assigned by a mechanism like TMP.

Another glaring limitation of TMP is its capability of parsing a single argument DP only. This was due to its space of hypotheses that was defined in Section 4.1.2 when the mechanism was originally laid out. As initially shown in Table 4.1, the ambiguous DPs that were analyzed and parsed were conceived as arguments in complete subject-object ambiguities. While TMP's mode of operation was good enough for the present undertaking, the system will inevitably run into problems if a second argument DP or the sentence-final verb have to be processed. TMP must not combine the features of one DP with the specification of another. Therefore, the mechanism has to be expanded insofar that it is able to build up a second DP alongside a first argument to access the verb's subcategorization frame and its features and to integrate both argument DPs into the verb's subcategorization frame.

TMP probably offers even more setting screws that allow for fine-tuning the mechanism. Concurrently, this reveals morphosyntactic features and TMP in particular to be very mighty tools. To remedy its aforementioned shortcomings, will ultimately lead to prosperous future research which the next chapter will touch upon.

10.3 Outlook

Opponents of a morphosyntactic approach may argue that positively and negatively valued properties will never be capable of quantifying or capturing the real world. This, however, is just an empirical question of both further decomposing existing categories into even more fine-grained features and future research meticulously controlling and tweaking these settings.

In order to attend to these issues, three areas for TMP's further investigation come to mind. First, the inadequacies mentioned in Section 10.2 have to be considered in order to confine the mechanism in an even narrower space of hypotheses. On a second, rather practical note, the sentences that were tested across Experiments 1 to 3 provide ERP data for a second DP and a sentence-final verb. These data can be analyzed with new hypotheses derived from a revised TMP. Apart from that, thirdly, leaving morphosyntax may allow for surprising insights from a neighboring linguistic field.

10.3.1 Addressing the shortcomings

Admittedly, the question arises whether TMP still can be explanatorily adequate with all these changes in specifications or minute adjustments to the parser's configuration. In addition, it could be the case that addressing each or a combination of the aforementioned possibilities for further fine-tuning a morphosyntactic approach could lead to a whole new set of claims and hypotheses virtually zeroing previous accomplishments. It could even be the case that a modification of TMP would revive one or more of the previously discarded underspecification approaches by Blevins or Wiese. Therefore, future investigations have to be scaled down in comparison to TMP's calculations. This means that every aforementioned shortcoming has to be investigated in isolation in order to rule out potentially confounding influences by other issues. In effect, new parses for decidedly fewer structures have to be commenced. These structures' lexical material has to be controlled in the minutest details.

Consider, for example, an investigation of the features' supposedly hierarchical information. In a first step, possible hierarchies like those of Lumsden (1987, 1992), Noyer (1992), and Wiese (1999) have to be unearthed. In a second step, it has to be stipulated whether a super- or subordinate feature is presumably advantageous regarding processing. In case of three different hierarchy scales, comparable lexical material has to be found that allows to discern identical features in varyingly hierarchical order across these three scales. Crucially though, the lexical material must not provide interfering feature qualities.

To a similar measure, in turn, inherent and imposed features must not be mixed with hierarchical information. From thereon, different parses for different structures could be calculated. Eventually, those could be compared in order to devise claims for one hierarchically superior feature in one structure's element having a processability advantage over another lower ranked feature of another element. Putative processing advantages have to be empirically investigated in order to find evidence for or against the explanatory adequacy of the originally stipulated advantage of hierarchically higher or lower ranked features.

Conversely, the same procedure would apply if the implications of inherent and imposed features were to be examined: Different inherent and imposed features have to be classified. If the claim that one had a processing advantage over the other should be made, this distinction would have to be stipulated first. After that, lexical material could be parsed that would make use of inherent versus imposed features only; interfering feature hierarchy information would have to be excluded. The parsing outcomes' comparisons would allow for claims on whether one feature—inherent or imposed—had a calculatory advantage over the other. Respective empirical assessments could reveal whether the stipulated difference between inherent and imposed features was mirrored in actual language processing.

In a similar fashion, TMP's ordering constraints—incompatibility, forward- and backward-directed non-retrievability and retrievability—as well as the possibility for a reanalysis-triggering threshold within the ranking on the one hand and entirely new feature specifications and treatments for disjunctive features on the other hand all have to be investigated in isolation. Each adjusting screw has to be tuned in a small scale and independently from others in order to ensure its effects and to exclude interference of other settings. Quite ironically, future investigations have to be more limited before eventually becoming broader with respect to the parses' sizes. Recall from above that, as of yet, TMP is only capable of analyzing a single DP. It cannot parse larger sequences of DPs that are arranged around a subcategorizing verb. The following section addresses this limitation as an opportunity for additional research.

10.3.2 TMP's claims for the second DP and the verb

Apart from addressing TMP's shortfalls by down-scaling its area of operation, the present thesis in fact already offers several options to the scope of investigation. Each of TMP's parsing analyses presumed the respective grammatical two-, grammatical three- and ungrammatical three-element DPs to be part of whole sentences. These were indeed necessary to present the DPs under investigation in the ERP experiments. Every experimental item from Experiments 1 to 3 contained a second DP and a sentence-final main verb. (73) repeats a shortened version of the experimental structure for NOM.M.SG from Experiment 1. It indicates the first DP's determiner and noun with Der and $_{\text{Der}}$Ner as already known. In similar fashion, the second DP's determiner and noun are designated with $_{\text{DerNer}}$Den and $_{\text{DerNerDen}}$Ner while the verb is labeled $_{\text{DerNerDenNer}}$V.

(73) Gestern hat der Bäcker [...] den Konditor [...] ausgelacht.
Yesterday has the baker [...] the confectioner [...] laughed-at
Der DerNer DerNerDen DerNerDenNer DerNerDenNerV
"Yesterday, the baker [...] laughed at the confectioner [...]."

Future research has to investigate how the positions of Der, DerNer, DerNerDen, DerNerDenNer and DerNerDenNerV interact. Clearly, TMP's usual Synchronization process can operate between Der and DerNer to build up DP1 as it was investigated in the present thesis. Likewise, TMP can synchronize DerNerDen and DerNerDenNer in order to construct DP2. This was, in fact, already indicated for TMP's provisional test run regarding the reassessment of nominative case in Section 4.3.2. However, TMP has yet to be extended by a mechanism that integrates the features of both DPs into what the subcategorization frame featurally requires. What would be interesting is whether TMP can make predictions for DP2 after having processed DP1. Can TMP predict to build up an accusative context in order to realize a direct object for the second DP if it previously integrated a DP for which it had realized a subject in nominative case *while* adhering to the proposed minimality-driven principle? The more intriguing scenarios, however, would enfold for two subsequent DPs with syncretic determiners in a canonical or non-canonical order as in (74a) and (74b) respectively. In the current investigation, TMP was able to predict the first *der* in DP1 in (74a) to be the *der*$_{\text{NOM.M.SG}}$ alternative. With the subsequent *Bäcker* it was able to build up the first argument in nominative case. Now, for the second DP, TMP has to be able to predictively exclude the *der*$_{\text{NOM.M.SG}}$ alternative for the ranked determiners. TMP has to be able to predict that, after successfully establishing a subject in nominative case, no second nominative DP can follow. Conversely, for (74b), the thesis demonstrated that TMP is capable of integrating the first DP's *der* as *der*$_{\text{NOM.M.SG}}$ and then reanalyze it after the subsequent noun *Kundin* was processed. In this way, TMP could build up a dative DP to realize an indirect object. With this information, TMP should, in turn, be able to predict that the second DP's *der* must be part of a subject DP in nominative case. If this is successful, the system has to insert both DP analyses into the verb's subcategorization slots.

(74) a. Gestern hat der Bäcker der Kundin geholfen.
Yesterday has [the baker].NOM.M [the customer].DAT.F helped
"Yesterday, the baker helped the customer."

b. Gestern hat der Kundin der Bäcker geholfen.
Yesterday has [the customer].DAT.F [the baker].NOM.M helped
"Yesterday, the baker helped the customer."

If it was possible to implement these mechanisms into TMP, the investigated structures could be re-parsed for the second argument DP and the sentence-final main verb. TMP's parses could be compared, claims derived and those translated into hypotheses. In fact, not only the DP1 but also the second DP and the verb were triggered onsets for EEG recordings. Thus, ERP data awaiting to be analyzed exists for all verb-relevant sentence positions including the verb itself.

10.3.3 Thinking outside the (morphosyntactic) box

For the third and last prospect, the present dissertation will go beyond morphosyntax. If there were areas of application in other linguistic fields that referred to similar mechanisms, this fact would not only count as additional evidence for the explanatory adequacy of TMP but could also establish its minimality-driven feature bias as a rather fundamental processing mechanism.

Interestingly, the investigation by Kretzschmar and Primus (submitted) seems to present this additional evidence. As presented before for morphological information, they assumed various features for semantic roles. In particular, they followed Dowty's (1991) multidimensional notion of the agent role which was decomposed into [VOL(ITION)], [SENT(IENCE)], [ACT(IVITY)][36], [CAUS(ATION)] and [EX(ISTENCE)]. Kretzschmar and Primus (submitted) tested these features across four verb classes that differed with respect to their specification. Most features realized verbs of the "work" class. Verbs within this category were presumably specified for [VOL, SENT, ACT]. Verbs in the "fear" class carried the feature [SENT], verbs within the "sweat" class were specified for [ACT] while the "glisten" class was featureless with [Ø]. In order to investigate these verb classes, they appeared within three different constructions that offered differently specified contexts. The featural environments were set by three contexts, namely active voice, impersonal passive and the German *man* ("one") construction. In turn, these constructions provided differently specified contexts: According to Kretzschmar and Primus (submitted), intransitive active voice was non-restricted with regard to agentivity and thus fully specified with the already introduced features among others. In contrast to that, they assumed that the *one* structure was specified for [SENT] or non-restrictive with regard to agentivity if the subject was human. Furthermore, the impersonal passive was specified for [VOL]. Verbs of the aforementioned classes could fit into these featural environments to varying degrees according to their own specifications. In two behavioral experiments, Kretzschmar and Primus (submitted) tested the configuration in (75), whereas the first questionnaire compared active voice in (75a) with the *one* construction in (75b) while the second questionnaire investigated active voice in (75a) and impersonal passive in (75c).

(75) Various preceding introductory sentences deployed...

a. ... active voice$_{[\text{VOL, SENT, ACT, CAUS, EX}]}$. Target sentence:
Sie arbeiteten / bangten / schwitzten / glänzten...
They worked$_{[\text{VOL, SENT, ACT}]}$ / feared$_{[\text{SENT}]}$ / sweated$_{[\text{ACT}]}$ / glistened$_{[\emptyset]}$...

b. ... *one* construction$_{[\text{SENT}]}$. Target sentence:
Man arbeitete / bangte / schwitzte / glänzte...
One worked$_{[\text{VOL, SENT, ACT}]}$ / feared$_{[\text{SENT}]}$ / sweated$_{[\text{ACT}]}$ / glistened$_{[\emptyset]}$...

c. ... impersonal passive$_{[\text{VOL}]}$. Target sentence:
Es wurde gearbeitet / gebangt / geschwitzt /
There was working$_{[\text{VOL, SENT, ACT}]}$ / fearing$_{[\text{SENT}]}$ / sweating$_{[\text{ACT}]}$ /

[36] Also designated as [AUTONOMOUS MOVEMENT] (Dowty, 1991, p. 572) or, more generally, [MOTION].

geglänzt...
glistening$_{[\emptyset]}$...

This approach bears a striking resemblance to the procedure of TMP's Synchronization process. Similar to TMP's filter specification that comprised the features of a preceding analysis, Kretzschmar and Primus' (submitted) constructions established varyingly specified contexts. The constructions open up a frame of features into which verbs of the respective classes could be integrated. The verb's fit was determined by how well their features accorded with the features of the construction. Whereas TMP made predictions on the preferred inflected element, Kretzschmar and Primus (submitted) tested how the "work", "fear", "sweat" and "glisten" verbs fit into the active voice, *one* and impersonal passive constructions. To do so, they obtained acceptability judgments from two questionnaire studies. The obtained ratings allowed for the acceptability clines in (76). Irrespective of the construction, the "glisten" class scored the lowest acceptability. The "work" class scored the highest rating in impersonal passive, clustered with the "fear" class in the *one* construction or even with the "sweat" class in the active voice.

(76) Acceptability clines:
  a. Active voice: work = fear = sweat > glisten
  b. *One* construction: work = fear > sweat > glisten
  c. Impersonal passive: work > fear > sweat > glisten

For obvious reasons, Kretzschmar and Primus (submitted) provided semantic reasons for the acceptability gradations. However, they also used the same terminology as the present morphosytax-related investigation did: They argued that the tested verbs fulfilled the contexts' semantic requirements to varying degrees. Interestingly, they stated that verbs with specifications overlapping with those of the context, had an acceptability advantage over those that had less features with construction's feature bundle in common. Verb semantics that shared no features with the constructions' specification resided at the lowest end of the acceptability cline (Kretzschmar and Primus, submitted, p. 22). To motivate this approach, the authors made use of two "widely used" (Kretzschmar and Primus, submitted, p. 24) morphological principles: the SPECIFICITY and SUBSET principles. Originally introduced in the present dissertation in Section 1.2, these two principles were the starting point for the formulation of TMP's core mechanism: the bias for minimal feature deviance that is for maximal feature overlap. Similar to the inadequacies that were admitted for TMP to eventually alter its operation and feature checking mechanism, Kretzschmar and Primus (submitted) also gave additional reasons for semantics and pragmatics constraining or manipulating the constructions' and the verb's specifications. Overall though, their approach can be translated into TMP's workflow in the following way: "work", "fear" and "sweat" class verbs have overlapping features with the contextual active voice construction. In contrast to that, the presumably featureless "glisten" class verbs have no common denominator with active voice's features. Thus, the bias for minimal feature deviance is fulfilled for "work", "fear" and "sweat" but not for "glisten" class verbs, resulting in the acceptability gradation in (76a). For the *one* construction, they assumed that it was specified for [SENT, ANIM(ATE)]. Thus, “work”$_{[\text{SENT, ANIM}]}$ and “fear”$_{[\text{SENT, ANIM}]}$ showed feature identity, while “sweat”$_{[\text{ANIM}]}$ lacked one and “glisten”$_{[\emptyset]}$ two features. This results in the cline shown in (76b). Lastly, the acceptability gradation in (76c) can be explained in the following way: “work”$_{[\text{VOL, SENT, ANIM}]}$, “fear”$_{[\text{SENT, ACT}]}$, “sweat”$_{[\text{SENT}]}$ and “glisten”$_{[\emptyset]}$ verbs gradually lack zero to three features in comparison to the impersonal passive construction that is specified for [VOL, SENT, ANIM].

Kretzschmar and Primus (submitted) presented evidence for the principles entertained in the present thesis independent of underspecification and morphosyntax. Both their results and their approach can be explained and modeled by TMP. This fact not only opens up prospective opportunities for fruitful, synergistic research collaborations, it also lends further credibility to TMP as an explanatorily adequate mechanism. On top of that, it also suggests that the principles pursued in this thesis are not limited to morphosyntax only but may be fundamental processing mechanisms. The subsequent section will elaborate on the thesis' research contribution and TMP's explanatory adequacy.

10.4 Explanatory Adequacy

The present dissertation developed and tested a morphosyntactic parser that incrementally picked up underspecified morphosyntactic features in order to build up an analysis: TMP. In doing so, the investigation contributes a step towards a cognitively plausible processing system that relinquishes hierarchical structure building as it operates on a flat and low level of analyzing features. The evaluation of TMP's overall explanatory adequacy was tied to the three guiding questions:

> Question 1: How do the parses differ between the elements of the subject-object ambiguities?
>
> Question 2: Which one of the underspecification approaches by Bierwisch, Blevins, Wunderlich and Wiese is explanatorily more adequate?
>
> Question 3: Does the presence or absence of an SP_{NOM} filter specification contribute to TMP's predictions?

The simple idea was that, if TMP derived claims for parsing certain structures, experimental data should either mirror these claims or falsify the mechanism's hypotheses. To answer Question 1, it can be concluded that parsing from one element to another—that was from a previous analysis to a determiner and from there to a noun or from a previous analysis to a determiner and from there to an intermediate adjective and to a noun—was modeled in a minimality-driven way. Minimal was the feature deviance between one and its subsequent analysis. The proposed parsing mechanism TMP associated a lower featural difference between one word and another with *simpler* calculatory work. Conversely, a higher featural difference was associated with a more *complex* calculatory work. Experimental evidence allowed to map calculatory work onto processing effort, whereas *simple* calculatory work yielded an easier integration which was reflected by a less pronounced negatively deflected ERP effect. Conversely, more *complex* calculatory work entailed a more effortful integration which was mirrored by a more pronounced negative-going ERP component:

(77)

	low	to	high feature deviance
	simple	to	*complex* calculatory work
TMP:	*candidate*$_1$	$<$	*candidate*$_2$
	less	to	more processing effort
NEG:	attenuated	$<$	pronounced

What was found for Question 1 allowed to assess Question 2: It turned out that, when minimal feature deviance was applied to the transitional contact points of words, Blevins' original and maximally underspecified as well as Wiese's approaches generated illicit predictions resulting in ungrammatical DPs. Parses that employed features of these frameworks were ungrammatical because they either ranked non-nominative determiners higher than nominative determiners when a subject DP in nominative case was to be realized or they ranked nouns after the correct determiners in a way that ungrammatical determiner-noun combinations entailed. Bierwisch's and Wunderlich's frameworks provided the most appropriate features and feature combinations for inflected determiners and nouns. As they both behaved in an identical way with regard to what was examined, the investigation reverted to Bierwisch's features.

Both aforementioned assessments of Questions 1 and 2, that is the featural transition and the selection of the most appropriate underspecification approach, allowed to gain insights into Question 3: TMP analyzed parses with and without an assumed precursory subject preference. According to this preference the first argument DP to be encountered should be analyzed as a subject in nominative case. Therefore, the subject preference was conceived as an SP$_{\text{NOM}}$, providing morphosyntactic features for nominative case. According to TMP's bias for minimal feature deviance, the lexical element that follows this preference should at best mirror the features of the SP$_{\text{NOM}}$ in order to keep calculatory work *simple*. In case of Bierwisch, the SP$_{\text{NOM}}$ was specified for [−OBJ, −OBL]. It was shown for TMP's parses that the mechanism ranked nominative-compatible determiners the highest irrespective of a present or absent precursory SP$_{\text{NOM}}$ filter specification. Tables 10.7 and 10.8 repeat the determiner rankings that list *der*$_{\text{NOM.M.SG}}$, *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ and *das*$_{\text{NOM/ACC.F.SG}}$ as the three top-ranked predicted candidates. Thus, if a given structure starts with a determiner in order to build up a DP, this DP is—in case of *der*, *die* or *das* enters the system—predestined to realize a subject in nominative, irrespective of the fact whether or not an SP$_{\text{NOM}}$ preceded the determiner.

However, the experimental data favored the absence of a precursory SP$_{\text{NOM}}$ filter specification. The determiner *den* was also investigated in TMP's parsings. Its accusative masculine singular alternative resides on the fifth rank in Table 10.7 for which an SP$_{\text{NOM}}$ is assumed and on the third position in the SP$_{\text{NOM}}$-free ranking in Table 10.8. If the former ranking was applied, *den*$_{\text{ACC.M.SG}}$'s SP$_{\text{NOM}}$-opposing [+OBJ] feature introduced incompatibility. In the experimental investigation, this case should have been mirrored

Table 10.7: Ranked determiner candidates after an SP$_{\text{NOM}}$.

rank	filter specification: [−OBJ, −OBL, −PL] (by current material's SP$_{\text{NOM}}$ + *hat*)		ϟ	🔍−		🔍+
	determiner	specification		⇒	⇐	
1.	*das*$_{\text{NOM/ACC.N.SG}}$	[Ø]	0	3	0	0
2.	*der*$_{\text{NOM.M.SG}}$	[+M]	0	3	1	0
3.	*die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[+PL ∨ +F]	1	3	1	0
	des$_{\text{GEN.M/N.SG}}$	[+OBL]	1	3	1	0
4.	*den*$_{\text{ACC.M.SG}}$	[+OBJ, +M]	1	3	2	0
5.	*dem*$_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL]	2	3	2	0
	der$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL, [+PL ∨ +F]]	2	3	2	0
6.	*den*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	3	3	3	0

Table 10.8: Ranked determiner candidates after no SP$_{\text{NOM}}$.

rank	filter specification: [Ø] (by current material's lack of an SP$_{\text{NOM}}$)		ϟ	🔍−		🔍+
	determiner	specification		⇒	⇐	
1.	*das*$_{\text{NOM/ACC.N.SG}}$	[Ø]	0	0	0	0
2.	*der*$_{\text{NOM.M.SG}}$	[+M]	0	0	1	0
	des$_{\text{GEN.M/N.SG}}$	[+OBL]	0	0	1	0
	die$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[+PL ∨ +F]	0	0	1	0
3.	*dem*$_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL]	0	0	2	0
	den$_{\text{ACC.M.SG}}$	[+OBJ, +M]	0	0	2	0
	der$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL, [+PL ∨ +F]]	0	0	2	0
4.	*den*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	3	0

by the occurrence of an ERP effect, signaling reanalysis. Since this component failed to appear, it can be concluded that there is no hard-coded precursory SP$_{\text{NOM}}$.

Most strikingly, though, it is the threefold interplay of TMP's bias for minimal feature deviance, the utilization of Bierwisch's particular features and an absent SP$_{\text{NOM}}$ filter specification that reveals the system's inherent preference for subject determiners. Admittedly, Chapter 3 already discussed research on the subject preference. Previous investigations already found an easier integration for subject DPs in comparison to non-canonical order. TMP's finding that *den*$_{\text{ACC.M.SG}}$ was harder to process than *der*$_{\text{NOM.M.SG}}$ is already well established. However, it was also argued that the research on subject-object ambiguities fell short of acknowledging the syncretic and thus ambiguous nature of the determiners in the DPs they investigated. Instead, the researchers entertained structural or movement-based explanations like the Active Filler Hypothesis to motivate the processing facilitation for one argument DP over the difficulty of another.

Therefore, the novelty of the proposed approach is that it operates in the most low-level and incremental fashion conceivable, allowing for unprecedented fine-grained observations of disambiguating processes. Furthermore, the proposed mechanism conceptually dispenses with abstract syntactical structures or hierarchies. This is an intuitively plausible way to model incremental processing: With nothing more than morphosyntactic features, the system successively proceeds from one element to another without branching or opening up a syntactically higher or lower node. In this way, the proposed mechanism was shown to be able to select subject-compatible determiners by design and not due to an external preference whose violating or adhering resulted in different syntactic structures. TMP did all that by merely expecting elements that featurally violated a subsequent element as little as possible in comparison to a previous analysis. This mechanism was called the bias for minimal feature deviance. With this mechanism and TMP at hand, the processing of underspecified morphosyntactic features allowed to argue not only for an integration advantage of one DP over another but also to look closer at the ambiguity of one syncretic determiner and its subsequent disambiguation by the following noun.

Every account denying underspecified morphosyntactic features owes explanations for the following two conceptual problems they run into: Firstly, full specification entails either the non-existence of subject-object ambiguities or a fifty-fifty chance of selecting the right or wrong inflected element. Both scenarios cannot be motivated in a meaningful way. No ordering principles like compatibility, specificity or the bias for minimal feature deviance proposed in this thesis were applicable if every element contains the features of all its grammatical categories. Considering the paradigm of the strong determiner, if every form is fully specified, there is only one that fits a given morphosyntactic context. In turn, this means that the remaining 23 determiners are incompatible with this certain context. This would preclude ambiguity as well as the measurable effects of reanalysis. Nevertheless, continuing this thought experiment would entail that, in some cases, the system would select the single proper form and in countless others it would illicit elements. No constraints come to mind that could systematically control these scenarios with regard to why and how many selections succeed and fail. Without a plausible constraint, the latter case–wrongly selecting a determiner—could occur 23 times more often than the former. These ungrammaticalities should definitely be measurable by an empirical account. Therefore, in order to still propagate maximal specification and to also avoid its aforementioned related issue, it would have to be argued that features may be fully represented but just not used for anything processing-related. It seems highly unlikely that in the previously hypothesized case of wrongly selected elements the conflicting features would not affect processing and result in numerous ungrammaticality effect. Rightly so, Penke et al. (2004, p. 432) concluded that

> a model with fully specified paradigm representations cannot account for the pattern we observed for the occurrence and non-occurrence of ungrammaticality effects. In such a model, all violations of nominal agreement features

> should have led to ungrammaticality effects.

Similarly, O13 (p. 234) predicted that

> if morphological underspecification does not play a role in language processing and if the difference between correct and incorrect conditions is a categorical one instead, both incorrect conditions should induce similar brain activity for detecting the mismatch.

Notably, as presented in Section 2.4, O13 found varying ERP responses for differently specified ungrammatical elements. Penke et al.'s (2004) and O13's conclusions that their results should have looked differently were corroborated by the data obtained for TMP in the sense that at least Experiment 1 should not have shown graded but uniform noun effects.

The second problem that full specification accounts face is that this assumption would entail "that the language user explicitly represents the full inflectional paradigm"(Pollard and Sag, 1987, p. 210). This would result in overblown mental lexicons with countless redundant entries. In addition, these forms would contain unnecessary morphosyntactic features. Both aspects would be disadvantageous for the architecture of the mental lexicon as they would increase memory load. In contrast to that, since TMP is grounded in an underspecification account, the model consequently inherits the plausible advantage of optimally stored mental entries.

Taking all aspects together, while TMP is undoubtedly in need of improvement, the current dissertation challenges the explanatory adequacy of purely syntactic approaches by presenting an equal processing system that is flat and—in principle—very basic. It is insofar flat and simple as the envisioned parser compares morphosyntactic features of one word with a newly incoming word allowing to explain processing difficulties at word-transition level. The driving force behind this comparison is the bias to keep the transitional feature differences between one element and another as low as possible. Due to this, the present approach is also more fine-grained than previous work since it involves decomposed, underspecified morphosyntactic features that allow to not only investigate whole DPs but also their constituting elements. In this way, a feature set grows from element to element and becomes more specific with the parser processing subsequent words, while subtle differences between feature bundles can cause different strengths in measurable processing load. In this respect, TMP represents an innovative way to address the processing difficulties of syntactically ambiguous constituents in German.

11 Conclusion

What commenced as a mere tentative curiosity for incremental language processing in first year linguistics classes, eventually assumed unexpected proportions. To quote the British diplomat Mr. Dryden from the historical drama *Lawrence of Arabia*, "big things have small beginnings" (*Lawrence of Arabia* 1962).[37] With this statement, Mr. Dryden referred to the impact a presumably insignificant Bedouin army may have on a grand-scale war. While his quote is also appropriate to describe the genesis of this dissertation, it even more so captures the gist of its content: To close the circle from the Introduction, the investigation brought to light that tiny linguistic properties can eventually comprise larger structures like the starting example (1), repeated in (78). The structure is composed of individual lexical elements that, in turn, consist of even smaller properties. These are—among others—morphosyntactic features. This thesis' research contribution is to present a system that incrementally picks up these features and assembles them to make up complete constituents.

(78) Die Botschafterin besuchte die Ministerin.
the ambassador visited the minister
"The ambassador/minister visited the minister/ambassador."

The Theoretical Part I of the dissertation was concerned with clarifying the theoretical peculiarities of (78). The fact that the example contained two identical determiners with two different functions was discussed in light of a morphological concept in Chapter 1. This concept—syncretism—was accounted for by means of underspecification. The term describes the use of the aforementioned, minuscule positively or negatively valued features. This measure was applied to capture the phenomenon of syncretism. A variety of underspecification approaches was presented, providing equally differing rules with regard to number and specification. These tools allowed to underspecify the German strong determiner which became pivotal for the present investigation. The chapter concluded that underspecification is a suitable means to assign morphosyntactic features to a lexical item alongside other linguistic information.

The subsequent Chapter 2 explored the question whether the features compiled for inflected elements, like a strong determiner, have implications for language processing. Discussing the sparse empirical evidence on this matter revealed that fine-grained underspecified morphosyntactic features may, in fact, have an equivalent in the mental

[37]I encountered the quote for the first time in Ridley 's (2012) science fiction *Prometheus*. In it, the android David—an avid fan of *Lawrence of Arabia*—recited Mr. Dryden when he wondered about creation itself, seemingly rising from a tiny inconsequential droplet of DNA. The original quote apparently dates back to Aristotle's (1939) *On the Heavens* in which he discussed terrestrial and extraterrestrial correlations. He understood that large consequences may follow from small things (I.v 271b).

representation of inflected items. Moreover, the outcome was that an underspecified architecture of the mental lexicon reduces memory load both with regard to the number of forms to be stored as well as concerning their constituting information. Without underspecification, the mental lexicon would have to store redundant, fully specified lexical entries.

Chapter 3 bridged the gap to the Introduction by discussing the starting example (78) in light of syntax and the processing of subject-object ambiguities. Relevant research provided the notion of minimality as the force behind structure-building. However, the chapter also recognized the connection between syncretism and morphosyntactic underspecification on the one hand and the processing of subject-object ambiguities on the other hand. This link was the first indication that assembling small morphosyntactic features may contribute to something bigger. The literature on subject-object ambiguities failed to realize this connection.

Due to this, the present dissertation merged the prior findings on the processing of morphosyntactic underspecification with the insights into structural ambiguity. As a result, Chapter 4 introduced a unifying, sophisticated system that incrementally processes morphosyntactic features in order to build up a larger analysis: The Morphosyntactic Parser. To do so, TMP used the available morphosyntactic features of one element and compared them with the incrementally available specification of the subsequent element. Crucially, the overlap between both sets should be maximal or, to put it differently, the difference should be as little as possible. This bias for minimal feature deviance allowed TMP to predict elements as upcoming input in descending order of preferability. Accordingly, higher ranked predicted candidates that actually entered the system were assumed to be integrated in a calculatory *simple* way since they shared features with a preceding analysis. In comparison, lower ranked elements entailed calculatory *complexity* as they deviated from the previously integrated material to greater extent.

In Chapter 5, the mechanism parsed and analyzed subject-object ambiguities that deployed differently specified elements according to the previously introduced underspecification approaches. TMP demonstrated that it was capable to predict a preferable alternative in case of syncretic input and to reanalyze its previous integration in case of newly conflicting input. These outcomes resulted in claims regarding the calculatory *simplicity* or *complexity* with regard to the integration of a particular structure's lexical element. In conclusion, TMP revealed that an initially minuscule change of features can lead to utterly different analyses with regard to case, gender or number.

The Experimental Part II of the present thesis experimentally evaluated the explanatory adequacy of TMP's claims. Three ERP experiments examined the first of two clause-medial DPs of subject-object ambiguities. The parser's and the experiments' outcomes were compared in order to decide whether the mechanism is able to make psycholinguistically plausible predictions. TMP's prediction for one element's calculatory *simplicity* due to low featural deviance should be mirrored by attenuated ERP effects, reflecting lower processing effort. In contrast, one element's calculatory *complexity* due to high featural deviance in comparison to a previous integration should be mirrored by a pronounced ERP effect and thus reflect high processing effort. From Experiment 1 via the second experiment to Experiment 3, the featural intricacy at the contact point from one element to another was increased.

Chapter 10 put the experimental data into perspective. With few exceptions, the first experiment could account for TMP's position-dependent predictions. Increasing the intricacy of featural contact points in Experiments 2 and 3 multiplied the respective parsing claims and reduced the possibility for differentiating results. In tracing these shortcomings back to TMP's design, many opportunities for future research were identified. Strengthened by the outlook into another linguistic area, namely semantics, TMP was revealed to be a versatile tool that might be able to account for questions aside from morphosyntax also.

This insight allowed to finally decide on the model's explanatory adequateness: The Morphosyntactic Parser adequately demonstrated that big things can have small beginnings indeed.

Appendix

A TMP's Provisional Test Run: Testing O13's Structures

This chapter of the appendix continues the provisional test run for O13's structures which has been started in Section 4.3.1. The PPs under investigation are repeated here in (79).

(79) Correct adjective inflections:

a. ACC.N.SG:

durch$_{[+\text{OBJ}, -\text{OBL}]}$	schlichtes$_{[-\text{F}]}$	Design$_{[-\text{F}]}$
by.ACC	plain.N	design.N.SG

→ 3 to 1 feature to compare on noun

b. ACC.F.SG:

durch$_{[+\text{OBJ}, -\text{OBL}]}$	schlichte$_{[\emptyset]}$	Struktur$_{[\emptyset]}$
by.ACC	plain.F	structure.F.SG

→ smallest LAN, shortest reaction time, highest accuracy, 2 to 1 (/0) features to compare on noun

c. ACC.M.SG:

durch$_{[+\text{OBJ}, -\text{OBL}]}$	schlichten$_{[+\text{OBJ}, -\text{OBL}, +\text{M}, -\text{F}]}$	Geschmack$_{[+\text{M}, -\text{F}]}$
by.ACC	plain.M	taste.M.SG

→ strongest LAN, longest reaction time, lowest accuracy, 4 to 2 features to compare on noun

A.1 Parsing *durch schlichtes Design*

The correct PP of (79a) shall be parsed: *durch schlichtes Design*. The entire parse will be illustrated in Figure A.1.

A.1.1 Stage 1: *durch* → *schlichtes*

Step 1 The current material and its specification is *durch*$_{\text{ACC.M.SG}}$ with [+OBJ, −OBL]. This bundle will be inserted into the current material slot and its specification respectively. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [+OBJ, −OBL] was the current material's specification and is maintained in the filter specification of the subsequent Step 2.

Step 2 Ranked candidates are derived and thoroughly presented in Table A.1. The adjective *schlichten*$_{\text{ACC.M.SG}}$ is the top-ranked candidate while others are still part of the list. The targeted *schlichtes*$_{\text{NOM/ACC.N.SG}}$ is the third-ranked candidate. How TMP switches from the top-ranked *schlichten*$_{\text{ACC.M.SG}}$ to the lower ranked *schlichtes*$_{\text{NOM/ACC.N}}$ alternative will be explained for the third step of the parsing along with the Synchronization process.

Step 3 The adjective *schlichtes* enters the system as newly incoming material. It is assumed that TMP simply "sees" *schlichtes* initially without any specification. In order to assign a specification and eventually integrate *schlichtes*, two operations are required: Firstly, TMP has to adopt *schlichtes* instead of the predicted *schlichten*$_{\text{ACC.M.SG}}$. If the predicted *schlichten*$_{\text{ACC.M.SG}}$ had really been the incoming material, then TMP would not even have to synchronize features. This should have been the most effortless way of synchronization. This is not the case in the example at hand. This means that the top-ranked candidate of *schlichten*$_{\text{ACC.M.SG}}$ has to be replaced by *schlichtes*. Secondly, the incoming material of *schlichtes* has to be associated with its respective feature specification. Synchronization handles these issues. In order to adopt *schlichtes*, TMP has to search the ranked candidates from the second step. The list provides one alternative, namely *schlichtes*$_{\text{NOM/ACC.N.SG}}$. That is why *schlichte* will be associated with [−F].

For the integration of *schlichtes*$_{\text{NOM/ACC.N.SG}}$, the current material's feature set of [+OBJ, −OBL] will thus be combined with the incoming material's specification [−F]. They will eventually be fed into the next parsing stage. The sum of the features of *durch*$_{\text{ACC.M.SG}}$ and *schlichtes* equals [+OBJ, −OBL, −F]. This is only possible since both feature bundles are mutually compatible and can thus be added up. This feature bundle can now enter Step 1 of Stage 2 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

Table A.1: Ranked adjective candidates after *durch*$_{\text{ACC.M.SG}}$.

rank	filter specification: [+OBJ, −OBL] (by current material's *durch*$_{\text{ACC.M.SG}}$ from prior step)		↯	🔍−		🔍+
	determiner	specification		⇒	⇐	
1.	*schlichten*$_{\text{ACC.M.SG}}$	[+OBJ, −OBL, +M, −F]	0	0	2	2
2.	*schlichte*$_{\text{NOM/ACC.F.SG/PL, NOM/ACC.PL}}$	[Ø]	0	2	0	0
3.	*schlichtes*$_{\text{NOM/ACC.N.SG}}$	[−F]	0	2	1	0

A.1.2 Stage 2: *durch* + *schlichtes* → *Design*

Step 1 The first step here is identical to the outcome of Step 3 from Appendix A.1.1. The current material and its specification are the combination of the *durch*$_{\text{ACC.M.SG}}$ and *schlichtes* that is [+OBJ, −OBL, −F] in total. This bundle will be inserted into the current material slot and its specification respectively. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [+OBJ, −OBL, −F] was the current material's specification and is maintained in the filter specification at Step 2.

Step 2 Ranked candidates are derived following the integration of *schlichtes* and thoroughly given in Table A.2. The noun *Design*$_{\text{NOM/ACC/DAT.N.SG}}$ is the top-ranked candidate while others are still part of the list. How TMP adopts the top-ranked *Design*$_{\text{NOM/ACC/DAT.N.SG}}$ will be explained for the third step of the parsing along with the Synchronization process.

Step 3 The noun *Design* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Design* initially without any specification. In order to assign a specification and eventually integrate *Design*, TMP can use the top-ranked candidate. As shown in Table A.2, there is only one instance of *Design* with its feature of [−F] that has precedence over *Geschmack* which carries [+M, −F] and *Struktur* which is featureless. Therefore, *Design* will be associated with [−F].

For the integration of *Design*$_{\text{NOM/ACC/DAT.N.SG}}$, the current material's specification [+OBJ, −OBL, −F] will thus be combined with the incoming material's specification [−F]. They will be fed into the first step at Stage 3, eventually concluding the parse.

Table A.2: Ranked noun candidates after *durch*$_{\text{ACC.M.SG}}$ + *schlichtes*.

rank	filter specification: [+OBJ, −OBL, −F] (by current material's *durch*$_{\text{ACC.M.SG}}$ + *schlichtes*$_{\text{NOM/ACC.N.SG}}$ from prior step)		⚡	🔍−		🔍+
	noun	specification		⇒	⇐	
1.	*Design*$_{\text{NOM/ACC/DAT.N.SG}}$	[−F]	0	2	0	1
2.	*Geschmack*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M, −F]	0	2	1	1
3.	*Struktur*$_{\text{NOM/ACC/DAT.F.SG}}$	[∅]	0	3	0	0

A.1.3 Stage 3: Conclusion

The sum of the features of *durch*$_{\text{ACC.M.SG}}$, *schlichtes* and *Design* equals [+OBJ, −OBL, −F]. This is only possible since both feature bundles are mutually compatible and can thus be added up. Figure A.1 shows that this feature bundle can now be fed into the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

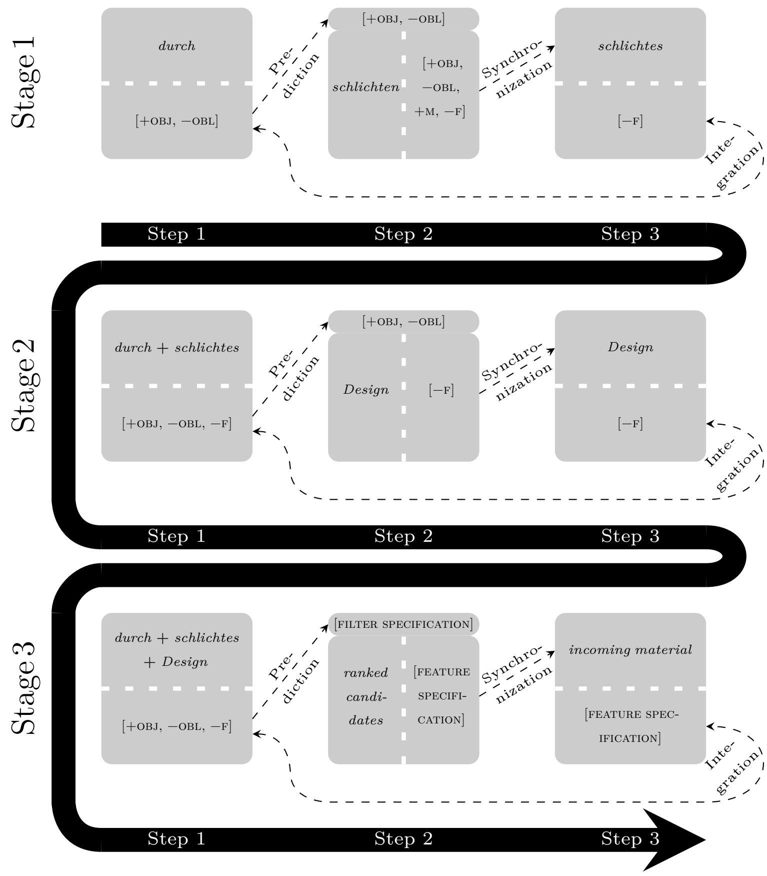


Figure A.1: Combining current and incoming material: *durch*$_{\text{ACC.M.SG}}$, *schlichtes* and *Design* equals [+OBJ, −OBL, −F].

A.2 Parsing *durch schlichte Struktur*

The correct PP of (79b) shall be parsed: *durch schlichte Struktur*. The entire parse will be illustrated in Figure A.2.

A.2.1 Stage 1: *durch* → *schlichte*

Step 1 At this point, Step 1 parallels Stage 1, Step 1 in Appendix A.1 since the conditions are identical: *durch*$_{\text{ACC.M.SG}}$ and its feature specification provide the feature specification for the subsequent Step 2 via the Prediction process.

Step 2 Here, Step 2 parallels Stage 1, Step 2 in Appendix A.1 due to complete overlap: The ranked candidates along with the top-ranked candidate are derived due to the feature specification.

Step 3 The adjective *schlichte* enters the system as newly incoming material. It is assumed that TMP simply "sees" *schlichte* initially without any specification. In order to assign a specification and eventually integrate *schlichte*, two operations are required: Firstly, TMP has to adopt *schlichte* instead of the predicted *schlichten*$_{\text{ACC.M.SG}}$. If the predicted *schlichten*$_{\text{ACC.M.SG}}$ had really been the incoming material, then TMP would not even have to synchronize features. This should have been the most effortless way of synchronization. This is not the case in the example at hand. This means that the top-ranked candidate of *schlichten*$_{\text{ACC.M.SG}}$ has to be replaced by *schlichte*. Secondly, the incoming material of *schlichte* has to be associated with its respective feature specification. Synchronization handles these issues. In order to adopt *schlichte*, TMP has to search the ranked candidates from the second step. The list provides one alternative, namely *schlichte*$_{\text{NOM/ACC.F.SG/PL, NOM/ACC.PL}}$. That is why *schlichte* will be associated with [Ø].

For the integration of *schlichte*$_{\text{NOM/ACC.F.SG/PL, NOM/ACC.PL}}$, the current material's feature set of [+OBJ, −OBL] will thus be combined with the incoming material's specification [Ø]. They will eventually be fed into the next parsing stage. The sum of the features of *durch*$_{\text{ACC.M.SG}}$ and *schlichte* equals [+OBJ, −OBL]. This is only possible since both feature bundles are mutually compatible and can thus be added up. This feature bundle can now be used for Step 1 of Stage 2 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

A.2.2 Stage 2: *durch* + *schlichte* → *Struktur*

Step 1 The first step here is identical to the outcome of Step 3 from Appendix A.1.1. The current material and its specification are the combination of the *durch*$_{\text{ACC.M.SG}}$ and *schlichte* that is [+OBJ, −OBL] in total. This bundle will be inserted into the current material slot and its specification respectively. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [+OBJ, −OBL] was the current material's specification and is maintained in the filter specification at Step 2.

Step 2 Ranked candidates are derived following the integration of *schlichte* and thoroughly given in Table A.3. The noun *Struktur*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$ is the top-ranked candidate while others are still part of the list. How TMP adopts the top-ranked *Struktur*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$ will be explained for the third step of the parsing along with the Synchronization process.

Step 3 The noun *Struktur* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Struktur* initially without any specification. In order to assign a specification and eventually integrate *Struktur*, TMP can use the top-ranked candidate. As shown in Table A.3, *Struktur*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$ with its feature of [Ø] has precedence over *Design* which carries [−F] and *Geschmack* which carries [+M, −F]. It is *simpler* for TMP to synchronize zero features with the incoming *Struktur* at the third step than a specification that is partially non-retrievable to the feature specification—namely [−F] in the case of *Design* or [+M, −F] in the case of *Geschmack*. That is why *Struktur* will be associated with [Ø]. In order to assign a specification and eventually integrate *Struktur*, TMP can use the top-ranked candidate. As shown in Table A.3, there is only one instance of *Struktur* with its empty feature set that has precedence over *Design* which carries [−F] and *Geschmack* which carries [+M, −F]. Therefore, *Struktur* will be associated with [Ø].

For the integration of *Struktur*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$, the current material's specification [+OBJ, −OBL] will thus be combined with the incoming material's specification [Ø]. They will be fed into the first step at Stage 3, eventually concluding the parse.

Table A.3: Ranked noun candidates after *durch*$_{\text{ACC.M.SG}}$ + *schlichte*.

rank	filter specification: [+OBJ, −OBL] (by current material's *durch*$_{\text{ACC.M.SG}}$ + *schlichte*$_{\text{NOM/ACC.F.SG/PL, NOM/ACC.PL}}$ from prior step)		⚡	🔍−		🔍+
	noun	specification		⇒	⇐	
1.	*Struktur*$_{\text{NOM/ACC/DAT.F.SG}}$	[Ø]	0	2	0	0
2.	*Design*$_{\text{NOM/ACC/DAT.N.SG}}$	[−F]	0	2	1	0
3.	*Geschmack*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M, −F]	0	2	2	0

A.2.3 Stage 3: Conclusion

The sum of the features of *durch*$_{\text{ACC.M.SG}}$, *schlichte* and *Struktur* equals [+OBJ, −OBL]. This is only possible since both feature bundles are mutually compatible and can thus be added up. As shown in Figure A.2, this feature bundle can now be fed into the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

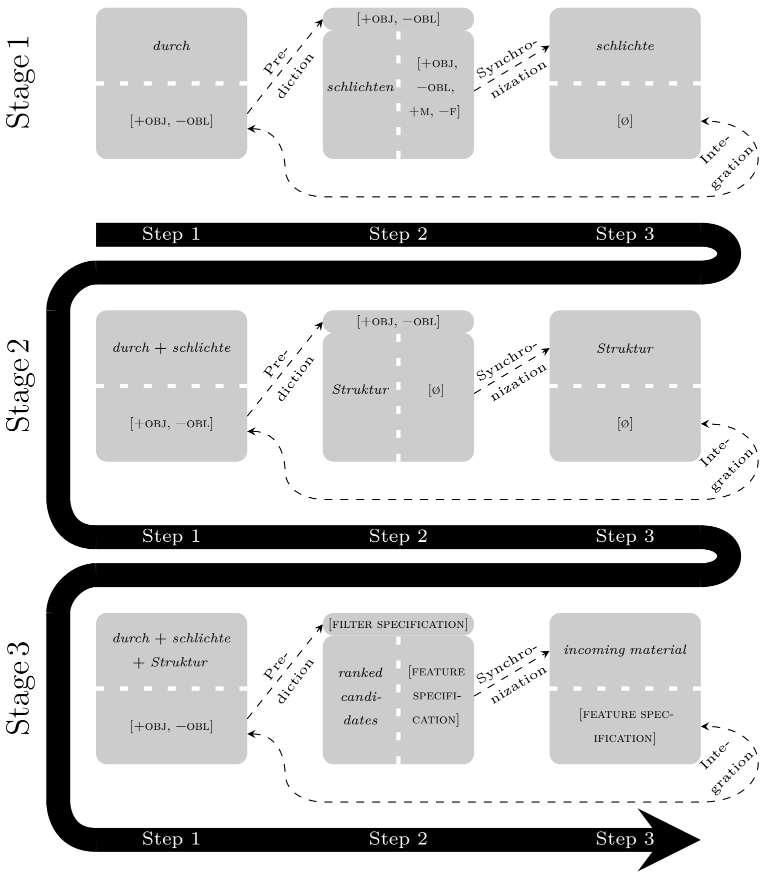


Figure A.2: Combining current and incoming material: *durch*$_{\text{ACC.M.SG}}$, *schlichte* and *Struktur* equals [+OBJ, −OBL].

A.3 Parsing *durch schlichten Geschmack*

The correct PP of (79c) shall be parsed: *durch schlichten Geschmack*. The entire parse will be illustrated in Figure A.3.

A.3.1 Stage 1: *durch* → *schlichten*

Step 1 At this point, Step 1 parallels Stage 1, Step 1 in Appendix A.1 since the conditions are identical: *durch*$_{\text{ACC.M.SG}}$ and its feature specification provide the feature specification for the subsequent Step 2 via the Prediction process.

Step 2 Here, Step 2 parallels Stage 1, Step 2 in Appendix A.1 due to complete overlap: The ranked candidates along with the top-ranked candidate are derived due to the feature specification.

Step 3 The adjective *schlichten* enters the system as newly incoming material. It is assumed that TMP simply "sees" *schlichten* initially without any specification. In order to assign a specification and eventually integrate *schlichten*, TMP can use the top-ranked candidate. As shown in Table A.1, *schlichten*$_{\text{ACC.M.SG}}$ with its features of [+OBJ, −OBL,

+M, −F] has precedence over *schlichte* which carries [Ø] and *schlichtes* which carries [−F]. It is *simpler* for TMP to synchronize zero features with the incoming *schlichten* at the third step than a specification that is partially non-retrievable to the feature specification—namely [Ø] in the case of *schlichte* or [−F] in the case of *schlichtes*. That is why *schlichten* will be associated with [+OBJ, −OBL, +M, −F].

For the integration of $schlichten_{\text{ACC.M.SG}}$, the current material's specification [+OBJ, −OBL] will thus be combined with the incoming material's specification [+OBJ, −OBL, +M, −F]. They will be fed into the first step at Stage 3, eventually concluding the parse. The sum of the features of $durch_{\text{ACC.M.SG}}$ and *schlichten* equals [+OBJ, −OBL, +M, −F]. This is only possible since both feature bundles are mutually compatible and can thus be added up. This feature bundle can now be used for Step 1 of Stage 2 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

A.3.2 Stage 2: *durch* + *schlichten* → *Geschmack*

Step 1 The first step here is identical to the outcome of Step 3 from Appendix A.1.1. The current material and its specification are the combination of the $durch_{\text{ACC.M.SG}}$ and *schlichte* that is [+OBJ, −OBL] in total. This bundle will be inserted into the current material slot and its specification respectively. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [+OBJ, −OBL] was the current material's specification and is maintained in the filter specification at Step 2.

Step 2 Ranked candidates are derived following the integration of *schlichten* and thoroughly given in Table A.4. The noun $Geschmack_{\text{NOM/ACC/DAT.M.SG}}$ is the top-ranked candidate while others are still part of the list. How TMP adopts the top-ranked $Geschmack_{\text{NOM/ACC/DAT.M.SG}}$ will be explained for the third step of the parsing along with the Synchronization process.

Step 3 The noun *Geschmack* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Geschmack* initially without any specification. In order to assign a specification and eventually integrate *Geschmack*, TMP can use the top-ranked candidate. As shown in Table A.4, $Geschmack_{\text{NOM/ACC/DAT.M.SG}}$ with its features of [+M, −F] has precedence over *Design* which carries [−F] and *Struktur* which is featureless. It is *simpler* for TMP to synchronize two identical features with the incoming *Geschmack* at the third step than specifications that are partially non-retrievable to the feature specification—namely [−F] in the case of *Design* or [Ø] in the case of *Struktur*. That is why *Geschmack* will be associated with [+M, −F]. In order to assign a specification and eventually integrate *Geschmack*, TMP can use the top-ranked candidate. As shown in Table A.4, there is only one instance of *Geschmack* with its features of [+M, −F] that has precedence over *Design* which carries [−F] and *Struktur* which carries [ø]. Therefore, *Geschmack* will be associated with [+M, −F].

For the integration of $Geschmack_{\text{NOM/ACC/DAT.M.SG}}$, the current material's specification

[+OBJ, −OBL, +M, −F] will thus be combined with the incoming material's specification [+M, −F]. They will be fed into the first step at Stage 3, eventually concluding the parse.

Table A.4: Ranked noun candidates after *durch*$_{\text{ACC.M.SG}}$ + *schlichten*.

rank	filter specification: [+OBJ, −OBL, +M, −F] (by current material's *durch*$_{\text{ACC.M.SG}}$ + *schlichten*$_{\text{ACC.M.SG}}$ from prior step)		⚡	🔍−		🔍+
	noun	specification		⇒	⇐	
1.	*Geschmack*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M, −F]	0	2	0	2
2.	*Design*$_{\text{NOM/ACC/DAT.N.SG}}$	[−F]	0	3	0	1
3.	*Struktur*$_{\text{NOM/ACC/DAT.F.SG}}$	[∅]	0	4	1	0

A.3.3 Stage 3: Conclusion

The sum of the features of *durch*$_{\text{ACC.M.SG}}$, *schlichten* and *Geschmack* equals [+OBJ, −OBL, +M, −F]. This is only possible since both feature bundles are mutually compatible and can thus be added up. Figure A.3 shows how this feature bundle can now be fed into the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

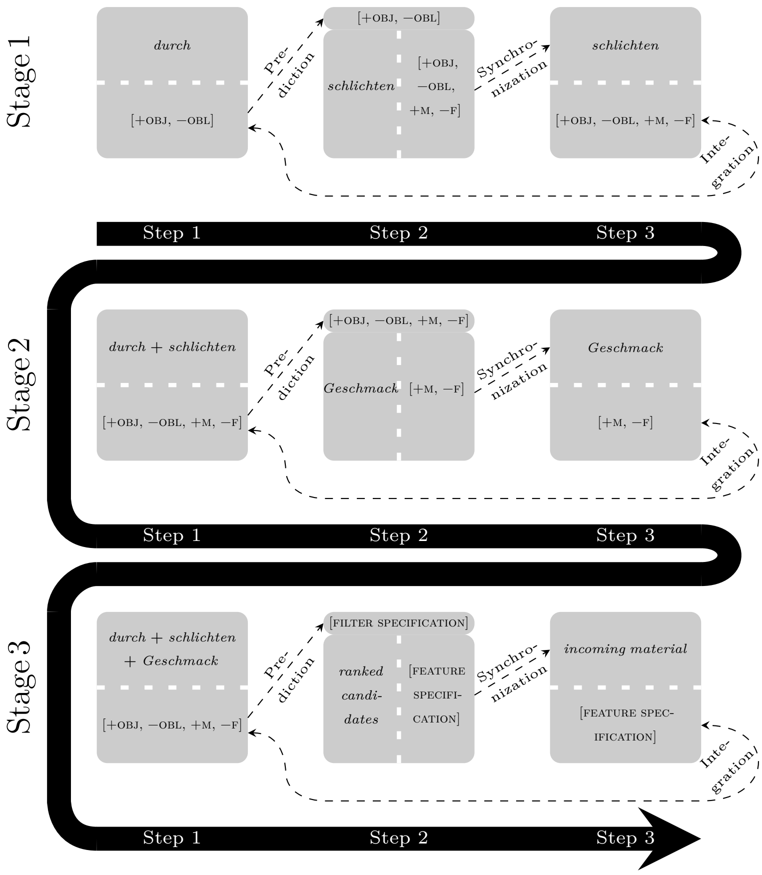


Figure A.3: Combining current and incoming material: *durch*$_{\text{ACC.M.SG}}$, *schlichten* and *Geschmack* equals [+OBJ, −OBL, +M, −F].

B Feeding TMP with Grammatical Two-Element DPs

This chapter of the appendix continues the two-element analyses which have been initiated in Chapter 5. In particular, it will complete the feature preparations and parsing calculations for the underspecification approaches by Blevins, Wunderlich and Wiese. The feature preparations from Section 5.1 will be concluded in Appendix B.1, the parses with a prior SP_{NOM} filter specification from Section 5.2.1 will be revisited in Appendix B.2.1, and the calculations without a precursory SP_{NOM} filter specification from Section 5.2.2 will be completed in Appendix B.2.1.

B.1 Feature Preparations

B.1.1 Compiling Blevins' original features

For Blevins' approach, two versions of determiner and noun underspecification shall be used. The original model from Blevins will be distinguished from a modified, maximally underspecified inventory proposed in Appendix B.1.2. The reasoning behind this is that O13 (p. 244) argued for further streamlining the inventory of Blevins by means of applying the principles of compatibility and specificity without damaging the corresponding paradigm. "For concreteness, it is the [−OBL] feature in the specifications associated with the markers /r/ (for nominative masculine singular contexts, [...] and /s/ (for nominative and accusative neuter singular contexts, [...] that is not strictly necessary in order to fully derive the paradigm." (O13, p. 244). This is not entirely correct, since this leads to a marker conflict in the genitive masculine singular context. By deleting the [−OBL] feature from the -*er* marker (equivalent to *der*$_{\text{NOM.M.SG}}$), two compatible markers would remain with the same number of features: *der*$_{\text{NOM.M.SG}}$'s [+M, −F] and *des*$_{\text{GEN.M/N.SG}}$'s [+OBJ, −F] are both compatible with the genitive masculine singular context's specification of [−OBJ, +OBL, +M, −F, −PL]. Due to this, it would be no longer possible for the specificity principle to decide which candidate would have to realize the syntactic context in question without stipulating a feature hierarchy. Since O13 did not mention an additional feature hierarchy to resolve this conflict, the original inventory in this Appendix B.1.1 will be distinguished from the maximally underspecified inventory in the following Appendix B.1.2.

Blevins inventory for the German strong determiner was introduced in Table 1.9 and shall be repeated here in Table B.1a. With regard to the nouns, Blevins—like Bierwisch—does not provide underspecified feature specifications for nominal inflection. Therefore, a noun inventory has to be developed. In trying to maintain the way he underspecified the paradigm for pronominal inflection, the inventory for *Bäcker* from Table 5.1 should look like the one in Table B.1b. It reflects Blevins' referral to negatively specified feature bundles. The order of nouns is determined by decreasing specificity. Similar to *Bäcker*, the paradigm for *Kundin* from Table 5.1 would be specified and ordered accordingly like in Table B.1c.

Table B.1: Inventories in Blevins' original manner.

(a) Inventory of the strong determiner paradigm.

determiner		feature specification
R_1 *den*$_{\text{DAT.PL}}$	↔	[+OBJ, +OBL, +PL]
R_2 *dem*$_{\text{DAT.M/N.SG}}$	↔	[+OBJ, +OBL, −F]
R_3 *des*$_{\text{GEN.M/N.SG}}$	↔	[+OBL, −F]
R_4 *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	↔	[+OBL]
R_5 *den*$_{\text{ACC.M.SG}}$	↔	[+OBJ, −OBL, +M, −F]
R_6 *der*$_{\text{NOM.M.SG}}$	↔	[−OBL, +M, −F]
R_7 *das*$_{\text{NOM/ACC.N.SG}}$	↔	[−OBJ, −F]
R_8 *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	↔	[Ø]

(b) Inventory of the *Bäcker* paradigm.

noun		feature specification
R_1 *Bäckers*$_{\text{GEN.M.SG}}$	↔	[−OBJ, +OBL, +M, −F]
R_2 *Bäckern*$_{\text{DAT.PL}}$	↔	[+OBJ, +OBL, +PL]]
R_3 *Bäcker*$_{\text{NOM/ACC/GEN.M.SG}}$	↔	[+M, −F]
R_4 *Bäcker*$_{\text{NOM/ACC/DAT.M.PL}}$	↔	[+PL]

(c) Inventory of the *Kundin* paradigm.

noun		feature specification
R_1 *Kundinnen*$_{\text{NOM/ACC/DAT/GEN.F.PL}}$	↔	[+PL]
R_2 *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	↔	[+F]

B.1.2 Compiling Blevins' maximally underspecified features

Turning to O13's (p. 244) maximally underspecified version of Blevins, the paradigm in Table B.2a lacks the [−OBL] feature for the forms *der*$_{\text{NOM.M.SG}}$ and *das*$_{\text{NOM/ACC.M.SG}}$ that was still there in the inventory in Table 1.9. The inventories for *Bäcker* and *Kundin* are identical to the previous ones in Tables B.1b and B.1c respectively. They shall be repeated for the sake of completeness in Tables B.2b and B.2c:

Table B.2: Inventories in Blevins' maximally underspecified manner.

(a) Inventory of the strong determiner paradigm.

determiner		feature specification
R_1 *den*$_{\text{DAT.PL}}$	$\leftrightarrow$	[+OBJ, +OBL, +PL]
R_2 *dem*$_{\text{DAT.M/N.SG}}$	$\leftrightarrow$	[+OBJ, +OBL, −F]
R_3 *des*$_{\text{GEN.M/N.SG}}$	$\leftrightarrow$	[+OBL, −F]
R_4 *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	$\leftrightarrow$	[+OBL]
R_5 *den*$_{\text{ACC.M.SG}}$	$\leftrightarrow$	[+OBJ, −OBL, +M, −F]
R_6 *der*$_{\text{NOM.M.SG}}$	$\leftrightarrow$	[+M, −F]
R_7 *das*$_{\text{NOM/ACC.N.SG}}$	$\leftrightarrow$	[−F]
R_8 *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	$\leftrightarrow$	[Ø]

(b) Inventory of the *Bäcker* paradigm.

noun		feature specification
R_1 *Bäckers*$_{\text{GEN.M.SG}}$	$\leftrightarrow$	[−OBJ, +OBL, +M, −F]
R_2 *Bäckern*$_{\text{DAT.PL}}$	$\leftrightarrow$	[+OBJ, +OBL, +PL]]
R_3 *Bäcker*$_{\text{NOM/ACC/GEN.M.SG}}$	$\leftrightarrow$	[+M, −F]
R_4 *Bäcker*$_{\text{NOM/ACC/DAT.M.PL}}$	$\leftrightarrow$	[+PL]

(c) Inventory of the *Kundin* paradigm.

noun		feature specification
R_1 *Kundinnen*$_{\text{NOM/ACC/DAT/GEN.F.PL}}$	$\leftrightarrow$	[+PL]
R_2 *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	$\leftrightarrow$	[+F]

B.1.3 Compiling Wunderlich's features

Wunderlich's inventory for the German strong determiner was introduced in Table 1.11 and shall be repeated here in Table B.3a for better comprehensibility. Note again the partially disjunctive feature specifications in R_1, R_2 and R_3. With regard to the nouns, Wunderlich—like Bierwisch and Blevins—does not provide underspecified feature specifications for nominal inflection. Therefore, a noun inventory has to be developed while maintaining the way he underspecified the paradigm for pronominal inflection. The inventory for *Bäcker* from Table 5.1 should look like the one in Table B.3b. Its rules are ordered from high to low specificity. Similar to *Bäcker*, the paradigm for *Kundin* from Table 5.1 would be specified and ordered accordingly like in Table B.3c.

Table B.3: Inventories in Wunderlich's manner.

(a) Inventory of the strong determiner paradigm.

determiner		feature specification
R_1 *den*$_{\text{DAT.PL}}$	↔	[+LR, +HR, +PL, [+F ∨ +PL]]
R_2 *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	↔	[+HR, [+LR ∨ +N], [+PL ∨ +F]]
R_3 *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	↔	[+PL ∨ +F]
R_4 *dem*$_{\text{DAT.M/N.SG}}$	↔	[+LR, +HR]
R_5 *des*$_{\text{GEN.M/N.SG}}$	↔	[+N, +HR]
R_6 *den*$_{\text{ACC.M.SG}}$	↔	[+HR, +M]
R_7 *der*$_{\text{NOM.M.SG}}$	↔	[+M]
R_8 *das*$_{\text{NOM/ACC.N.SG}}$	↔	[∅]

(b) Inventory of the *Bäcker* paradigm.

noun		feature specification
R_1 *Bäckers*$_{\text{GEN.M.SG}}$	↔	[−OBJ, +OBL, +M, −F]
R_2 *Bäckern*$_{\text{DAT.M.PL}}$	↔	[+OBJ, +OBL, +PL]
R_3 *Bäcker*$_{\text{NOM/ACC/GEN.M.SG}}$	↔	[+M, −F]
R_4 *Bäcker*$_{\text{NOM/ACC/DAT.M.PL}}$	↔	[+PL]

(c) Inventory of the *Kundin* paradigm.

noun		feature specification
R_1 *Kundinnen*$_{\text{DAT.F.PL}}$	↔	[+OBJ, +OBL, +PL]
R_2 *Kundinnen*$_{\text{NOM/ACC/GEN.F.PL}}$	↔	[+PL]
R_3 *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	↔	[∅]

B.1.4 Compiling Wiese's features

Wiese's inventory for the German strong determiner was introduced in Table 1.13 and shall be repeated here in Table B.4a for better readability. With regard to the nouns, Wiese—like the previous authors—does not provide underspecified feature specifications for nominal inflection. Therefore, a noun inventory has to be developed. In trying to maintain the way he underspecified the paradigm for pronominal inflection, the inventory for *Bäcker* from Table 5.1 should look like the one in Table B.4b. The nouns are ordered according to their phonological properties of heavy to medium heavy markers as well as according to decreasing specificity. Similar to *Bäcker*, the paradigm for *Kundin* from Table 5.1 would be specified and ordered accordingly like in Table B.4c.

Table B.4: Inventories in Wieses's manner.

(a) Inventory of the strong determiner paradigm.

determiner	weight		feature specification
R_1 *dem*$_{\text{DAT.M/N.SG}}$	heavy	↔	[+OBJ, +OBL, +M]
R_2 *des*$_{\text{GEN.M/N.SG}}$		↔	[+OBL, +M]
R_3 *das*$_{\text{NOM/ACC.N.SG}}$		↔	[+M, −F]
R_4 *den*$_{\text{ACC.M.SG}}$	medium heavy	↔	[+OBJ, +M]
R_5 *der*$_{\text{NOM.M.SG}}$		↔	[+M]
R_6 *der*$_{\text{DAT/GEN.F.SG}}$		↔	[+OBL, +F]
R_7 *den*$_{\text{DAT.PL}}$		↔	[+OBJ, +OBL]
R_8 *der*$_{\text{GEN.PL}}$		↔	[+OBL]
R_9 *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	light	↔	[Ø]

(b) Inventory of the *Bäcker* paradigm.

noun			feature specification
R_1 *Bäckers*$_{\text{GEN.M.SG}}$	heavy	↔	[−OBJ, +OBL, +M, −F]
R_2 *Bäckern*$_{\text{DAT.PL}}$	medium heavy	↔	[+OBJ, +OBL, +PL]
R_3 *Bäcker*$_{\text{NOM/ACC/GEN.M.SG}}$		↔	[+M, −F]
R_4 *Bäcker*$_{\text{NOM/ACC/DAT.M.PL}}$		↔	[+PL]

(c) Inventory of the *Kundin* paradigm.

noun	weight		feature specification
R_1 *Kundinnen*$_{\text{NOM/ACC/DAT/GEN.F.PL}}$	medium heavy	↔	[+PL]
R_2 *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$		↔	[+F]

B.1.5 Compiling Müller's features

As laid out in Section 1.2.5, Müller's approach greatly departs from the previously discussed constructive rule models of Bierwisch, Blevins, Wunderlich and Wiese insofar as Müller deploys a set of destructive rules. Obviously, the way TMP operates is incompatible with destructive feature specifications. TMP is designed to positively add up specifications of *what is* when it encounters lexical material. Implementing destructive features into TMP's inner workings would require serious alterations. Additional assumptions would weaken the model's supposed explanatory power. Therefore, Müller's approach will be neglected for the present dissertation.

B.2 TMP's Calculations

This chapter of the appendix continues the two-element analyses which have been started in Section 5.2. The respective DPs are repeated here in (80). In particular, it will lay out the parsing calculations for the remaining approaches by Blevins, Wunderlich and Wiese. The parses with a prevalent SP_{NOM} filter specification will be carried out in Appendix B.2.1 while the calculations without a preceding SP_{NOM} filter specification can be found in Appendix B.2.2.

(80) a. der Bäcker
the.NOM.M, DAT.F baker.NOM.M

b. der Kundin
the.NOM.M, DAT.F customer.DAT.F

c. den Bäcker
the.ACC.M, DAT.PL baker.ACC.M

d. den Bäckern
the.ACC.M, DAT.PL bakers.DAT.PL

B.2.1 Parsing with a prior SP_{NOM}

The two-element DPs from (80) have to be tested by TMP with an a priori assumed SP_{NOM}.

B.2.1.1 Using Blevins' original features

B.2.1.1.1 Parsing *der Bäcker* The DP *der Bäcker* from (80a) shall be parsed. It is the first clause-medial syntactic argument of sentence (a) from Table 4.1 and thus part of the sentence *Gestern hat der Bäcker den Konditor gesehen* ("Yesterday, the baker saw the confectioner"). The DP's conclusive parse will be illustrated in Figure B.1.

B.2.1.1.1.1 Stage 1: SP_{NOM} + *hat* → *der*

Step 1 The current material and its specification are the SP_{NOM} with [−OBJ, −OBL, −PL] that also includes [−PL] from the auxiliary verb *hat*. This bundle will be inserted into the current material slot and its specification respectively. The sentence initial adverb *gestern* does not provide relevant morphosyntactic features with respect to the parsing of the DP. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [−OBJ, −OBL, −PL] was the current material's specification and is maintained in the filter specification of the subsequent Step 2.

Step 2 Ranked candidates are derived and thoroughly presented in Table B.5. The determiner $das_{NOM/ACC.N.SG}$ is the top-ranked candidate while others are still part of the list. The targeted $der_{NOM.M.SG}$ is the second-ranked candidate according to Blevins' original account. How TMP switches from the top-ranked $das_{NOM/ACC.N.SG}$ to the lower ranked *der*$_{\text{NOM.M.SG}}$ alternative will be explained for the third step of the parsing along with the Synchronization process.

Table B.5: Ranked determiner candidates after an SP$_{\text{NOM}}$.

rank	filter specification: [−OBJ, −OBL, −PL] (by current material's SP$_{\text{NOM}}$ + *hat*)		ϟ	⊖		⊕
	determiner	specification		⇒	⇐	
1.	*das*$_{\text{NOM/ACC.N.SG}}$	[−OBL, −F]	0	2	1	1
2.	*der*$_{\text{NOM.M.SG}}$	[−OBL, +M, −F]	0	2	2	1
3.	*die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[Ø]	0	3	0	0
4.	*den*$_{\text{ACC.M.SG}}$	[+OBJ, −OBL, +M, −F]	1	2	3	1
5.	*der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL]	1	3	1	0
6.	*des*$_{\text{GEN.M/N.SG}}$	[+OBL, −F]	1	3	2	0
7.	*dem*$_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL, −F]	2	3	3	0
8.	*den*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	3	3	3	0

Step 3 The determiner *der* enters the system as newly incoming material. It is assumed that TMP simply "sees" *der* initially without any specification. In order to assign a specification and eventually integrate *der*, two operations are required: Firstly, TMP has to adopt *der* instead of the predicted *das*$_{\text{NOM/ACC.N.SG}}$. If the predicted *das*$_{\text{NOM/ACC.N.SG}}$ had really been the incoming material, then TMP would not even have to synchronize features. This should have been the most effortless way of synchronization. This is not the case in the example at hand. This means that the top-ranked candidate of *das*$_{\text{NOM/ACC.N.SG}}$ has to be replaced by an alternative of *der*. Secondly, the incoming material of *der* has to be associated with its respective feature specification. This means that the syncretism between *der*$_{\text{NOM.M.SG}}$ and *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ has to be resolved. Synchronization handles these issues. In order to adopt *der*, TMP has to search the ranked candidates from the second step. The list provides two alternatives, namely the higher ranked *der*$_{\text{NOM.M.SG}}$ and lower ranked *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$. Again, TMP's bias toward minimal featural deviance comes into effect. Therefore, in order to ensure lower featural deviance, TMP selects the next higher ranked candidate that matches the form of *der*. As shown in Table B.5, *der*$_{\text{NOM.M.SG}}$ with its features of [−OBL, +M, −F] has precedence over the syncretic *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ which carries [+OBL]. It is *simpler* for TMP to synchronize just one feature that is not retrievable—namely [−OBL]—with the incoming *der* at the third step than a specification that is entirely incompatible with the feature specification. That is why *der* will be associated with [−OBL, +M, −F] and not with [+OBL].

For the integration of *der* in the nominative masculine singular alternative, the current material's feature set of [−OBJ, −OBL, −PL] will thus be combined with the incoming material's specification [−OBL, +M, −F]. They will eventually be fed into the next parsing stage. The sum of the features of SP$_{\text{NOM}}$, *hat* and *der* equals [−OBJ, −OBL, +M, −F, −PL]. This is only possible since both feature bundles are mutually compatible and can thus be added up. This feature bundle can now enter Step 1 of Stage 2 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

B.2.1.1.1.2 Stage 2: SP_{NOM} + *hat* + *der* → *Bäcker*

Step 1 The first step here is identical to the outcome of Step 3 from Paragraph B.2.1.1.1.1. The current material and its specification are the combination of the SP_{NOM} + *hat*'s *der* that is [−OBJ, −OBL, +M, −F, −PL] in total. This bundle will be inserted into the current material slot and its specification respectively. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [−OBJ, −OBL, +M, −F, −PL] was the current material's specification and is maintained in the filter specification at Step 2.

Step 2 Ranked candidates are derived following the integration of *der* and thoroughly given in Table B.6. The noun *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ is the top-ranked candidate while others are still part of the list. How TMP adopts the top-ranked *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ will be explained for the third step of the parsing along with the Synchronization process.

Table B.6: Ranked noun candidates after SP_{NOM} + *der*$_{\text{NOM.M.SG}}$.

rank	filter specification: [−OBJ, −OBL, +M, −F, −PL] (by current material's *den*$_{\text{ACC.M.SG}}$)		⚡	🔍−		🔍+
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M, −F]	0	3	0	2
2.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M, −F]	1	2	1	2
3.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	1	5	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	1	5	1	0
4.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[−M, +F]	2	5	2	0
5.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	3	5	3	0

Step 3 The noun *Bäcker* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäcker* initially without any specification. In order to assign a specification and eventually integrate *Bäcker*, TMP can use the top-ranked candidate. As shown in Table B.6, *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ with its features of [+M, −F] has precedence over the syncretic *Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$ which carries [+PL]. It is *simpler* for TMP to synchronize two features that are retrievable—namely [+M] and [−F]—with the incoming *Bäcker* at the third step than a specification that is partially incompatible with the feature specification—namely [+PL]. That is why *Bäcker* will be associated with [+M, −F] and not with [+PL].

For the integration of *Bäcker* in the nominative/accusative/dative masculine singular alternative, the current material's specification [−OBJ, −OBL, +M, −F, -PL] will thus be combined with the incoming material's specification [+M, −F]. They will be fed into the first step at Stage 3, eventually concluding the parse.

B.2.1.1.1.3 Stage 3: Conclusion
The sum of the features of SP_{NOM}, *hat*, *der* and *Bäcker* equals [−OBJ, −OBL, +M, −F, −PL]. This is only possible since both feature bundles are mutually compatible and can thus be added up. As depicted in Figure B.1, this feature bundle can now enter the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

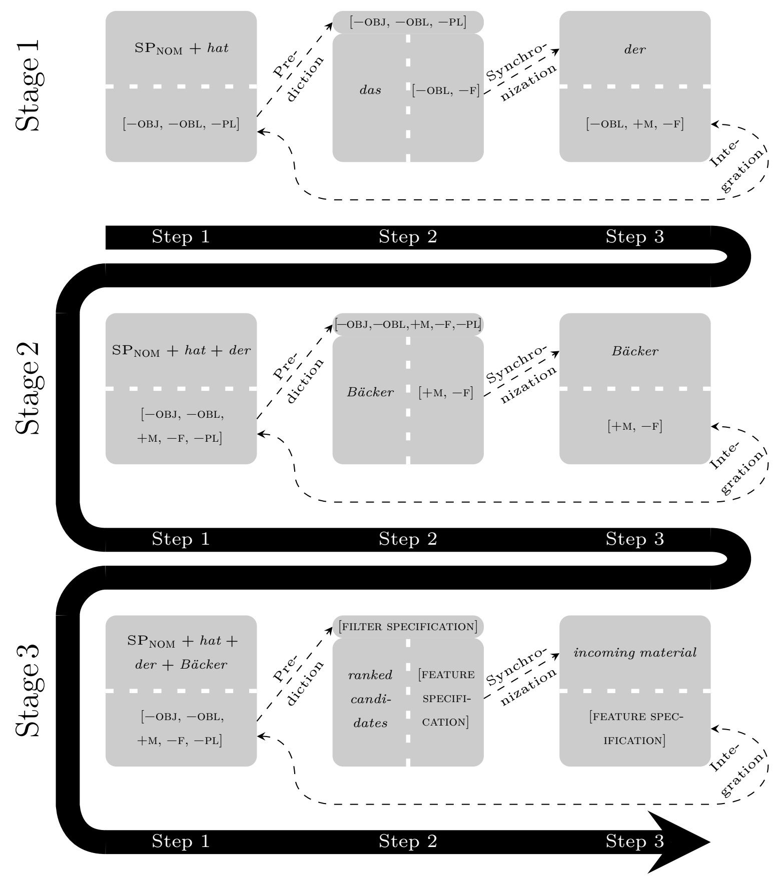


Figure B.1: Combining current and incoming material: SP_{NOM}, *hat*, *der* and *Bäcker* equals [−OBJ, −OBL, +M, −F, −PL].

B.2.1.1.2 Parsing *der Kundin* The DP *der Kundin* from (80b) shall be parsed. It is the first clause-medial syntactic argument of sentence (b) from Table 4.1 and thus part of the sentence *Gestern hat der Kundin der Konditor geholfen* ("Yesterday, the confectioner helped the costumer"). The DP's conclusive parse will be illustrated in Figure B.2.

B.2.1.1.2.1 Stage 1: SP_{NOM} + *hat* → *der*

At this point, Steps 1–3 parallel Stage 1 in Paragraph B.2.1.1.1.1 since the material is identical. The SP_{NOM} + *hat* provide the feature specification for Step 2 via the Prediction process. Subsequently, the ranked candidates are derived. In Step 3, the incoming *der* is synchronized and integrated.

B.2.1.1.2.2 Stage 2: "..." + *der* → *Kundin*

Steps 1–2 At this point, Steps 1–2 parallel Steps 1–2 from Stage 1 in Paragraph B.2.1.1.1.2 since the material is identical. The SP_{NOM} + *hat* + *der* provide the feature specification for Step 2 via the Prediction process.

Step 3 The noun *Kundin* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Kundin* initially without any specification. In order to assign a specification and eventually integrate *Kundin*, two operations are required: Firstly, TMP has to adopt *Kundin* instead of the predicted *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$. This means that the top-ranked candidate of *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ has to be replaced by *Kundin*. Secondly, the incoming material of *Kundin* has to be associated with its respective feature specification. In order to adopt *Kundin*, TMP has to search the ranked candidates from the second step. The list provides *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$. No other candidate is available. Therefore, TMP synchronizes [−M, +F] with the incoming *Kundin* at the third step.

Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. With *Kundin* as incoming material, the selection of an incompatibly ranked candidate was necessary. This particular ranked candidate provides two features that are incompatible with the feature specification—namely *Kundin*'s [−M, +F]. This means that *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$ with its features of [−M, +F] opposes the current material's specification that also carries [+M, −F]. The language processing system cannot change the input but the initial analysis of the current material and its specification. Therefore, reanalysis becomes necessary. Selecting another alternative of *Kundin* would not be effective since there is none. The only way to maintain processing is by abandoning the SP_{NOM}.

Deleting the SP_{NOM} and its specification within the Integration process renders the feature specification and the order of the ranked candidates for the determiners at Step 2 no longer applicable. By restarting with a clean slate, the other syncretic alternative of *der*, that is *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ which carries [+OBL], can be synchronized.

This, however, also overwrites the contents of the first step of the subsequent parsing stage which would once again render the feature specification and the order of the ranked candidates for the nouns at Step 2 no longer applicable. By restarting with a clean slate, *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$'s [−M, +F] at Step 3 no longer provide incompatible features to the current material's specification with [+OBL] of Step 1. The current material's feature set of [+OBL] will thus be combined with the incoming material's specification [−M, +F]. They will eventually be fed into the next parsing step at Stage 3. The parse will be concluded in Paragraph B.2.1.1.2.3.

B.2.1.1.2.3 Stage 3: Conclusion
TMP will now combine the specifications of the reanalyzed *der* with the one of *Kundin* after the SP_{NOM} and its specification have been abandoned. That is the sum of [+OBL] and [−M, +F] which equals [+OBL, −M, +F]. Figure B.2 shows that this feature bundle can now be fed into the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

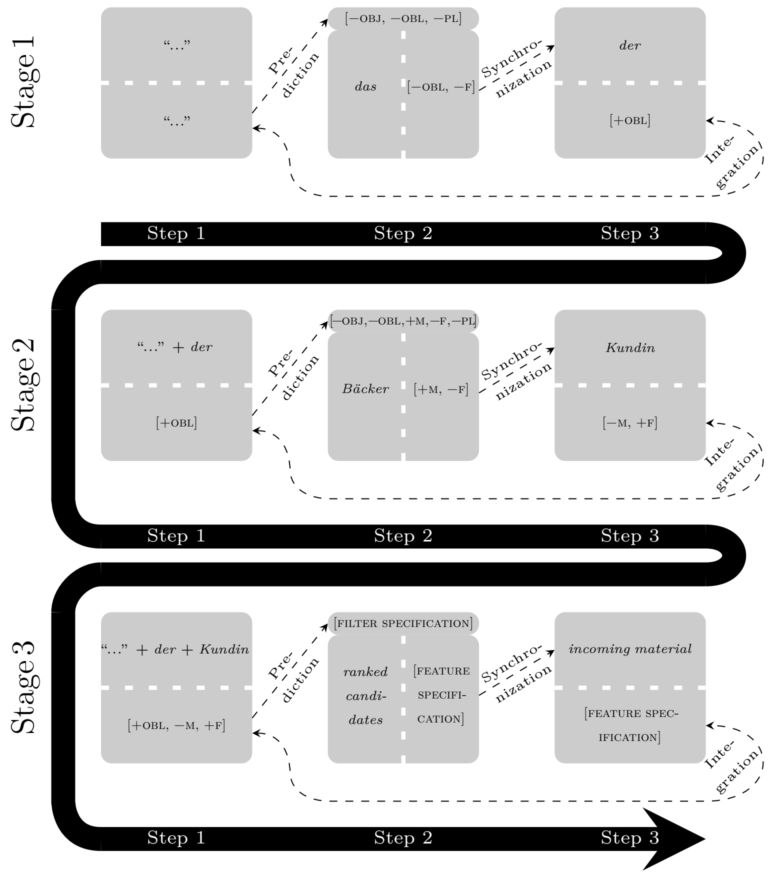


Figure B.2: Combining current and incoming material: *der* and *Kundin* equals [+OBL, −M, +F].

B.2.1.1.3 Parsing *den Bäcker* The DP *den Bäcker* from (80c) shall be parsed. It is the first clause-medial syntactic argument of sentence (c) from Table 4.1 and thus part of the sentence *Gestern hat den Bäcker der Konditor gesehen* ("Yesterday, the confectioner saw the baker"). The DP's conclusive parse will be illustrated in Figure B.3.

B.2.1.1.3.1 Stage 1: SP_{NOM} + *hat* → *den*
Steps 1–2 At this point, Steps 1–2 parallel Steps 1–2 from Stage 1 in Paragraph B.2.1.1.1.1 since the material is identical. The SP_{NOM} + *hat* provide the feature specification for Step 2 via the Prediction process.

Step 3 The determiner *den* enters the system as newly incoming material. It is assumed that TMP simply "sees" *den* initially without any specification. In order to assign a specification and eventually integrate *den*, two operations are required: Firstly, TMP has to adopt *den* instead of the predicted $das_{\text{NOM/ACC.N.SG}}$. This means that the top-ranked candidate of $das_{\text{NOM/ACC.N.SG}}$ has to be replaced by an alternative of *den*. Secondly, the incoming material of *den* has to be associated with its respective feature specification. This means that the syncretism between $den_{\text{ACC.M.SG}}$ and $den_{\text{DAT.PL}}$ has to be resolved. Synchronization handles these issues. In order to adopt *den*, TMP has to search the ranked candidates from the second step. The list in Table B.5 provides two alternatives, namely the higher ranked $den_{\text{ACC.M.SG}}$ and lower ranked $den_{\text{DAT.PL}}$. Again, TMP's bias toward minimal featural deviance comes into effect. Therefore, in order to ensure lower featural deviance, TMP selects the next higher ranked candidate that matches the form of *den*. As shown in Table B.5, $den_{\text{ACC.M.SG}}$ with its features of [+OBJ, −OBL, +M, −F] has precedence over the syncretic $den_{\text{DAT.PL}}$ which carries [+OBJ, +OBL, +PL]. It is *simpler* for TMP to synchronize a less incompatible specification with a retrievable feature—namely [+OBJ, −OBL, +M, −F]—with the incoming *den* at the third step than three features that are maximally incompatible with the feature specification—namely [+OBJ, +OBL, +PL]. That is why *den* will be associated with [+OBJ, −OBL, +M, −F].

Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. With *den* as incoming material, the selection of an incompatibly ranked candidate was necessary. This particular ranked candidate provides a feature that is incompatible with the feature specification—namely *den*'s [+OBJ]. This means that $den_{\text{ACC.M.SG}}$ with its features of [+OBJ, −OBL, +M, −F] opposes the current material's specification. The language processing system cannot change the input but the initial analysis of the current material and its specification. This necessitates reanalysis. Selecting the other alternative of *den*—$den_{\text{DAT.PL}}$ which carries [+OBJ, +OBL, +PL]—would not be effective since it is even more incompatible with the current material's specification. The only way to maintain processing is by abandoning the SP_{NOM}.

Deleting the SP_{NOM} and its specification within the Integration process renders the feature specification and the order of the ranked candidates for the determiners no longer applicable. By restarting with a clean slate, $den_{\text{ACC.M.SG}}$ no longer provides incompatible features to any specification.

In the current case of the integration of *den* in the accusative masculine singular alternative, the current material's feature set that is now empty will thus be combined with the incoming material's specification of [+OBJ, −OBL, +M, −F]. They will eventually be fed into the next parsing stage.

After the SP_{NOM} and its specification have been deleted, the sum of virtually nothing and *den*'s [+OBJ, −OBL, +M, −F] equals [+OBJ, −OBL, +M, −F]. This feature bundle can now be used for the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

B.2.1.1.3.2 Stage 2: "..." + *den* → *Bäcker*

Step 1 The first step here is identical to the outcome of Step 3 from Paragraph B.2.1.1.3.1. The current material and its specification are the combination of virtually nothing with *den*'s [+OBJ, −OBL, +M, −F]. This bundle will be inserted into the current material slot and its specification respectively. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [+OBJ, −OBL, +M, −F] was the current material's specification and is maintained in the filter specification.

Step 2 Ranked candidates are derived following the integration of *den* and thoroughly given in Table B.7. The noun *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ is the top-ranked candidate while others are still part of the list. How TMP adopts the top-ranked *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ will be explained for the third step of the parsing along with the Synchronization process.

Table B.7: Ranked noun candidates after *den*$_{\text{ACC.M.SG}}$.

rank	filter specification: [+OBJ, −OBL, +M, −F] (by current material's *den*$_{\text{ACC.M.SG}}$)		ϟ	🔍−		🔍+
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M, −F]	0	2	0	2
2.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	4	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	4	1	0
3.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	1	3	2	1
4.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M, −F]	2	2	2	2
5.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[−M, +F]	2	4	2	0

Step 3 The noun *Bäcker* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäcker* initially without any specification. In order to assign a specification and eventually integrate *Bäcker*, TMP can use the top-ranked candidate. As shown in Table B.7, *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ with its features of [+M, −F] has precedence over the syncretic *Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$ which carries [+PL]. It is *simpler* for TMP to synchronize two features that are retrievable—namely [+M, −F]—with the incoming *Bäcker* at the third step than a specification that is potentially incompatible with the feature specification. Recall that any plural specification excludes gender information. That is why *Bäcker* will be associated with [+M, −F] and not with [+PL].

For the integration of *Bäcker* in the nominative/accusative/dative masculine singular alternative, the current material's specification [+OBJ, −OBL, +M, −F] will thus be combined with the incoming material's specification [+M, −F]. They will be fed into the first step at Stage 3, eventually concluding the parse.

B.2.1.1.3.3 Stage 3: Conclusion

The sum of the features of "...", *den* and *Bäcker* equals [+OBJ, −OBL, +M, −F]. This is only possible since both feature bundles are mutually compatible and can thus be added up. As shown in Figure B.3, this feature bundle can now be used for the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

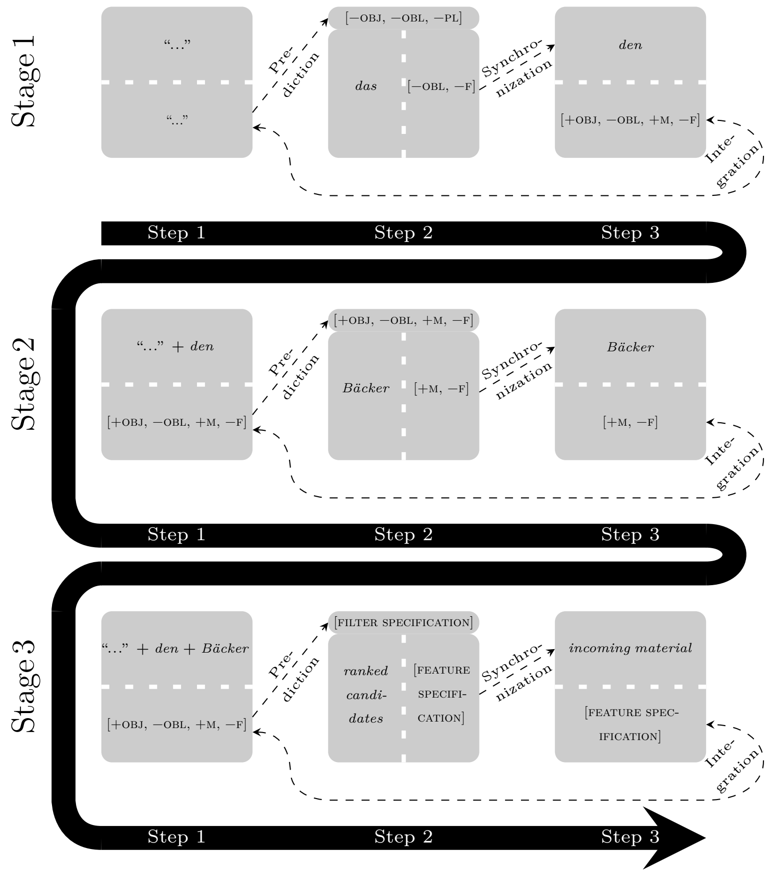


Figure B.3: Combining current and incoming material: "…", *den* and *Bäcker* equals [+OBJ, −OBL, +M, −F].

B.2.1.1.4 Parsing *den Bäckern* The DP *den Bäckern* from (80d) shall be parsed. It is the first clause-medial syntactic argument of sentence (d) from Table 4.1 and thus part of the sentence *Gestern hat den Bäckern der Konditor geholfen* ("Yesterday, the confectioner helped the bakers"). The DP's conclusive parse will be illustrated in Figure B.4.

B.2.1.1.4.1 Stage 1: SP_{NOM} + *hat* → *den*

At this point, Steps 1–3 parallel Stage 1 in Paragraph B.2.1.1.3.1 since the material is identical. The SP_{NOM} + *hat* provide the feature specification for Step 2 via the Prediction process. Subsequently, the ranked candidates are derived. In Step 3, the incoming *den* is synchronized and integrated.

B.2.1.1.4.2 Stage 2: "..." + *den* → *Bäckern*

Steps 1–2 At this point, Steps 1-2 parallel Steps 1–2 from Stage 2 in Paragraph B.2.1.1.3.2 since the material is identical. The SP_{NOM} + *hat* + *den* provide the feature specification for Step 2 via the Prediction process.

Step 3 The noun *Bäckern* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäckern* initially without any specification. In order to assign a specification and eventually integrate *Bäckern*, two operations are required: Firstly, TMP has to adopt *Bäckern* instead of the predicted $\textit{Bäcker}_{\text{NOM/ACC/DAT.M.SG}}$. This means that the top-ranked candidate of $\textit{Bäcker}_{\text{NOM/ACC/DAT.M.SG}}$ has to be replaced by *Bäckern*. Secondly, the incoming material of *Bäckern* has to be associated with its respective feature specification. In order to adopt *Bäckern*, TMP has to search the ranked candidates from the second step. The list provides $\textit{Bäckern}_{\text{DAT.PL}}$. No other candidate is available. Therefore, TMP synchronizes [+OBJ, +OBL, +PL] with the incoming *Bäckern* at the third step.

Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. With *Bäckern* as incoming material, the selection of an incompatibly ranked candidate was necessary. This particular ranked candidate provides at least one feature that is incompatible with the feature specification—namely *Bäckern*'s [+OBL]. This means that $\textit{Bäckern}_{\text{DAT.PL}}$ with its features of [+OBJ, +OBL, +PL] opposes the current material's specification that also carries [−OBL]. The language processing system cannot change the input but the initial analysis of the current material and its specification. Therefore, reanalysis becomes necessary. Selecting another alternative of *Bäckern* would not be effective since there is none. The only way to maintain processing is by abandoning the integration of *den* as $\textit{den}_{\text{ACC.M.SG}}$ in the previous parsing stage. Since the SP_{NOM} has already been deleted when *den* instead of *der* had to be integrated, the other syncretic alternative of *den*, that is $\textit{den}_{\text{DAT.PL}}$ which carries [+OBJ, +OBL, +PL], can be synchronized right away.

This, in turn, also overwrites the contents of the first step of the subsequent parsing stage which would once again render the feature specification and the order of the ranked candidates for the nouns at Step 2 no longer applicable. By restarting with a clean slate, $\textit{Bäckern}_{\text{DAT.PL}}$'s [+OBJ, +OBL, +PL] at Step 3 no longer provide incompatible features to the current material's specification with [+OBJ, +OBL, +PL] of Step 1. The current material's feature set of [+OBJ, +OBL, +PL] will thus be combined with the incoming material's specification [+OBJ, +OBL, +PL]. They will eventually be fed into the next parsing step at Stage 3. The parse will be concluded in Paragraph B.2.1.1.4.3.

B.2.1.1.4.3 Stage 3: Conclusion

TMP will now combine the specifications of the reanalyzed *den* with the one of *Bäckern* after the SP_{NOM} and its specification have been abandoned. That is the sum of [+OBJ, +OBL, +PL] and [+OBJ, +OBL, +PL] which equals [+OBJ, +OBL, +PL]. Figure B.4 shows that this feature bundle can now enter the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

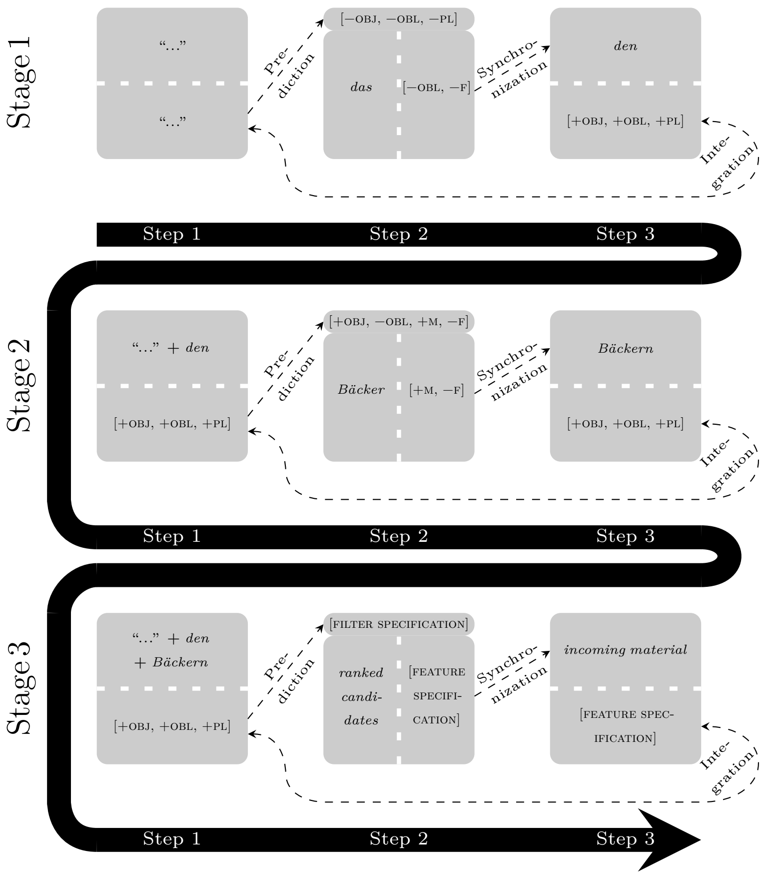


Figure B.4: Combining current and incoming material: *den* and *Bäckern* equals [+OBJ, +OBL, +PL].

B.2.1.2 Using Blevins' maximally underspecified features

B.2.1.2.1 Parsing *der Bäcker* The DP *der Bäcker* from (80a) shall be parsed. It is the first clause-medial syntactic argument of sentence (a) from Table 4.1 and thus part of the sentence *Gestern hat der Bäcker den Konditor gesehen* ("Yesterday, the baker saw the confectioner"). The DP's conclusive parse will be illustrated in Figure B.5.

B.2.1.2.1.1 Stage 1: SP_{NOM} + *hat* → *der*

Step 1 The current material and its specification are the SP_{NOM} with [−OBJ, −OBL, −PL] that also includes [−PL] from the auxiliary verb *hat*. This bundle will be inserted into the current material slot and its specification respectively. The sentence initial adverb *gestern* does not provide relevant morphosyntactic features with respect to the parsing of the DP. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [−OBJ, −OBL, −PL] was the current material's specification and is maintained in the filter specification of the subsequent Step 2.

Step 2 Ranked candidates are derived and thoroughly presented in Table B.8. The determiner *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ is the top-ranked candidate while others are still part of the list. The targeted *der*$_{\text{NOM.M.SG}}$ is the third-ranked candidate according to Blevins' maximally underspecified account. How TMP switches from the top-ranked *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ to the lower ranked *der*$_{\text{NOM.M.SG}}$ alternative will be explained for the third step of the parsing along with the Synchronization process.

Table B.8: Ranked determiner candidates after an SP_{NOM}.

rank	filter specification: [−OBJ, −OBL, −PL] (by current material's SP_{NOM} + *hat*)		ϟ	⊖		⊕
	determiner	specification		⇒	⇐	
1.	*die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[∅]	0	3	0	0
2.	*das*$_{\text{NOM/ACC.N.SG}}$	[−F]	0	3	1	0
3.	*der*$_{\text{NOM.M.SG}}$	[+M, −F]	0	3	2	0
4.	*den*$_{\text{ACC.M.SG}}$	[+OBJ, −OBL, +M, −F]	1	2	3	1
5.	*der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL]	1	3	1	0
6.	*des*$_{\text{GEN.M/N.SG}}$	[+OBL, −F]	1	3	2	0
7.	*dem*$_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL, −F]	2	3	3	0
8.	*den*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	3	3	3	0

Step 3 The determiner *der* enters the system as newly incoming material. It is assumed that TMP simply "sees" *der* initially without any specification. In order to assign a specification and eventually integrate *der*, two operations are required: Firstly, TMP has to adopt *der* instead of the predicted *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$. If the predicted *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ had really been the incoming material, then TMP would not even have to synchronize features. This should have been the most effortless way of synchronization. This is not the case in the example at hand. This means that the top-ranked candidate of *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ has to be replaced by an alternative of *der*. Secondly, the incoming material of *der* has to be associated with its respective feature specification. This means that the syncretism between *der*$_{\text{NOM.M.SG}}$ and *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ has to be resolved. Synchronization handles these issues. In order to adopt *der*, TMP has to search the ranked candidates from the second step. The list provides two alternatives, namely the higher ranked *der*$_{\text{NOM.M.SG}}$ and lower ranked *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$. Again, TMP's bias toward minimal featural deviance comes into effect. Therefore, in order to ensure lower featural deviance, TMP selects the next higher ranked candidate that matches the form of *der*. As shown in Table B.8, *der*$_{\text{NOM.M.SG}}$ with its features of [+M, −F] has precedence over the syncretic *der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$ which carries [+OBL]. It is *simpler* for TMP to synchronize features that are non-incompatible and—namely [+M, −F]—with the incoming *der* at the third step than a specification that is entirely incompatible with the feature specification. That is why *der* will be associated with [+M, −F] and not with [+OBL].

For the integration of *der* in the nominative masculine singular alternative, the current material's feature set of [−OBJ, −OBL, −PL] will thus be combined with the incoming material's specification [+M, −F]. They will be fed into the next parsing stage. The sum of the features of SP$_{\text{NOM}}$, *hat* and *der* equals [−OBJ, −OBL, +M, −F, −PL]. This is only possible since both feature bundles are mutually compatible and can thus be added up. This feature bundle can now be fed into Step 1 of Stage 2 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

B.2.1.2.1.2 Stage 2: SP$_{\text{NOM}}$ + *hat* + *der* → *Bäcker*

Step 1 The first step here is identical to the outcome of Step 3 from Paragraph B.2.1.2.1.1. The current material and its specification are the combination of the SP$_{\text{NOM}}$ + *hat*'s *der* that is [−OBJ, −OBL, +M, −F, −PL] in total. This bundle will be inserted into the current material slot and its specification respectively. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [−OBJ, −OBL, +M, −F, −PL] was the current material's specification and is maintained in the filter specification at Step 2.

Step 2 Ranked candidates are derived following the integration of *der* and thoroughly given in Table B.9. The noun *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ is the top-ranked candidate while others are still part of the list. How TMP adopts the top-ranked *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ will be explained for the third step of the parsing along with the Synchronization process.

Table B.9: Ranked noun candidates after SP$_{\text{NOM}}$ + *der*$_{\text{NOM.M.SG}}$.

rank	filter specification: [−OBJ, −OBL, +M, −F, −PL] (by current material's SP$_{\text{NOM}}$ + *hat* + *der*$_{\text{NOM.M.SG}}$)		ϟ	⊖		⊕
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M, −F]	0	3	0	2
2.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M, −F]	1	2	1	2
3.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[Ø]	0	5	0	0
4.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	1	5	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	1	5	1	0
5.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	3	5	3	0

Step 3 The noun *Bäcker* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäcker* initially without any specification. In order to assign a specification and eventually integrate *Bäcker*, TMP can use the top-ranked candidate. As shown in Table B.9, *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ with its features of [+M, −F] has precedence over the syncretic *Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$ which carries [+PL]. It is *simpler* for TMP to synchronize two features that are retrievable—namely [+M] and [−F]—with the incoming *Bäcker* at the third step than a specification that is partially incompatible

with the feature specification—namely [+PL]. That is why *Bäcker* will be associated with [+M, −F] and not with [+PL].

For the integration of *Bäcker* in the nominative/accusative/dative masculine singular alternative, the current material's specification [−OBJ, −OBL, +M, −F, -PL] will thus be combined with the incoming material's specification [+M, −F]. They will be fed into the first step at Stage 3, eventually concluding the parse.

B.2.1.2.1.3 Stage 3: Conclusion

The sum of the features of SP_{NOM}, *hat*, *der* and *Bäcker* equals [−OBJ, −OBL, +M, −F, −PL]. This is only possible since both feature bundles are mutually compatible and can thus be added up. Figure B.5 depicts how this feature bundle can now be used for the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

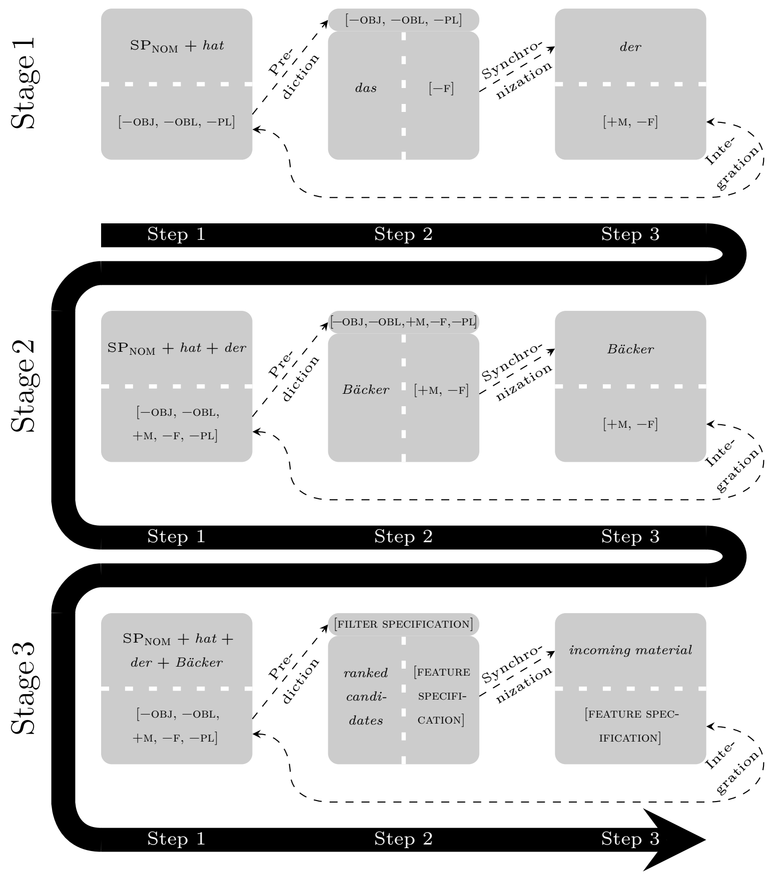


Figure B.5: Combining current and incoming material: SP_{NOM}, *hat*, *der* and *Bäcker* equals [−OBJ, −OBL, +M, −F, −PL].

B.2.1.2.2 Parsing *der Kundin* The DP *der Kundin* from (80b) shall be parsed. It is the first clause-medial syntactic argument of sentence (b) from Table 4.1 and thus part of the sentence *Gestern hat der Kundin der Konditor geholfen* ("Yesterday, the confectioner helped the costumer"). The DP's conclusive parse will be illustrated in Figure B.6.

B.2.1.2.2.1 Stage 1: SP_{NOM} + *hat* → *der*
At this point, Steps 1–3 parallel Stage 1 in Paragraph B.2.1.2.1.1 since the material is identical. The SP_{NOM} + *hat* provide the feature specification for Step 2 via the Prediction process. Subsequently, the ranked candidates are derived. In Step 3, the incoming *der* is synchronized and integrated.

B.2.1.2.2.2 Stage 2: "..." + *der* → *Kundin*
Steps 1–2 At this point, Steps 1–2 parallel Steps 1–2 from Stage 1 in Paragraph B.2.1.2.1.2 since the material is identical. The SP_{NOM} + *hat* + *der* provide the feature specification for Step 2 via the Prediction process.

Step 3 The noun *Kundin* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Kundin* initially without any specification. In order to assign a specification and eventually integrate *Kundin*, two operations are required: Firstly, TMP has to adopt *Kundin* instead of the predicted $\textit{Bäcker}_{\text{NOM/ACC/DAT.M.SG}}$. This means that the top-ranked candidate of $\textit{Bäcker}_{\text{NOM/ACC/DAT.M.SG}}$ has to be replaced by *Kundin*. Secondly, the incoming material of *Kundin* has to be associated with its respective feature specification. In order to adopt *Kundin*, TMP has to search the ranked candidates from the second step. The list provides $\textit{Kundin}_{\text{NOM/ACC/DAT/GEN.F.SG}}$. No other candidate is available. Therefore, TMP synchronizes [Ø] with the incoming *Kundin* at the third step.

For the integration of *Kundin* in the nominative/accusative/dative masculine singular alternative, the current material's specification [−OBJ, −OBL, +M, −F, -PL] will thus be combined with the incoming material's specification [Ø]. They will be fed into the first step at Stage 3, eventually concluding the parse.

B.2.1.2.2.3 Stage 3 Conclusion
The sum of the features of SP_{NOM}, *hat*, *der* and *Kundin* equals [−OBJ, −OBL, +M, −F, −PL]. This is only possible since both feature bundles are mutually compatible and can thus be added up. As shown in Figure B.6, this feature bundle can now be used for the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

The combination of SP_{NOM} + *hat* + *der* + *Kundin* yields, however, an illicit combination since there is no way to combine a masculine determiner with a feminine noun in order to realize a grammatical subject in nominative case.

B.2.1.2.3 Parsing *den Bäcker* The DP *den Bäcker* from (80c) shall be parsed. It is the first clause-medial syntactic argument of sentence (c) from Table 4.1 and thus part of the sentence *Gestern hat den Bäcker der Konditor gesehen* ("Yesterday, the confectioner saw the baker"). The DP's conclusive parse will be illustrated in Figure B.7.

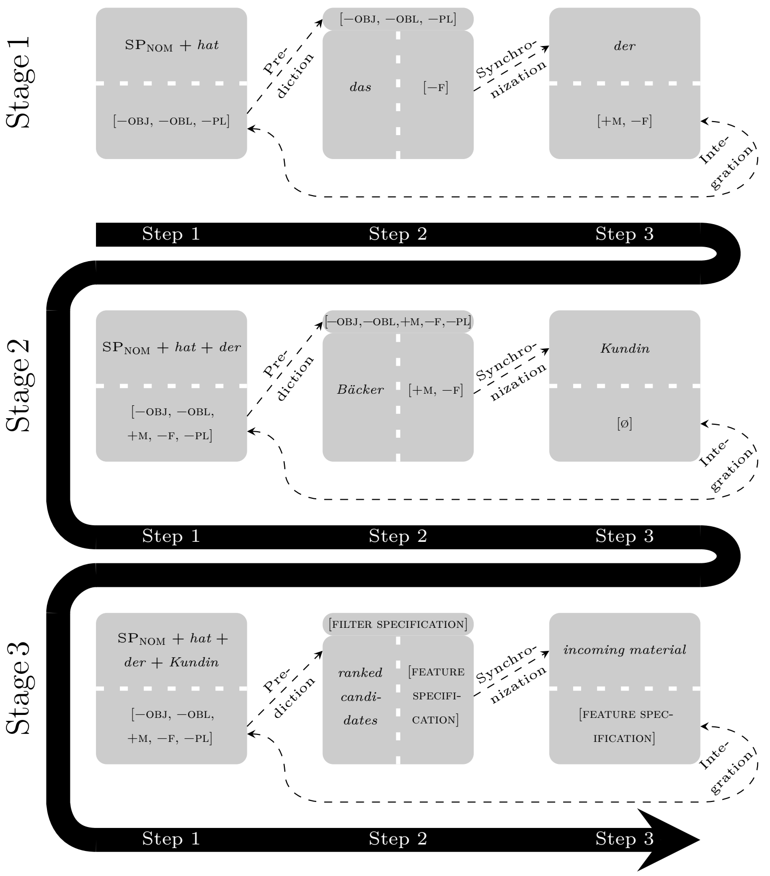


Figure B.6: Combining current and incoming material: SP_{NOM}, *hat*, *der* and *Kundin* equals [−OBJ, −OBL, +M, −F, −PL].

B.2.1.2.3.1 Stage 1: SP_{NOM} + *hat* → *den*

Steps 1–2 At this point, Steps 1–2 parallel Steps 1–2 from Stage 1 in Paragraph B.2.1.2.1.1 since the material is identical. The SP_{NOM} + *hat* provide the feature specification for Step 2 via the Prediction process.

Step 3 The determiner *den* enters the system as newly incoming material. It is assumed that TMP simply "sees" *den* initially without any specification. In order to assign a specification and eventually integrate *den*, two operations are required: Firstly, TMP has to adopt *den* instead of the predicted $das_{NOM/ACC.N.SG}$. This means that the top-ranked candidate of $das_{NOM/ACC.N.SG}$ has to be replaced by an alternative of *den*. Secondly, the incoming material of *den* has to be associated with its respective feature specification. This means that the syncretism between $den_{ACC.M.SG}$ and $den_{DAT.PL}$ has to be resolved. Synchronization handles these issues. In order to adopt *den*, TMP has to search the ranked candidates from the second step. The list in Table B.8 provides two alternatives, namely the higher ranked $den_{ACC.M.SG}$ and lower ranked $den_{DAT.PL}$. Again, TMP's bias toward minimal featural deviance comes into effect. Therefore, in order to ensure lower featural deviance, TMP selects the next higher ranked candidate that matches the form of *den*. As shown in Table B.8, $den_{ACC.M.SG}$ with its features of [+OBJ, −OBL, +M,

−F] has precedence over the syncretic *den*$_{\text{DAT.PL}}$ which carries [+OBJ, +OBL, +PL]. It is *simpler* for TMP to synchronize a less incompatible specification with a retrievable feature—namely [+OBJ, −OBL, +M, −F]—with the incoming *den* at the third step than three features that are maximally incompatible with the feature specification—namely [+OBJ, +OBL, +PL]. That is why *den* will be associated with [+OBJ, −OBL, +M, −F].

Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. With *den* as incoming material, the selection of an incompatibly ranked candidate was necessary. This particular ranked candidate provides a feature that is incompatible with the feature specification—namely *den*'s [+OBJ]. This means that *den*$_{\text{ACC.M.SG}}$ with its features of [+OBJ, −OBL, +M, −F] opposes the current material's specification. The language processing system cannot change the input but the initial analysis of the current material and its specification. This necessitates reanalysis. Selecting the other alternative of *den*—*den*$_{\text{DAT.PL}}$ which carries [+OBJ, +OBL, +PL]—would not be effective since it is even more incompatible with the current material's specification. The only way to maintain processing is by abandoning the SP$_{\text{NOM}}$.

Deleting the SP$_{\text{NOM}}$ and its specification within the Integration process renders the feature specification and the order of the ranked candidates for the determiners no longer applicable. By restarting with a clean slate, *den*$_{\text{ACC.M.SG}}$ no longer provides incompatible features to any specification.

In the current case of the integration of *den* in the accusative masculine singular alternative, the current material's feature set that is now empty will thus be combined with the incoming material's specification of [+OBJ, −OBL, +M, −F]. They will eventually be fed into the next parsing stage.

After the SP$_{\text{NOM}}$ and its specification have been deleted, the sum of virtually nothing and *den*'s [+OBJ, −OBL, +M, −F] equals [+OBJ, −OBL, +M, −F]. This feature bundle can now be fed into the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

B.2.1.2.3.2 Stage 2: "..." + *den* → *Bäcker*

Step 1 The first step here is identical to the outcome of Step 3 from Paragraph B.2.1.2.3.1. The current material and its specification are the combination of virtually nothing with *den*'s [+OBJ, −OBL, +M, −F]. This bundle will be inserted into the current material slot and its specification respectively. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [+OBJ, −OBL, +M, −F] was the current material's specification and is maintained in the filter specification.

Step 2 Ranked candidates are derived following the integration of *den* and thoroughly given in Table B.10. The noun *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ is the top-ranked candidate while others are still part of the list. How TMP adopts the top-ranked *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ will be explained for the third step of the parsing along with the

Synchronization process.

Table B.10: Ranked noun candidates after *den*$_{\text{ACC.M.SG}}$.

rank	filter specification: [+OBJ, −OBL, +M, −F] (by current material's *den*$_{\text{ACC.M.SG}}$)		⚡	🔍−		🔍+
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M, −F]	0	2	0	2
2.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[Ø]	0	4	0	0
3.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	4	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	4	1	0
4.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	1	3	2	1
5.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M, −F]	2	2	1	3

Step 3 The noun *Bäcker* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäcker* initially without any specification. In order to assign a specification and eventually integrate *Bäcker*, TMP can use the top-ranked candidate. As shown in Table B.10, *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ with its features of [+M, −F] has precedence over the syncretic *Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$ which carries [+PL]. It is *simpler* for TMP to synchronize two features that are retrievable—namely [+M, −F]—with the incoming *Bäcker* at the third step than a specification that is potentially incompatible with the feature specification. Recall that any plural specification excludes gender information. That is why *Bäcker* will be associated with [+M, −F] and not with [+PL].

For the integration of *Bäcker* in the nominative/accusative/dative masculine singular alternative, the current material's specification [+OBJ, −OBL, +M, −F] will thus be combined with the incoming material's specification [+M, −F]. They will be fed into the first step at Stage 3, eventually concluding the parse.

B.2.1.2.3.3 Stage 3: Conclusion

The sum of the features of "...", *den* and *Bäcker* equals [+OBJ, −OBL, +M, −F]. This is only possible since both feature bundles are mutually compatible and can thus be added up. As depicted in Figure B.7, this feature bundle can now enter the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

B.2.1.2.4 Parsing *den Bäckern* The DP *den Bäckern* from (80d) shall be parsed. It is the first clause-medial syntactic argument of sentence (d) from Table 4.1 and thus part of the sentence *Gestern hat den Bäckern der Konditor geholfen* ("Yesterday, the confectioner helped the bakers"). The DP's conclusive parse will be illustrated in Figure B.8.

B.2.1.2.4.1 Stage 1: SP$_{\text{NOM}}$ + *hat* → *den*

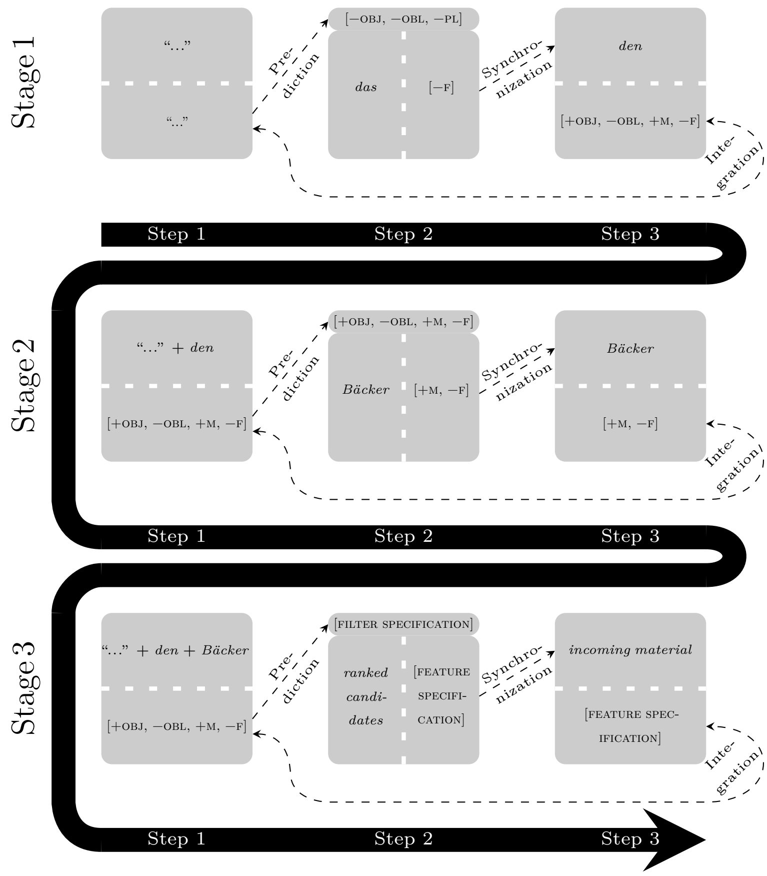


Figure B.7: Combining current and incoming material: "...", *den* and *Bäcker* equals [+OBJ, −OBL, +M, −F].

At this point, Steps 1–3 parallel Stage 1 in Paragraph B.2.1.2.3.1 since the material is identical. The SP_{NOM} + *hat* provide the feature specification for Step 2 via the Prediction process. Subsequently, the ranked candidates are derived. In Step 3, the incoming *den* is synchronized and integrated.

B.2.1.2.4.2 Stage 2: "..." + *den* → *Bäckern*

Steps 1–2 At this point, Steps 1-2 parallel Steps 1–2 from Stage 2 in Paragraph B.2.1.2.3.2 since the material is identical. The SP_{NOM} + *hat* + *den* provide the feature specification for Step 2 via the Prediction process.

Step 3 The noun *Bäckern* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäckern* initially without any specification. In order to assign a specification and eventually integrate *Bäckern*, two operations are required: Firstly, TMP has to adopt *Bäckern* instead of the predicted $\textit{Bäcker}_{\text{NOM/ACC/DAT.M.SG}}$. This means that the top-ranked candidate of $\textit{Bäcker}_{\text{NOM/ACC/DAT.M.SG}}$ has to be replaced by *Bäckern*. Secondly, the incoming material of *Bäckern* has to be associated with its respective feature specification. In order to adopt *Bäckern*, TMP has to search the ranked candidates from the second step. The list provides $\textit{Bäckern}_{\text{DAT.PL}}$. No other candidate is available. Therefore, TMP synchronizes [+OBJ, +OBL, +PL] with the incoming *Bäckern* at the third step.

Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. With *Bäckern* as incoming material, the selection of an incompatibly ranked candidate was necessary. This particular ranked candidate provides at least one feature that is incompatible with the feature specification—namely *Bäckern*'s [+OBL]. This means that *Bäckern*$_{\text{DAT.PL}}$ with its features of [+OBJ, +OBL, +PL] opposes the current material's specification that also carries [−OBL]. The language processing system cannot change the input but the initial analysis of the current material and its specification. Therefore, reanalysis becomes necessary. Selecting another alternative of *Bäckern* would not be effective since there is none. The only way to maintain processing is by abandoning the integration of *den* as *den*$_{\text{ACC.M.SG}}$ in the previous parsing stage. Since the SP$_{\text{NOM}}$ has already been deleted when *den* instead of *der* had to be integrated, the other syncretic alternative of *den*, that is *den*$_{\text{DAT.PL}}$ which carries [+OBJ, +OBL, +PL], can be synchronized right away.

This, however, also overwrites the contents of the first step of the subsequent parsing stage which would once again render the feature specification and the order of the ranked candidates for the nouns at Step 2 no longer applicable. By restarting with a clean slate, *Bäckern*$_{\text{DAT.PL}}$'s [+OBJ, +OBL, +PL] at Step 3 no longer provide incompatible features to the current material's specification with [+OBJ, +OBL, +PL] of Step 1. The current material's feature set of [+OBJ, +OBL, +PL] will thus be combined with the incoming material's specification [+OBJ, +OBL, +PL]. They will eventually be fed into the next parsing step at Stage 3. The parse will be concluded in Paragraph B.2.1.2.4.3.

B.2.1.2.4.3 Stage 3: Conclusion

TMP will now combine the specifications of the reanalyzed *den* with the one of *Bäckern* after the SP$_{\text{NOM}}$ and its specification have been abandoned. That is the sum of [+OBJ, +OBL, +PL] and [+OBJ, +OBL, +PL] which equals [+OBJ, +OBL, +PL]. Figure B.8 shows how this feature bundle can now be used for the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

B.2.1.3 Using Wunderlich's features

B.2.1.3.1 Parsing *der Bäcker* The DP *der Bäcker* from (80a) shall be parsed. It is the first clause-medial syntactic argument of sentence (a) from Table 4.1 and thus part of the sentence *Gestern hat der Bäcker den Konditor gesehen* ("Yesterday, the baker saw the confectioner"). The DP's conclusive parse will be illustrated in Figure B.9.

B.2.1.3.1.1 Stage 1: SP$_{\text{NOM}}$ + *hat* → *der*

Step 1 The current material and its specification are the SP$_{\text{NOM}}$ with [−HR, −LR, −PL] that also includes [−PL] from the auxiliary verb *hat*. This bundle will be inserted into the current material slot and its specification respectively. The sentence initial adverb *gestern* does not provide relevant morphosyntactic features with respect to the

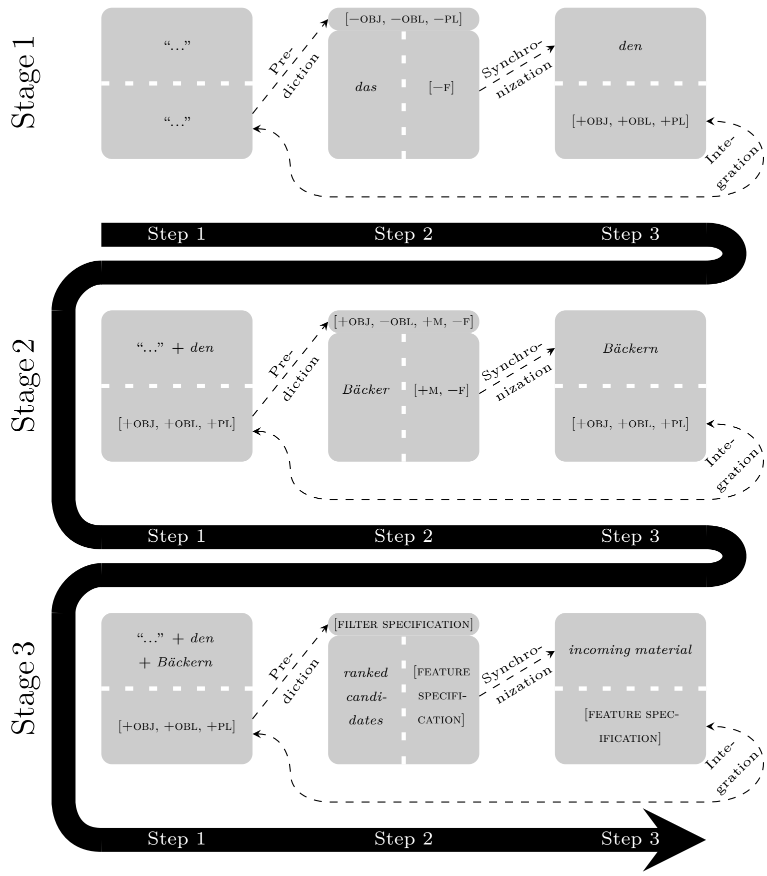


Figure B.8: Combining current and incoming material: *den* and *Bäckern* equals [+OBJ, +OBL, +PL].

parsing of the DP. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [−HR, −LR, −PL] was the current material's specification and is maintained in the filter specification of the subsequent Step 2.

Step 2 Ranked candidates are derived and thoroughly presented in Table B.11. The determiner *das*$_{\text{NOM/ACC.N.SG}}$ is the top-ranked candidate while others are still part of the list. The targeted *der*$_{\text{NOM.M.SG}}$ is the second-ranked candidate according to Wunderlich's account.

Parallel to Bierwisch in Section 4.2.3.2 and Paragraph 5.2.1.1.1, recall from the introduction of Wunderlich's framework that his inventory in Table 1.11 also contained elements with disjunctive specifications. Likewise, these disjunctive feature bundles could require a secondary mechanism to resolve those disjunctions. However, no additional operations shall be assumed. The Experimental Part II will reiterate on this mechanism's aspect. How TMP switches from the top-ranked *das*$_{\text{NOM/ACC.N.SG}}$ to the lower ranked *der*$_{\text{NOM.M.SG}}$ alternative will be explained for the third step of the parsing along with the Synchronization process.

Table B.11: Ranked determiner candidates after an SP_{NOM}.

rank	filter specification: [−HR, −LR, −PL] (by current material's SP_{NOM} + *hat*)		⚡	🔍−		🔍+
	determiner	specification		⇒	⇐	
1.	$das_{\text{NOM/ACC.N.SG}}$	[∅]	0	3	0	0
2.	$der_{\text{NOM.M.SG}}$	[+M]	0	3	1	0
3.	$die_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[+PL ∨ +F]	1	3	1	0
4.	$den_{\text{ACC.M.SG}}$	[+HR, +M]	1	3	2	0
	$des_{\text{GEN.M/N.SG}}$	[+HR, +N]	1	3	2	0
5.	$dem_{\text{DAT.M/N.SG}}$	[+HR, +LR]	2	3	2	0
6.	$der_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+HR, [+LR ∨ +N], [+PL ∨ +F]]	3	3	5	0
	$den_{\text{DAT.PL}}$	[+HR, +LR, +PL, [+PL ∨ +F]]	3	3	5	0

Step 3 The determiner *der* enters the system as newly incoming material. It is assumed that TMP simply "sees" *der* initially without any specification. In order to assign a specification and eventually integrate *der*, two operations are required: Firstly, TMP has to adopt *der* instead of the predicted $das_{\text{NOM/ACC.N.SG}}$. If the predicted $das_{\text{NOM/ACC.N.SG}}$ had really been the incoming material, then TMP would not even have to synchronize features. This should have been the most effortless way of synchronization. This is not the case in the example at hand. This means that the top-ranked candidate of $das_{\text{NOM/ACC.N.SG}}$ has to be replaced by an alternative of *der*. Secondly, the incoming material of *der* has to be associated with its respective feature specification. This means that the syncretism between $der_{\text{NOM.M.SG}}$ and $der_{\text{DAT/GEN.F.SG, GEN.PL}}$ has to be resolved. Synchronization handles these issues. In order to adopt *der*, TMP has to search the ranked candidates from the second step. The list provides two alternatives, namely the higher ranked $der_{\text{NOM.M.SG}}$ and lower ranked $der_{\text{DAT/GEN.F.SG, GEN.PL}}$. Again, TMP's bias toward minimal featural deviance comes into effect. Therefore, in order to ensure lower featural deviance, TMP selects the next higher ranked candidate that matches the form of *der*. As shown in Table B.11, $der_{\text{NOM.M.SG}}$ with its feature of [+M] has precedence over the syncretic $der_{\text{DAT/GEN.F.SG, GEN.PL}}$ which carries [+HR, [+HR ∨ +N], [+PL ∨ +F]]. It is *simpler* for TMP to synchronize just one feature that is non-incompatible—namely [+M]—with the incoming *der* at the third step than a specification that is entirely incompatible with the feature specification. That is why *der* will be associated with [+M] and not with [+HR, [+HR ∨ +N], [+PL ∨ +F]].

For the integration of *der* in the nominative masculine singular alternative, the current material's feature set of [−HR, −LR, −PL] will thus be combined with the incoming material's specification [+M]. They will eventually be fed into the next parsing stage. The sum of the features of SP_{NOM}, *hat* and *der* equals [−HR, −LR, +M, −PL]. This is only possible since both feature bundles are mutually compatible and can thus be added up. This feature bundle can now be fed into Step 1 of Stage 2 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

B.2.1.3.1.2 Stage 2: SP$_{\text{NOM}}$ + *hat* + *der* → *Bäcker*

Step 1 The first step here is identical to the outcome of Step 3 from Paragraph B.2.1.3.1.1. The current material and its specification are the combination of the SP$_{\text{NOM}}$ + *hat*'s *der* that is [−HR, −LR, +M, −PL] in total. This bundle will be inserted into the current material slot and its specification respectively. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [−HR, −LR, +M, −PL] was the current material's specification and is maintained in the filter specification at Step 2.

Step 2 Ranked candidates are derived following the integration of *der* and thoroughly given in Table B.12. The noun *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ is the top-ranked candidate while others are still part of the list. How TMP adopts the top-ranked *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ will be explained for the third step of the parsing along with the Synchronization process.

Table B.12: Ranked noun candidates after SP$_{\text{NOM}}$ + *der*$_{\text{NOM.M.SG}}$.

rank	filter specification: [−HR, −LR, +M, −PL] (by current material's SP$_{\text{NOM}}$ + *hat* + *der*$_{\text{NOM.M.SG}}$)		⚡	⊖		⊕
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	3	0	1
2.	*Bäckers*$_{\text{GEN.M.SG}}$	[+N, +M]	0	3	1	1
3.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	4	1	0
4.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+M, +PL]	1	3	1	1
5.	*Bäckern*$_{\text{DAT.PL}}$	[+LR, +M, +PL]	1	3	2	1
6.	*Kundinnen*$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	1	4	1	0

Step 3 The noun *Bäcker* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäcker* initially without any specification. In order to assign a specification and eventually integrate *Bäcker*, TMP can use the top-ranked candidate. As shown in Table B.12, *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ with its feature of [+M] has precedence over the syncretic *Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$ which carries [+M, +PL]. It is *simpler* for TMP to synchronize one feature that are retrievable—namely [+M] and [−F]—with the incoming *Bäcker* at the third step than a specification that is partially incompatible with the feature specification—namely [+PL]. That is why *Bäcker* will be associated with [+M] and not with [+M, +PL].

For the integration of *Bäcker* in the nominative/accusative/dative masculine singular alternative, the current material's specification [−HR, −LR, +M, -PL] will thus be combined with the incoming material's specification [+M]. They will be fed into the first step at Stage 3, eventually concluding the parse.

B.2.1.3.1.3 Stage 3: Conclusion
The sum of the features of SP_{NOM}, *hat*, *der* and *Bäcker* equals [−HR, −LR, +M, −PL]. This is only possible since both feature bundles are mutually compatible and can thus be added up. As shown in Figure B.9, this feature bundle can now enter the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

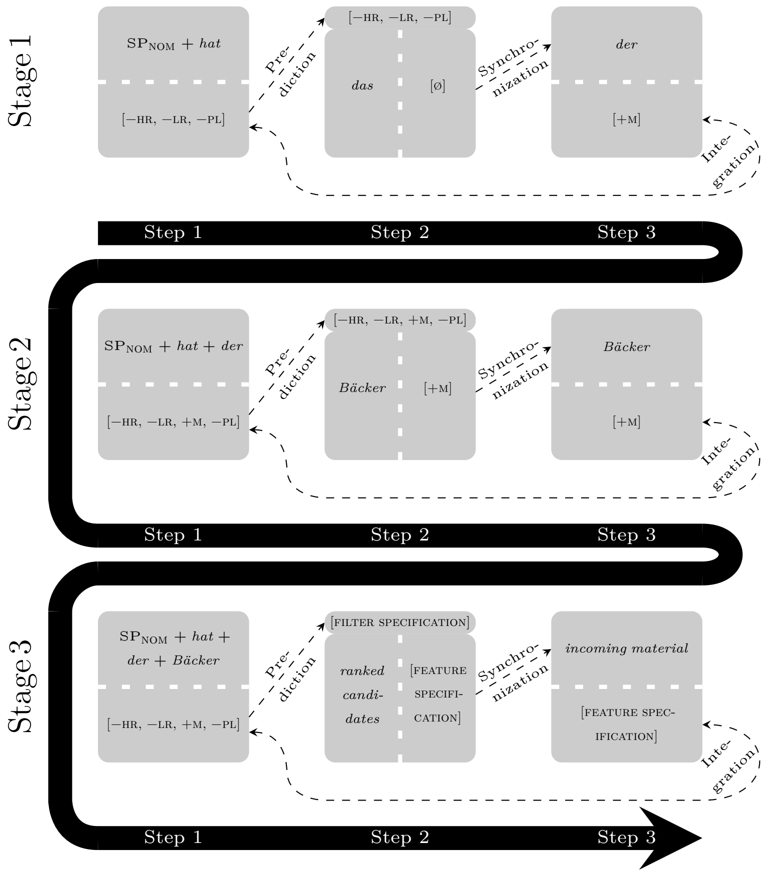


Figure B.9: Combining current and incoming material: SP_{NOM}, *hat*, *der* and *Bäcker* equals [−HR, −LR, +M, −PL].

B.2.1.3.2 Parsing *der Kundin* The DP *der Kundin* from (80b) shall be parsed. It is the first clause-medial syntactic argument of sentence (b) from Table 4.1 and thus part of the sentence *Gestern hat der Kundin der Konditor geholfen* ("Yesterday, the confectioner helped the costumer"). The DP's conclusive parse will be illustrated in Figures B.10 and B.11.

B.2.1.3.2.1 Stage 1: SP_{NOM} + *hat* → *der*

At this point, Steps 1–3 parallel Stage 1 in Paragraph B.2.1.3.1.1 since the material is identical. The SP_{NOM} + *hat* provide the feature specification for Step 2 via the Prediction process. Subsequently, the ranked candidates are derived. In Step 3, the incoming *der* is synchronized and integrated.

B.2.1.3.2.2 Stage 2: "..." + *der* → *Kundin*

Steps 1–2 At this point, Steps 1–2 parallel Steps 1–2 from Stage 1 in Paragraph B.2.1.3.1.2 since the material is identical. The SP_{NOM} + *hat* + *der* provide the feature specification for Step 2 via the Prediction process.

Step 3 The noun *Kundin* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Kundin* initially without any specification. In order to assign a specification and eventually integrate *Kundin*, two operations are required: Firstly, TMP has to adopt *Kundin* instead of the predicted $\textit{Bäcker}_{\text{NOM/ACC/DAT.M.SG}}$. This means that the top-ranked candidate of $\textit{Bäcker}_{\text{NOM/ACC/DAT.M.SG}}$ has to be replaced by *Kundin*. Secondly, the incoming material of *Kundin* has to be associated with its respective feature specification. In order to adopt *Kundin*, TMP has to search the ranked candidates from the second step. The list provides $\textit{Kundin}_{\text{NOM/ACC/DAT/GEN.F.SG}}$. No other candidate is available. Therefore, TMP synchronizes [+F] with the incoming *Kundin* at the third step.

Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. Now, two continuations are conceivable: The [+F] of *Kundin* can either be treated as being incompatible or compatible with the feature specification of [−HR, −LR, +M, −PL]. Both alternatives will be discussed in the following two paragraphs and enfolded in Paragraph B.2.1.3.2.3.

Step 3's incompatibility route Pursuing the route of incompatibility, one would have to derive the incompatibility by Wunderlich's exclusion of a specification that carries both [+M] and [+F]. With *Kundin* as incoming material, the selection of an incompatibly ranked candidate would be necessary. This particular ranked candidate would provide a feature that is incompatible with the feature specification—namely *Kundin*'s [+F]. This would mean that $\textit{Kundin}_{\text{NOM/ACC/DAT/GEN.F.SG}}$ with its feature of [+F] would oppose the current material's specification that carries [+M]. The language processing system cannot change the input but the initial analysis of the current material and its specification. This necessitates reanalysis. Selecting another alternative of *Kundin* would not be effective since there is none. The only way to maintain processing is by abandoning the SP_{NOM}.

Deleting the SP_{NOM} and its specification within the Integration process renders the feature specification and the order of the ranked candidates for the determiners at Step 2 no longer applicable. By restarting with a clean slate, the other syncretic alternative of *der*, that is $\textit{der}_{\text{DAT/GEN.F.SG, GEN.PL}}$ which carries [+HR, [+LR ∨ +N], [+PL ∨ +F]], can be synchronized.

This, in turn, also overwrites the contents of the first step of the subsequent parsing stage which would once again render the feature specification and the order of the ranked candidates for the nouns at Step 2 no longer applicable. By restarting with a clean slate, *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$'s [+F] at Step 3 no longer provides incompatible features to the current material's specification with [+HR, [+LR ∨ +N], [+PL ∨ +F]] of Step 1. The current material's feature set of [+HR, [+LR ∨ +N], [+PL ∨ +F]] will thus be combined with the incoming material's specification [+F]. They will eventually be fed into the first parsing step at Stage 3. The parse will be concluded in Paragraph B.2.1.3.2.3.

Step 3's compatibility route Pursuing the route of compatibility, which is that the [+F] of Kundin would be compatible with the feature specification of [−HR, −LR, +M, −PL], one would have to disregard the possible incompatibility between [+M] and [+F] and assume that they are mutually compatible instead. For the integration of *Kundin* in the nominative/accusative/dative/genitive feminine singular alternative, the current material's feature set of [−HR, −LR, +M, −PL] will thus be combined with the incoming material's specification [+F]. They will eventually be fed into the first parsing step at Stage 3. The parse will be concluded in Paragraph B.2.1.3.2.3.

B.2.1.3.2.3 Stage 3: Conclusion

Continuing Stage 2, Step 3's incompatibility route By continuing the incompatibility route from Stage 2, Step 3 in Paragraph B.2.1.3.2.2, TMP will now combine the specifications of the reanalyzed *der* with the one of *Kundin* after the SP_{NOM} and its specification have been abandoned. That is the sum of [+HR, [+LR ∨ +N], [+PL ∨ +F]] and [+F] which equals [+HR, [+LR ∨ +N], [+PL ∨ +F]]. As depicted in Figure B.10, this feature bundle can now enter the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

Continuing Stage 2, Step 3's compatibility route By continuing the compatibility route from Stage 2, Step 3 in Paragraph B.2.1.3.2.2, TMP will combine the specifications of the SP_{NOM}, *hat* and *der* with the one of *Kundin*. That is the sum of [−HR, −LR, +M, −PL] and [+F] which equals [−HR, −LR, +M, −F, −PL]. This is only possible if one assumes that both feature bundles are mutually compatible and can thus be added up. Figure B.11 shows that this feature bundle can now be used for the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

The combination of SP_{NOM}, *hat*, *der*$_{\text{NOM.M.SG}}$ *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$ yields, however, an illicit combination since there is no way to combine a masculine determiner with a feminine noun in order to realize a grammatical subject in nominative case.

B.2.1.3.3 Parsing *den Bäcker*

The DP *den Bäcker* from (80c) shall be parsed. It is the first clause-medial syntactic argument of sentence (c) from Table 4.1 and thus part of the sentence *Gestern hat den Bäcker der Konditor gesehen* ("Yesterday, the confectioner saw the baker"). The DP's conclusive parse will be illustrated in Figure B.12.

B.2.1.3.3.1 Stage 1: SP_{NOM} + *hat* → *den*

Steps 1–2 At this point, Steps 1–2 parallel Steps 1–2 from Stage 1 in Paragraph B.2.1.3.1.1 since the material is identical. The SP_{NOM} + *hat* provide the feature

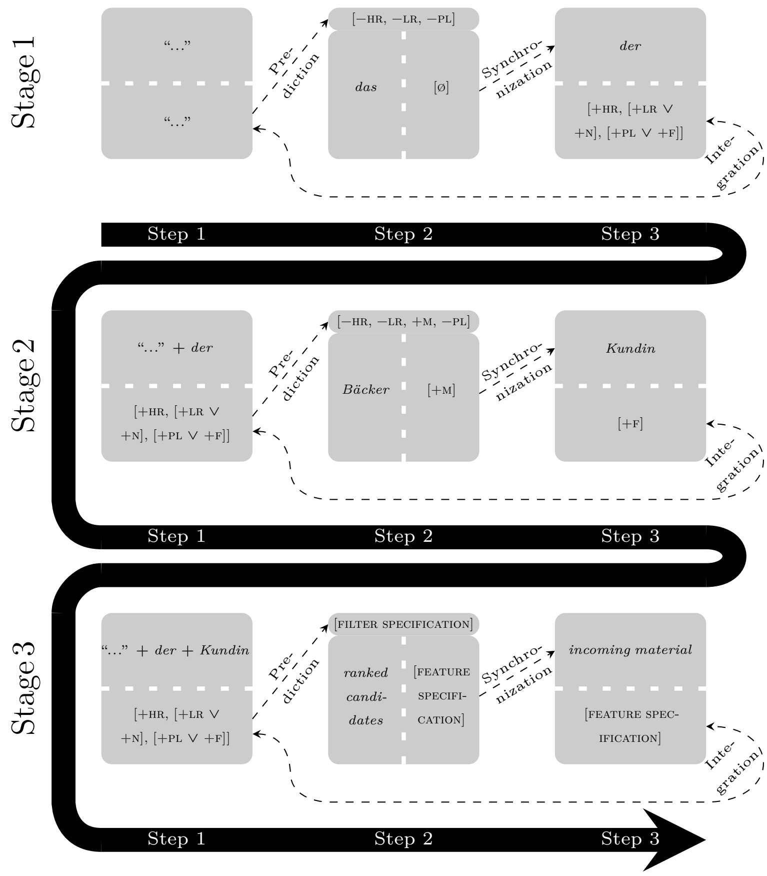


Figure B.10: Combining current and incoming material: *der* and *Kundin* equals [+HR, [+LR ∨ +N], [+PL ∨ +F]].

specification for Step 2 via the Prediction process.

Step 3 The determiner *den* enters the system as newly incoming material. It is assumed that TMP simply "sees" *den* initially without any specification. In order to assign a specification and eventually integrate *den*, two operations are required: Firstly, TMP has to adopt *den* instead of the predicted *das*$_{\text{NOM/ACC.N.SG}}$. This means that the top-ranked candidate of *das*$_{\text{NOM/ACC.N.SG}}$ has to be replaced by an alternative of *den*. Secondly, the incoming material of *den* has to be associated with its respective feature specification. This means that the syncretism between *den*$_{\text{ACC.M.SG}}$ and *den*$_{\text{DAT.PL}}$ has to be resolved. Synchronization handles these issues. In order to adopt *den*, TMP has to search the ranked candidates from the second step. The list in Table B.11 provides two alternatives, namely the higher ranked *den*$_{\text{ACC.M.SG}}$ and lower ranked *den*$_{\text{DAT.PL}}$. Again, TMP's bias toward minimal featural deviance comes into effect. Therefore, in order to ensure lower featural deviance, TMP selects the next higher ranked candidate that matches the form of *den*. As shown in Table B.11, *den*$_{\text{ACC.M.SG}}$ with its features of [+HR, +M] has precedence over the syncretic *den*$_{\text{DAT.PL}}$ which carries [+HR, +LR, +PL, [+PL ∨ +F]]. It is *simpler* for TMP to synchronize a less incompatible specification with a retrievable feature—namely [+HR]—with the incoming *den* at the third step than three

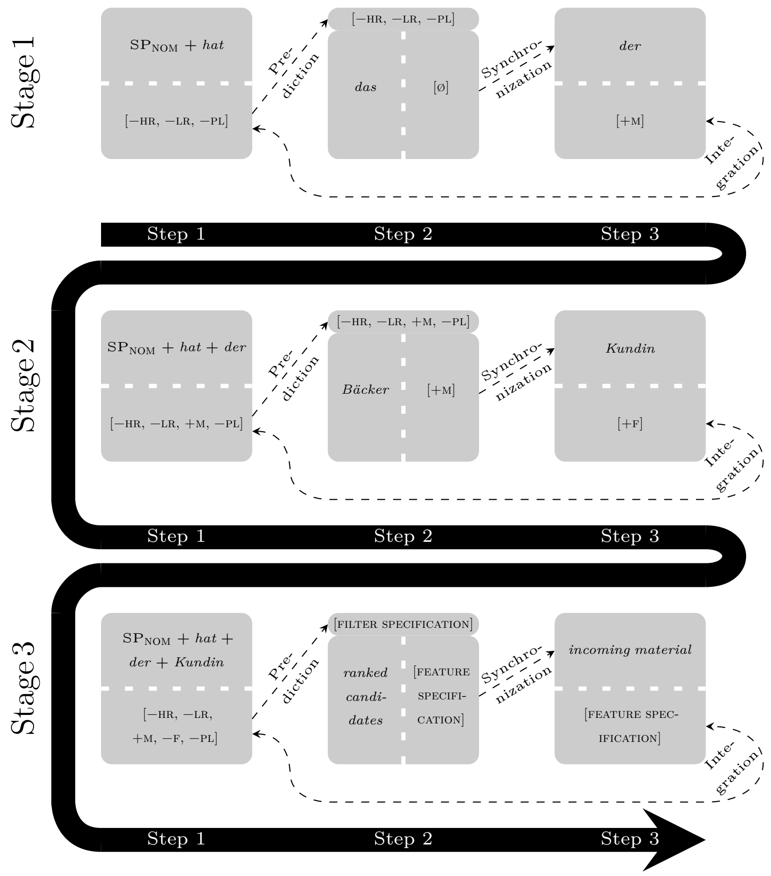


Figure B.11: Combining current and incoming material: SP$_{NOM}$, *hat*, *der* and *Kundin* equals [−HR, −LR, +M, −F, −PL].

features that are maximally incompatible with the feature specification—namely [+HR, +LR, +PL]. That is why *den* will be associated with [+HR, +M].

Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. With *den* as incoming material, the selection of an incompatibly ranked candidate was necessary. This particular ranked candidate provides a feature that is incompatible with the feature specification—namely *den*'s [+HR]. This means that *den*$_{ACC.M.SG}$ with its features of [+HR, +M] opposes the current material's specification. The language processing system cannot change the input but the initial analysis of the current material and its specification. Therefore, reanalysis becomes necessary. Selecting the other alternative of *den*—*den*$_{DAT.PL}$ which carries [+HR, +LR, +PL, [+PL ∨ +F]]—would not be effective since it is even more incompatible with the current material's specification. The only way to maintain processing is by abandoning the SP$_{NOM}$.

Deleting the SP$_{NOM}$ and its specification within the Integration process renders the feature specification and the order of the ranked candidates for the determiners no longer applicable. By restarting with a clean slate, *den*$_{ACC.M.SG}$ no longer provides incompatible features to any specification.

In the current case of the integration of *den* in the accusative masculine singular alternative, the current material's feature set that is now empty will thus be combined with the incoming material's specification of [+HR, +M]. They will eventually be fed into the next parsing stage.

After the SP$_{\text{NOM}}$ and its specification have been deleted, the sum of virtually nothing and *den*'s [+HR, +M] equals [+HR, +M]. This feature bundle can now be fed into the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

B.2.1.3.3.2 Stage 2: "..." + *den* → *Bäcker*

Step 1 The first step here is identical to the outcome of Step 3 from Paragraph B.2.1.3.3.1. The current material and its specification are the combination of virtually nothing with *den*'s [+HR, +M]. This bundle will be inserted into the current material slot and its specification respectively. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [+HR, +M] was the current material's specification and is maintained in the filter specification.

Step 2 Ranked candidates are derived following the integration of *den* and thoroughly given in Table B.13. The noun *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ is the top-ranked candidate while others are still part of the list. How TMP adopts the top-ranked *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ will be explained for the third step of the parsing along with the Synchronization process.

Table B.13: Ranked noun candidates after an *den*$_{\text{ACC.M.SG}}$.

rank	filter specification: [+HR, +M] (by current material's *den*$_{\text{ACC.M.SG}}$)		⚡	🔍−		🔍+
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	0	1
2.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+M, +PL]	0	1	1	1
	Bäckers$_{\text{GEN.M.SG}}$	[+N, +M]	0	1	1	1
3.	*Bäckern*$_{\text{DAT.PL}}$	[+LR, +M, +PL]	0	1	2	0
4.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	2	1	0
5.	*Kundinnen*$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	2	1	0

Step 3 The noun *Bäcker* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäcker* initially without any specification. In order to assign a specification and eventually integrate *Bäcker*, TMP can use the top-ranked candidate. As shown in Table B.13, *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ with its feature of [+M] has precedence over the syncretic *Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$ which carries [+M, +PL]. It is *simpler* for TMP to synchronize two features that are retrievable—namely [+M, −F]—with

the incoming *Bäcker* at the third step than a specification that is potentially incompatible with the feature specification. Recall that any plural specification excludes gender information. That is why *Bäcker* will be associated with [+M] and not with [+M, +PL].

For the integration of *Bäcker* in the nominative/accusative/dative masculine singular alternative, the current material's specification [+HR, +M] will thus be combined with the incoming material's specification [+M, −F]. They will be fed into the first step at Stage 3, eventually concluding the parse.

B.2.1.3.3.3 Stage 3 Conclusion

The sum of the features of "...", *den* and *Bäcker* equals [+HR, +M]. This is only possible since both feature bundles are mutually compatible and can thus be added up. As depicted in Figure B.12, this feature bundle can now be used for the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

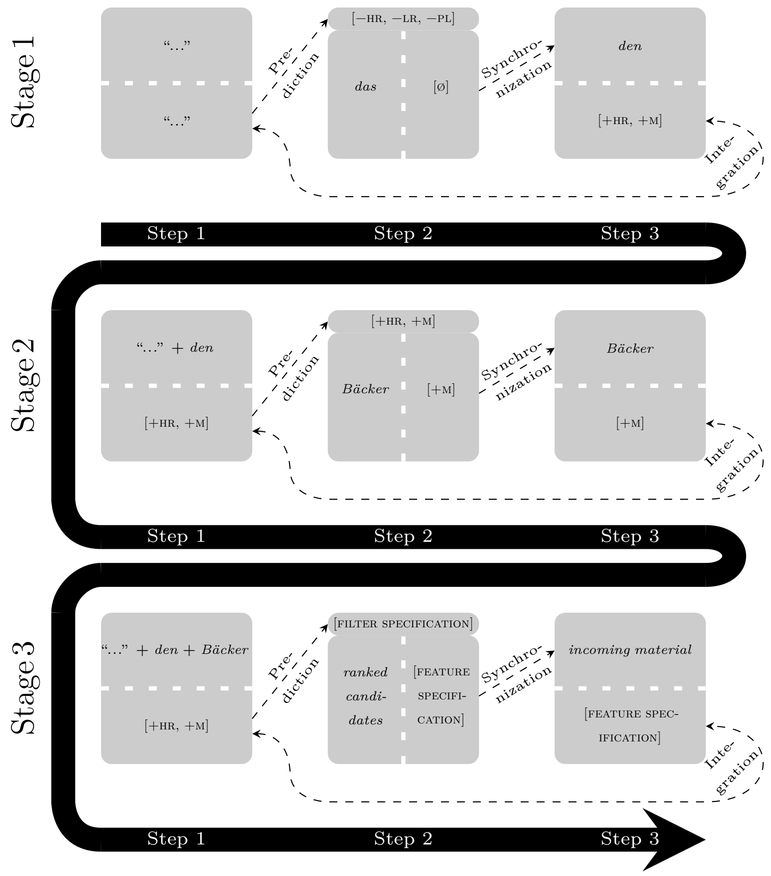


Figure B.12: Combining current and incoming material: "...", *den* and *Bäcker* equals [+HR, +M].

B.2.1.3.4 Parsing *den Bäckern* The DP *den Bäckern* from (80d) shall be parsed. It is the first clause-medial syntactic argument of sentence (d) from Table 4.1 and thus part of the sentence *Gestern hat den Bäckern der Konditor geholfen* ("Yesterday, the confectioner helped the bakers"). The DP's conclusive parse will be illustrated in Figures B.13 and B.14.

B.2.1.3.4.1 Stage 1: SP_{NOM} + *hat* → *den*
At this point, Steps 1–3 parallel Stage 1 in Paragraph B.2.1.3.3.1 since the material is identical. The SP_{NOM} + *hat* provide the feature specification for Step 2 via the Prediction process. Subsequently, the ranked candidates are derived. In Step 3, the incoming *den* is synchronized and integrated.

B.2.1.3.4.2 Stage 2: "..." + *den* → *Bäckern*
Steps 1–2 At this point, Steps 1-2 parallel Steps 1–2 from Stage 2 in Paragraph B.2.1.3.3.2 since the material is identical. The SP_{NOM} + *hat* + *den* provide the feature specification for Step 2 via the Prediction process.

Step 3 The noun *Bäckern* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäckern* initially without any specification. In order to assign a specification and eventually integrate *Bäckern*, two operations are required: Firstly, TMP has to adopt *Bäckern* instead of the predicted $\textit{Bäcker}_{\text{NOM/ACC/DAT.M.SG}}$. This means that the top-ranked candidate of $\textit{Bäcker}_{\text{NOM/ACC/DAT.M.SG}}$ has to be replaced by *Bäckern*. Secondly, the incoming material of *Bäckern* has to be associated with its respective feature specification. In order to adopt *Bäckern*, TMP has to search the ranked candidates from the second step. The list provides $\textit{Bäckern}_{\text{DAT.PL}}$. No other candidate is available. Therefore, TMP synchronizes [+LR, +M, +PL] with the incoming *Bäckern* at the third step.

Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. Now, two continuations are conceivable: The [+LR, +M, +PL] of *Bäckern* can either be treated as being incompatible or compatible with the feature specification of [+HR, +M]. Both alternatives will be discussed in the following two paragraphs and enfolded in Paragraph B.2.1.3.4.3.

Step 3's incompatibility route Pursuing the route of incompatibility, one would have to derive the incompatibility by Wunderlich's exclusion of a specification that carries both [+M] and [+PL]. With *Bäckern* as incoming material, the selection of an incompatibly ranked candidate would then be necessary. This particular ranked candidate would provide a feature that is incompatible with the feature specification—namely *Bäckern*'s [+PL]. This would mean that $\textit{Bäckern}_{\text{DAT.PL}}$ with its feature of [+PL] would oppose the current material's specification that carries [+M]. The language processing system cannot change the input but the initial analysis of the current material and its specification. This necessitates reanalysis. Selecting another alternative of *Bäckern* would not be effective since there is none. The only way to maintain processing is by abandoning the integration of *den* as $\textit{den}_{\text{ACC.M.SG}}$ in the previous parsing stage. Since the SP_{NOM} has already been deleted when *den* instead of *der* had to be integrated, the other syncretic alternative of *den*, that is $den_{\text{DAT.PL}}$ which carries [+HR, +LR, +PL, [+PL ∨ +F]], can be synchronized right away.

This, however, also overwrites the contents of the first step of the subsequent parsing stage which would once again render the feature specification and the order of the ranked candidates for the nouns at Step 2 no longer applicable. By restarting with a clean slate, $Bäckern_{\text{DAT.PL}}$'s [+LR, +M, +PL] at Step 3 no longer provide incompatible features to the current material's specification with [+HR, +LR, +PL, [+PL ∨ +F]] of Step 1. The current material's feature set of [+LR, +M, +PL] will thus be combined with the incoming material's specification [+HR, +LR, +PL, [+PL ∨ +F]]. They will eventually be fed into the next parsing step at Stage 3. The parse will be concluded in Paragraph B.2.1.3.4.3.

Step 3's compatibility route Pursuing the route of compatibility, which is that the [+LR, +M, +PL] of *Bäckern* would be compatible with the feature specification of [+HR, +M], one would have to disregard the possible incompatibility between [+M] and [+PL] and assume that they are mutually compatible instead. For the integration of *Bäckern* in the dative plural alternative, the current material's feature set of [+HR, +M] will thus be combined with the incoming material's specification [+LR, +M, +PL]. They will eventually be fed into the next parsing step at Stage 3. The parse will be concluded in Paragraph B.2.1.3.4.3.

B.2.1.3.4.3 Stage 3: Conclusion

Continuing Stage 2, Step 3's incompatibility route By continuing the incompatibility route from Stage 2, Step 3 in Paragraph B.2.1.3.4.2, TMP will now combine the specifications of the reanalyzed *den* with the one of *Bäckern* after the SP_{NOM} and its specification have been abandoned. That is the sum of [+HR, +LR, +PL, [+PL ∨ +F]] and [+LR, +M, +PL] which equals [+HR, +LR, +M, +PL]. This feature bundle can now enter the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

Continuing Stage 2, Step 3's compatibility route By continuing the compatibility route from Stage 2, Step 3 in Paragraph B.2.1.3.2.2, TMP will combine the specifications of "..." and *den* with the one of *Bäckern*. That is the sum of [+HR, +M] and [+LR, +M, +PL] which equals [+HR, +LR, +M, +PL]. This is only possible if one assumes that both feature bundles are mutually compatible and can thus be added up. Figure B.14 shows how this feature bundle can now be fed into the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

The combination of "..." + *den* + *Bäckern* yields, however, an illicit combination since there is no way to combine a masculine singular determiner with a plural noun in order to realize a grammatical object in accusative case.

B.2.1.4 Using Wiese's features

B.2.1.4.1 Parsing *der Bäcker* The DP *der Bäcker* from (80a) shall be parsed. It is the first clause-medial syntactic argument of sentence (a) from Table 4.1 and thus part

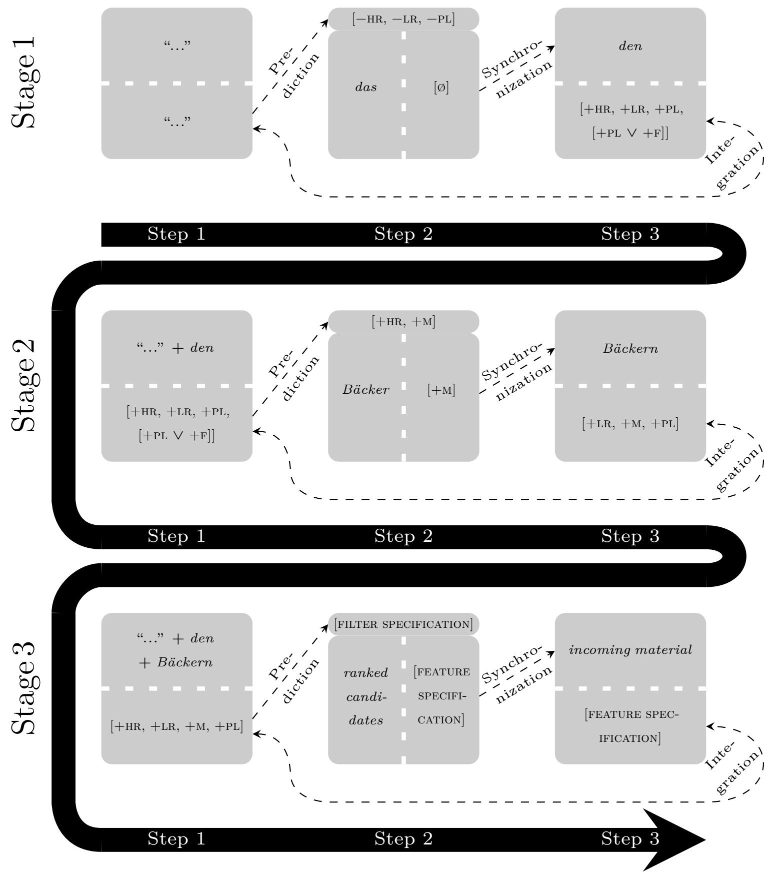


Figure B.13: Combining current and incoming material: *den* and *Bäckern* equals [+HR, +LR, +M, +PL].

of the sentence *Gestern hat der Bäcker den Konditor gesehen* ("Yesterday, the baker saw the confectioner"). The DP's conclusive parse will be illustrated in Figure B.15.

B.2.1.4.1.1 Stage 1: SP_{NOM} + *hat* → *der*

Step 1 The current material and its specification are the SP_{NOM} with [−OBJ, −OBL, −PL] that also includes [−PL] from the auxiliary verb *hat*. This bundle will be inserted into the current material slot and its specification respectively. The sentence initial adverb *gestern* does not provide relevant morphosyntactic features with respect to the parsing of the DP. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [−OBJ, −OBL, −PL] was the current material's specification and is maintained in the filter specification of the subsequent Step 2.

Step 2 Ranked candidates are derived and thoroughly presented in Table B.14. The determiner $die_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ is the top-ranked candidate while others are still part of the list. The targeted $der_{\text{NOM.M.SG}}$ is the second-ranked candidate according to Wiese's account. How TMP switches from the top-ranked $die_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ to the lower

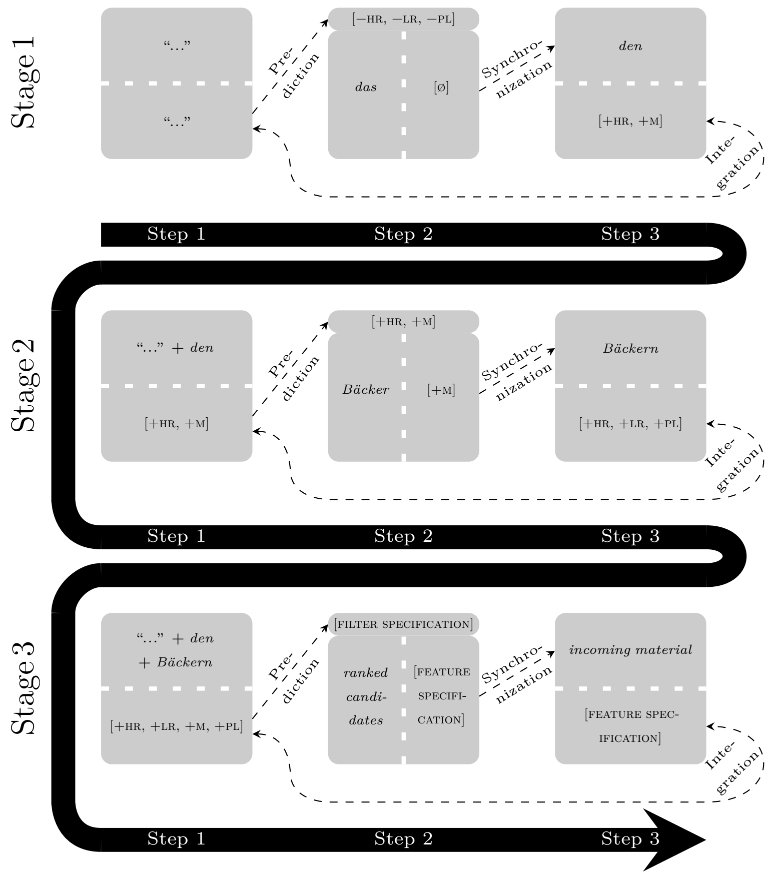


Figure B.14: Combining current and incoming material: "…", *den* and *Bäckern* equals [+HR, +LR, +M, +PL].

ranked *der*$_{\text{NOM.M.SG}}$ alternative will be explained for the third step of the parsing along with the Synchronization process.

Step 3 The determiner *der* enters the system as newly incoming material. It is assumed that TMP simply "sees" *der* initially without any specification. In order to assign a specification and eventually integrate *der*, two operations are required: Firstly, TMP has to adopt *der* instead of the predicted *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$. If the predicted *die*$_{\text{NOM/ACC.F.SG. NOM/ACC.PL}}$ had really been the incoming material, then TMP would not even have to synchronize features. This should have been the most effortless way of synchronization. This is not the case in the example at hand. This means that the top-ranked candidate of *die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$ has to be replaced by an alternative of *der*. Secondly, the incoming material of *der* has to be associated with its respective feature specification. This means that the syncretism between *der*$_{\text{NOM.M.SG}}$, *der*$_{\text{GEN.PL}}$ and *der*$_{\text{DAT/GEN.F.SG}}$ has to be resolved. Synchronization handles these issues. In order to adopt *der*, TMP has to search the ranked candidates from the second step. The list provides three alternatives, namely the highest ranked *der*$_{\text{NOM.M.SG}}$, the lower ranked *der*$_{\text{GEN.PL}}$ and the lowest ranked *der*$_{\text{DAT/GEN.F.SG}}$. Again, TMP's bias toward minimal featural deviance comes into effect. Therefore, in order to ensure lower featural deviance, TMP selects the

Table B.14: Ranked determiner candidates after an SP_{NOM}.

rank	filter specification: [−OBJ, −OBL, −PL] (by current material's SP_{NOM} + *hat*)		ϟ	⊖		⊕
	determiner	specification		⇒	⇐	
1.	*die*$_{NOM/ACC.F.SG,\ NOM/ACC.PL}$	[Ø]	0	3	0	0
2.	*der*$_{NOM.M.SG}$	[+M]	0	3	1	0
3.	*das*$_{NOM/ACC.N.SG}$	[+M, +F]	0	3	2	0
4.	*der*$_{GEN.PL}$	[+OBL]	1	3	1	0
	den$_{ACC.M.SG}$	[+OBJ, +M]	1	3	2	0
5.	*des*$_{GEN.M/N.SG}$	[+OBL, +M]	1	3	2	0
	der$_{DAT/GEN.F.SG}$	[+OBL +F]	1	3	2	0
6.	*den*$_{DAT.PL}$	[+OBJ, +OBL]	2	3	2	0
7.	*dem*$_{DAT.M/N.SG}$	[+OBJ, +OBL, +M]	2	3	3	0

next higher ranked candidate that matches the form of *der*. As shown in Table B.14, *der*$_{NOM.M.SG}$ with its feature of [+M] has precedence over the syncretic *der*$_{GEN.PL}$ which carries [+OBL] and *der*$_{DAT/GEN.F.SG}$ which carries [+OBL, +F]. It is *simpler* for TMP to synchronize just one feature that is non-retrievable but also non-incompatible—namely [+M]—with the incoming *der* at the third step than a specification that is entirely incompatible with the feature specification. That is why *der* will be associated with [+M] and neither with [+OBL] or [+OBL, +F].

For the integration of *der* in the nominative masculine singular alternative, the current material's feature set of [−OBJ, −OBL, −PL] will thus be combined with the incoming material's specification [+M]. They will eventually be fed into the next parsing stage. The sum of the features of SP_{NOM}, *hat* and *der* equals [−OBJ, −OBL, +M, −PL]. This is only possible since both feature bundles are mutually compatible and can thus be added up. This feature bundle can now enter Step 1 of Stage 2 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

B.2.1.4.1.2 Stage 2: SP_{NOM} + *hat* + *der* → *Bäcker*

Step 1 The first step here is identical to the outcome of Step 3 from Paragraph B.2.1.4.1.1. The current material and its specification are the combination of the SP_{NOM} + *hat*'s *der* that is [−OBJ, −OBL, +M, −PL] in total. This bundle will be inserted into the current material slot and its specification respectively. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [−OBJ, −OBL, +M, −PL] was the current material's specification and is maintained in the filter specification at Step 2.

Step 2 Ranked candidates are derived following the integration of *der* and thoroughly given in Table B.15. The noun *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ is the top-ranked candidate while others are still part of the list. How TMP adopts the top-ranked *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ will be explained for the third step of the parsing along with the Synchronization process.

Table B.15: Ranked noun candidates after SP$_{\text{NOM}}$ + *der*$_{\text{NOM.M.SG}}$.

rank	filter specification: [−OBJ, −OBL, +M, −PL] (by current material's SP$_{\text{NOM}}$ + *hat* + *der*$_{\text{NOM.M.SG}}$)		⚡	⊖		⊕
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	3	0	1
2.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	4	1	0
3.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	1	2	1	2
4.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	1	4	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	1	4	1	0
5.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	3	4	3	0

Step 3 The noun *Bäcker* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäcker* initially without any specification. In order to assign a specification and eventually integrate *Bäcker*, TMP can use the top-ranked candidate. As shown in Table B.15, *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ with its feature of [+M] has precedence over the syncretic *Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$ which carries [+PL]. It is *simpler* for TMP to synchronize just one feature that is retrievable—namely [+M]—with the incoming *Bäcker* at the third step than a specification that is partially incompatible with the feature specification—namely [+PL]. That is why *Bäcker* will be associated with [+M] and not with [+PL].

For the integration of *Bäcker* in the nominative/accusative/dative masculine singular alternative, the current material's specification [−OBJ, −OBL, +M, -PL] will thus be combined with the incoming material's specification [+M]. They will be fed into the first step at Stage 3, eventually concluding the parse.

B.2.1.4.1.3 Stage 3: Conclusion

The sum of the features of SP$_{\text{NOM}}$, *hat*, *der* and *Bäcker* equals [−OBJ, −OBL, −PL, +M]. This is only possible since both feature bundles are mutually compatible and can thus be added up. As shown in Figure B.15, this feature bundle can now be used for the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

B.2.1.4.2 Parsing *der Kundin*

The DP *der Kundin* from (80b) shall be parsed. It is the first clause-medial syntactic argument of sentence (b) from Table 4.1 and thus part of the sentence *Gestern hat der Kundin der Konditor geholfen* ("Yesterday, the confectioner helped the costumer"). The DP's conclusive parse will be illustrated in Figures B.16 and B.17.

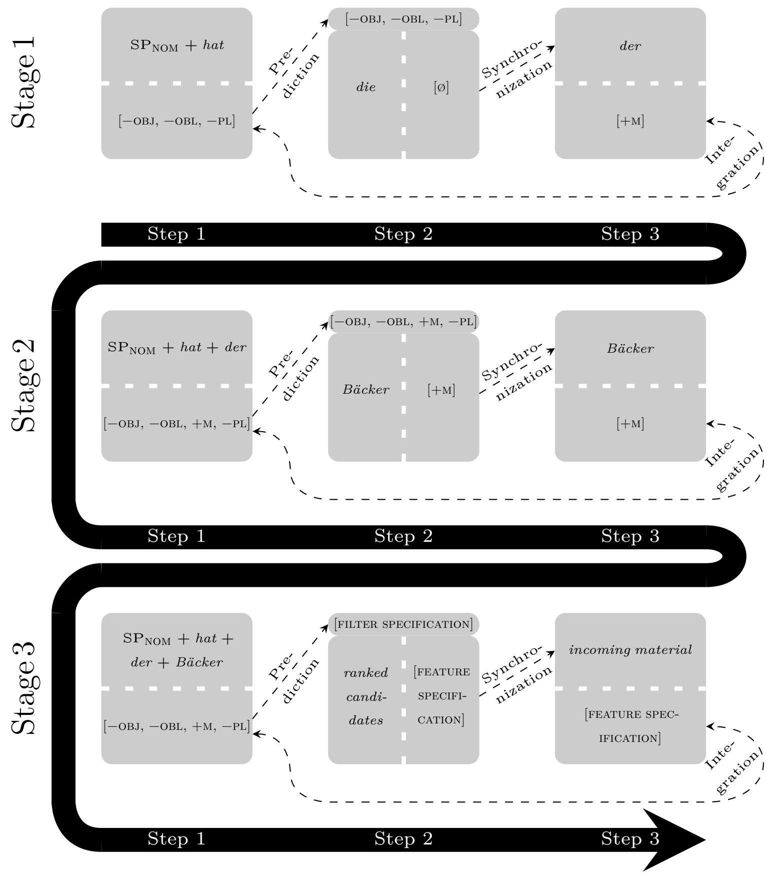


Figure B.15: Combining current and incoming material: SP_{NOM}, *hat*, *der* and *Bäcker* equals [−OBJ, −OBL, −PL, +M].

B.2.1.4.2.1 Stage 1: SP_{NOM} + *hat* → *der*

At this point, Steps 1–3 parallel Stage 1 in Paragraph B.2.1.4.1.1 since the material is identical. The SP_{NOM} + *hat* provide the feature specification for Step 2 via the Prediction process. Subsequently, the ranked candidates are derived. In Step 3, the incoming *der* is synchronized and integrated.

B.2.1.4.2.2 Stage 2: "..." + *der* → *Kundin*

Steps 1–2 At this point, Steps 1–2 parallel Steps 1–2 from Stage 1 in Paragraph B.2.1.4.1.2 since the material is identical. The SP_{NOM} + *hat* + *der* provide the feature specification for Step 2 via the Prediction process.

Step 3 The noun *Kundin* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Kundin* initially without any specification. In order to assign a specification and eventually integrate *Kundin*, two operations are required: Firstly, TMP has to adopt *Kundin* instead of the predicted *Bäcker*$_{NOM/ACC/DAT.M.SG}$. This means that the top-ranked candidate of *Bäcker*$_{NOM/ACC/DAT.M.SG}$ has to be replaced by *Kundin*. Secondly, the incoming material of *Kundin* has to be associated with its respective feature specification. In order to adopt *Kundin*, TMP has to search the ranked candidates from the second step. The list provides *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$. No other candidate is available. Therefore, TMP synchronizes [+F] with the incoming *Kundin* at the third step.

Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. Now, two continuations are conceivable: The [+F] of *Kundin* can either be treated as being incompatible or compatible with the feature specification of [−OBJ, −OBL, −PL, +M]. Both alternatives will be discussed in the following two paragraphs and enfolded in Paragraph B.2.1.4.2.3.

Step 3's incompatibility route Pursuing the route of incompatibility, one would have to derive the incompatibility by Wiese's exclusion of a specification that carries both [+M] and [+F]. With *Kundin* as incoming material, the selection of an incompatibly ranked candidate would be necessary. This particular ranked candidate would provide a feature that is incompatible with the feature specification—namely *Kundin*'s [+F]. This would mean that *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$ with its feature of [+F] would oppose the current material's specification that carries [+M]. The language processing system cannot change the input but the initial analysis of the current material and its specification. Therefore, reanalysis becomes necessary. Selecting another alternative of *Kundin* would not be effective since there is none. The only way to maintain processing is by abandoning the SP_{NOM}.

Deleting the SP_{NOM} and its specification within the Integration process renders the feature specification and the order of the ranked candidates for the determiners at Step 2 no longer applicable. By restarting with a clean slate, one of the other syncretic alternatives of *der*, that is either *der*$_{\text{GEN.PL}}$ which carries [+OBL] or *der*$_{\text{DAT/GEN.F.SG}}$ which carries [+OBL, +F], can be synchronized. The determiner that provides the lowest featural deviance will be selected. In the current case, *der*$_{\text{DAT/GEN.F.SG}}$ which carries [+OBL, +F], complies to this criterion.

This, in turn, also overwrites the contents of the first step of the subsequent parsing stage which would once again render the feature specification and the order of the ranked candidates for the nouns at Step 2 no longer applicable. By restarting with a clean slate, *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$'s [+F] at Step 3 no longer provides incompatible features to the current material's specification with [+OBL, +F] of Step 1. The current material's feature set of [+OBL, +F] will thus be combined with the incoming material's specification [+F]. They will eventually be fed into the first parsing step at Stage 3. The parse will be concluded in Paragraph B.2.1.4.2.3.

Step 3's compatibility route Pursuing the route of compatibility, which is that the [+F] of Kundin would be compatible with the feature specification of [−OBJ, −OBL, −PL, +M], one would have to disregard the possible incompatibility between [+M] and [+F] and assume that they are mutually compatible instead. For the integration of *Kundin* in the nominative/accusative/dative/genitive feminine singular alternative, the current material's feature set of [−OBJ, −OBL, −PL, +M] will thus be combined with the incoming material's specification [+F]. They will eventually be fed into the first parsing step at Stage 3. The parse will be concluded in Paragraph B.2.1.4.2.3.

B.2.1.4.2.3 Stage 3: Conclusion

Continuing Stage 2, Step 3's incompatibility route By continuing the incompatibility route from Stage 2, Step 3 in Paragraph B.2.1.4.2.2, TMP will now combine the specifications of the reanalyzed *der* with the one of *Kundin* after the SP$_{\text{NOM}}$ and its specification have been abandoned. That is the sum of [+OBL, +F] and [+F] which equals [+OBL, +F]. Figure B.16 depicts how this feature bundle can now be fed into the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

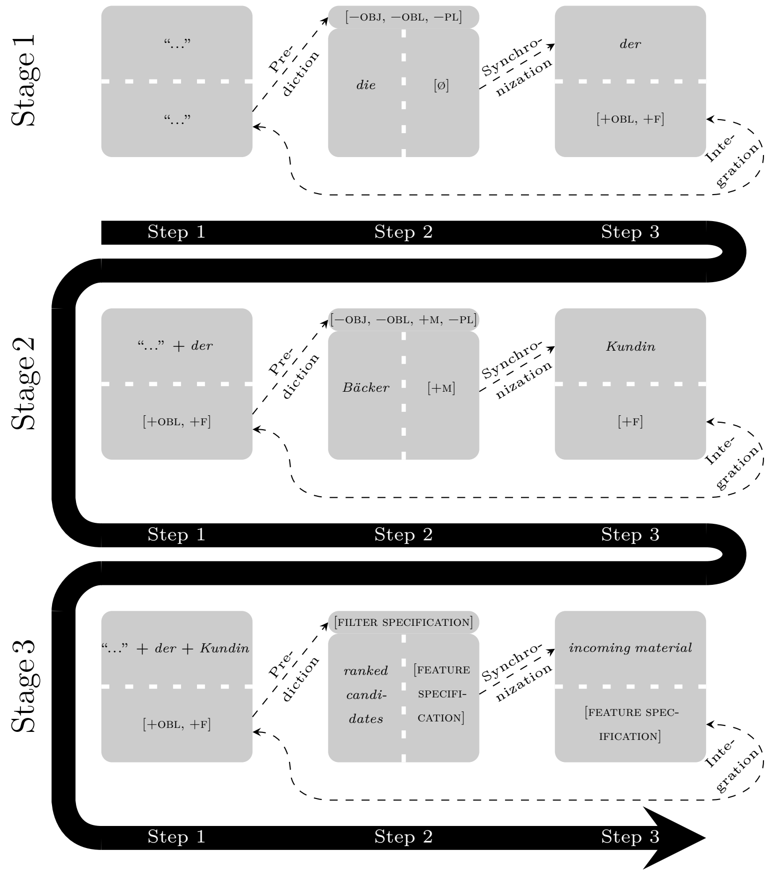


Figure B.16: Combining current and incoming material: *der* and *Kundin* equals [+OBL, +F].

Continuing Stage 2, Step 3's compatibility route By continuing the compatibility route from Stage 2, Step 3 in Paragraph B.2.1.4.2.2, TMP will combine the specifications of the SP$_{\text{NOM}}$, *hat* and *der* with the one of *Kundin*. That is the sum of [−OBJ, −OBL, +M, −PL] and [+F] which equals [−OBJ, −OBL, +M, +F, −PL]. This is only possible if one assumes that both feature bundles are mutually compatible and can thus be added up. Figure B.17 shows how this feature bundle can now enter the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

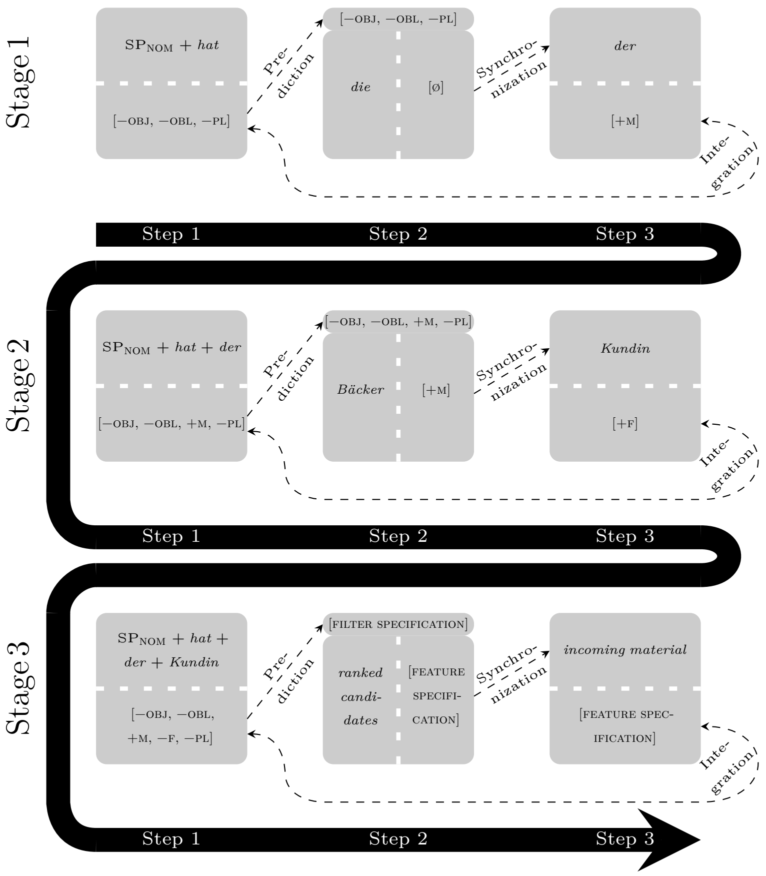


Figure B.17: Combining current and incoming material: SP_{NOM}, *hat*, *der* and *Kundin* equals [−OBJ, −OBL, +M, +F, −PL].

The combination of SP_{NOM} + *hat* + $\textit{der}_{\text{NOM.M.SG}}$ $\textit{Kundin}_{\text{NOM/ACC/DAT/GEN.F.SG}}$ yields, however, an illicit combination since there is no way to combine a masculine determiner with a feminine noun in order to realize a grammatical subject in nominative case.

B.2.1.4.3 Parsing *den Bäcker* The DP *den Bäcker* from (80c) shall be parsed. It is the first clause-medial syntactic argument of sentence (c) from Table 4.1 and thus part of the sentence *Gestern hat den Bäcker der Konditor gesehen* ("Yesterday, the confectioner saw the baker"). The DP's conclusive parse will be illustrated in Figure B.18.

The DP in (80c) shall be parsed: *den Bäcker*. It is the first clause-medial syntactic argument of sentence (c) from Table 4.1: *Gestern hat den Bäcker der Konditor gesehen* ("Yesterday, the confectioner saw the baker"). The entire parse will be illustrated in Figure B.18.

B.2.1.4.3.1 Stage 1: SP_{NOM} + *hat* → *den*

Steps 1–2 At this point, Steps 1–2 parallel Steps 1–2 from Stage 1 in Paragraph B.2.1.4.1.1 since the material is identical. The SP_{NOM} + *hat* provide the feature specification for Step 2 via the Prediction process.

Step 3 The determiner *den* enters the system as newly incoming material. It is assumed that TMP simply "sees" *den* initially without any specification. In order to assign a specification and eventually integrate *den*, two operations are required: Firstly, TMP has to adopt *den* instead of the predicted $das_{\text{NOM/ACC.N.SG}}$. This means that the top-ranked candidate of $das_{\text{NOM/ACC.N.SG}}$ has to be replaced by an alternative of *den*. Secondly, the incoming material of *den* has to be associated with its respective feature specification. This means that the syncretism between $den_{\text{ACC.M.SG}}$ and $den_{\text{DAT.PL}}$ has to be resolved. Synchronization handles these issues. In order to adopt *den*, TMP has to search the ranked candidates from the second step. The list in Table B.14 provides two alternatives, namely the higher ranked $den_{\text{ACC.M.SG}}$ and lower ranked $den_{\text{DAT.PL}}$. Again, TMP's bias toward minimal featural deviance comes into effect. Therefore, in order to ensure lower featural deviance, TMP selects the next higher ranked candidate that matches the form of *den*. As shown in Table B.14, $den_{\text{ACC.M.SG}}$ with its features of [+OBJ, +M] has precedence over the syncretic $den_{\text{DAT.PL}}$ which carries [+OBJ, +OBL]. It is *simpler* for TMP to synchronize a less incompatible specification with a retrievable feature—namely [+OBJ, +M]—with the incoming *den* at the third step than three features that are maximally incompatible with the feature specification—namely [+OBJ, +OBL]. That is why *den* will be associated with [+OBJ, +M].

Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. With *den* as incoming material, the selection of an incompatibly ranked candidate was necessary. This particular ranked candidate provides a feature that is incompatible with the feature specification—namely *den*'s [+OBJ]. This means that $den_{\text{ACC.M.SG}}$ with its features of [+OBJ, +M] opposes the current material's specification. The language processing system cannot change the input but the initial analysis of the current material and its specification. This necessitates reanalysis. Selecting the other alternative of *den*—$den_{\text{DAT.PL}}$ which carries [+OBJ, +OBL]—would not be effective since it is even more incompatible with the current material's specification. The only way to maintain processing is by abandoning the SP_{NOM}.

Deleting the SP_{NOM} and its specification within the Integration process renders the feature specification and the order of the ranked candidates for the determiners no longer applicable. By restarting with a clean slate, $den_{\text{ACC.M.SG}}$ no longer provides incompatible features to any specification.

In the current case of the integration of *den* in the accusative masculine singular alternative, the current material's feature set that is now empty will thus be combined with the incoming material's specification of [+OBJ, +M]. They will eventually be fed into the next parsing stage.

After the SP_{NOM} and its specification have been deleted, the sum of virtually nothing and *den*'s [+OBJ, +M] equals [+OBJ, +M]. This feature bundle can now be used for the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

B.2.1.4.3.2 Stage 2: "..." + *den* → *Bäcker*

Step 1 The first step here is identical to the outcome of Step 3 from Paragraph B.2.1.4.3.1. The current material and its specification are the combination of virtually nothing with *den*'s [+OBJ, +M]. This bundle will be inserted into the current material slot and its specification respectively. The Prediction process originates unidirectionally from the current material's specification. Transitioning to Step 2, the feature specification of the current material acts like a filter for possible continuations due to TMP's minimality-driven bias to maintain features. Thus, [+OBJ, +M] was the current material's specification and is maintained in the filter specification.

Step 2 Ranked candidates are derived following the integration of *den* and thoroughly given in Table B.16. The noun *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ is the top-ranked candidate while others are still part of the list. How TMP adopts the top-ranked *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ will be explained for the third step of the parsing along with the Synchronization process.

Table B.16: Ranked noun candidates after *den*$_{\text{ACC.M.SG}}$.

rank	filter specification: [+OBJ, +M] (by current material's *den*$_{\text{ACC.M.SG}}$)		↯	🔍−		🔍+
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	0	1
2.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	1	2	1
	Kundin$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	2	1	0
3.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	2	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	2	1	0
4.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	1	1	2	1

Step 3 The noun *Bäcker* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäcker* initially without any specification. In order to assign a specification and eventually integrate *Bäcker*, TMP can use the top-ranked candidate. As shown in Table B.16, *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$ with its feature of [+M] has precedence over the syncretic *Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$ which carries [+PL]. It is *simpler* for TMP to synchronize just one feature that is retrievable—namely [+M]—with the incoming *Bäcker* at the third step than a specification that is partially incompatible with the feature specification—namely [+PL]. That is why *Bäcker* will be associated with [+M] and not with [+PL].

For the integration of *Bäcker* in the nominative/accusative/dative masculine singular alternative, the current material's specification [+OBJ, +M] will thus be combined with the incoming material's specification [+M]. They will be fed into the first step at Stage 3, eventually concluding the parse.

B.2.1.4.3.3 Stage 3: Conclusion

The sum of the features of "...", *den* and *Bäcker* equals [+OBJ, +M]. This is only possible since both feature bundles are mutually compatible and can thus be added up.

As depicted in Figure B.18, this feature bundle can now be fed into the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

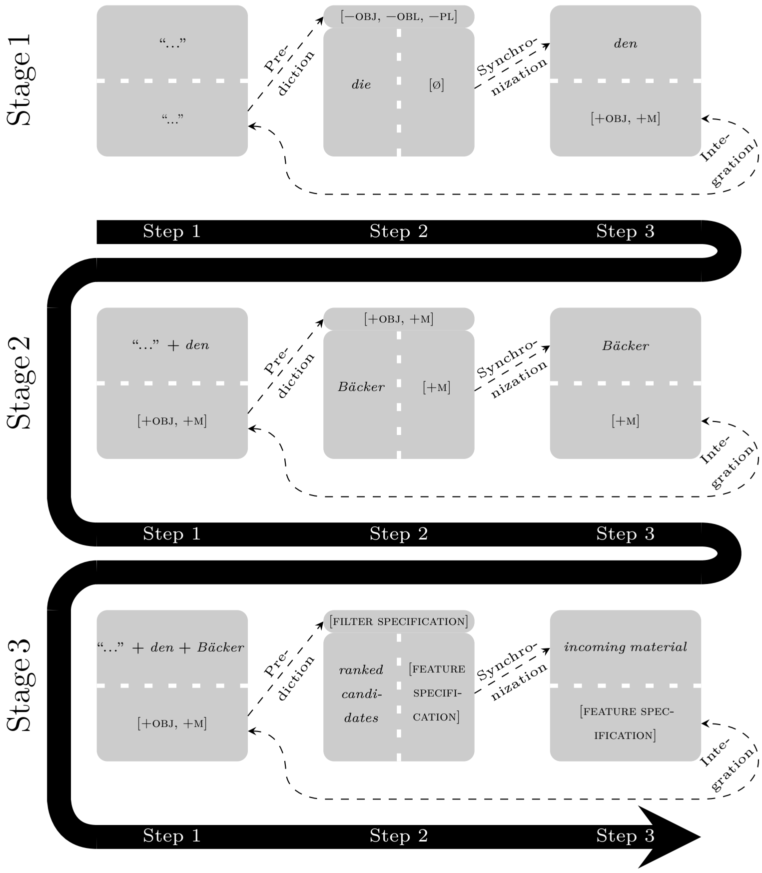


Figure B.18: Combining current and incoming material: "...", *den* and *Bäcker* equals [+OBJ, +M].

B.2.1.4.4 Parsing *den Bäckern*

The DP *den Bäckern* from (80d) shall be parsed. It is the first clause-medial syntactic argument of sentence (d) from Table 4.1 and thus part of the sentence *Gestern hat den Bäckern der Konditor geholfen* ("Yesterday, the confectioner helped the bakers"). The DP's conclusive parse will be illustrated in Figures B.19 and B.20.

B.2.1.4.4.1 Stage 1: SP_{NOM} + *hat* → *den*

At this point, Steps 1–3 parallel Stage 1 in Paragraph B.2.1.4.3.1 since the material is identical. The SP_{NOM} + *hat* provide the feature specification for Step 2 via the Prediction process. Subsequently, the ranked candidates are derived. In Step 3, the incoming *den* is synchronized and integrated.

B.2.1.4.4.2 Stage 2: *"..."* + *den* → *Bäckern*

Steps 1–2 At this point, Steps 1-2 parallel Steps 1–2 from Stage 2 in Paragraph B.2.1.4.3.2 since the material is identical. The SP_{NOM} + *hat* + *den* provide the feature specification for Step 2 via the Prediction process.

Step 3 The noun *Bäckern* enters the system as newly incoming material. It is assumed that TMP simply "sees" *Bäckern* initially without any specification. In order to assign a specification and eventually integrate *Bäckern*, two operations are required: Firstly, TMP has to adopt *Bäckern* instead of the predicted $Bäcker_{NOM/ACC/DAT.M.SG}$. This means that the top-ranked candidate of $Bäcker_{NOM/ACC/DAT.M.SG}$ has to be replaced by *Bäckern*. Secondly, the incoming material of *Bäckern* has to be associated with its respective feature specification. In order to adopt *Bäckern*, TMP has to search the ranked candidates from the second step. The list provides $Bäckern_{DAT.PL}$. No other candidate is available. Therefore, TMP synchronizes [+OBJ, +OBL, +PL] with the incoming *Bäckern* at the third step.

Finally, the incoming material has to be integrated into the current material in order to proceed to the next parsing step. Now, two continuations are conceivable: The [+OBJ, +OBL, +PL] of *Bäckern* can either be treated as being incompatible or compatible with the feature specification of [+OBJ, +M]. Both alternatives will be discussed in the following two paragraphs and enfolded in Paragraph B.2.1.4.4.3.

Step 3's incompatibility route Pursuing the route of incompatibility, one would have to derive the incompatibility by Wiese's exclusion of a specification that carries both [+M] and [+PL]. With *Bäckern* as incoming material, the selection of an incompatibly ranked candidate would then be necessary. This particular ranked candidate would provide a feature that is incompatible with the feature specification—namely *Bäckern*'s [+PL]. This would mean that $Bäckern_{DAT.PL}$ with its feature of [+PL] would oppose the current material's specification that carries [+M]. The language processing system cannot change the input but the initial analysis of the current material and its specification. Therefore, reanalysis becomes necessary. Selecting another alternative of *Bäckern* would not be effective since there is none. The only way to maintain processing is by abandoning the integration of *den* as $den_{ACC.M.SG}$ in the previous parsing stage. Since the SP_{NOM} has already been deleted when *den* instead of *der* had to be integrated, the other syncretic alternative of *den*, that is $den_{DAT.PL}$ which carries [+OBJ, +OBL], can be synchronized right away.

This, however, also overwrites the contents of the first step of the subsequent parsing stage which would once again render the feature specification and the order of the ranked candidates for the nouns at Step 2 no longer applicable. By restarting with a clean slate, $Bäckern_{DAT.PL}$'s [+OBJ, +OBL, +PL] at Step 3 no longer provide incompatible features to the current material's specification with [+OBJ, +OBL] of Step 1. The current material's feature set of [+OBJ, +OBL] will thus be combined with the incoming material's specification [+OBJ, +OBL, +PL]. They will eventually be fed into the next parsing step at Stage 3. The parse will be concluded in Paragraph B.2.1.4.4.3.

Step 3's compatibility route Pursuing the route of compatibility, which is that the [+PL] of *Bäckern* would be compatible with the feature specification of [+OBJ, +M], one would have to disregard the possible incompatibility between [+M] and [+PL] and assume that they are mutually compatible instead. For the integration of *Bäckern* in the dative plural alternative, the current material's feature set of [+OBJ, +M] will thus be combined with the incoming material's specification [+OBJ, +OBL, +PL]. They will eventually be fed into the next parsing step at Stage 3. The parse will be concluded in Paragraph B.2.1.4.4.3.

B.2.1.4.4.3 Stage 3: Conclusion

Continuing Stage 2, Step 3's incompatibility route By continuing the incompatibility route from Stage 2, Step 3 in Paragraph B.2.1.4.4.2, TMP will now combine the specifications of the reanalyzed *den* with the one of *Bäckern* after the SP_{NOM} and its specification have been abandoned. That is the sum of [+OBJ, +OBL] and [+OBJ, +OBL, +PL] which equals [+OBJ, +OBL, +PL]. Figure B.19 shows that this feature bundle can now be used for the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

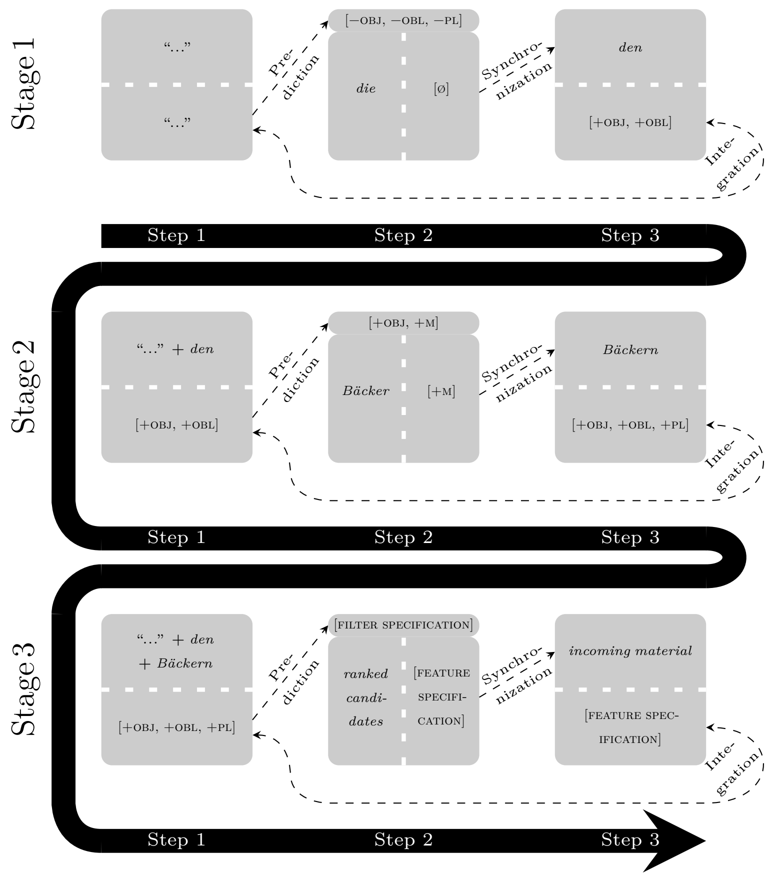


Figure B.19: Combining current and incoming material: *den* and *Bäckern* equals [+OBJ, +OBL, +PL].

Continuing Stage 2, Step 3's compatibility route By continuing the compatibility route from Stage 2, Step 3 in Paragraph B.2.1.4.2.2, TMP will combine the specifications of "..." and *den* with the one of *Bäckern*. That is the sum of [+OBJ, +M] and [+OBJ, +OBL, +PL] which equals [+OBJ, +OBL, +M, +PL]. This is only possible if one assumes that both feature bundles are mutually compatible and can thus be added up. As shown in Figure B.20, this feature bundle can now enter the next parsing stage's Step 1 where the entire process starts over again for the next ranked candidates and incoming material at Steps 2 and 3 respectively.

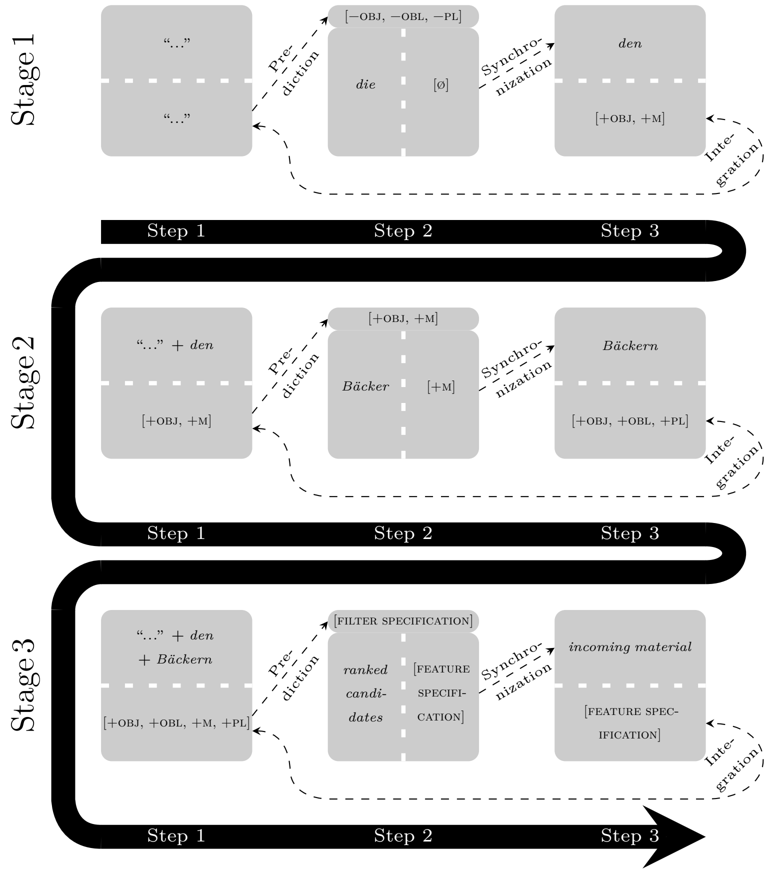


Figure B.20: Combining current and incoming material: "...", *den* and *Bäckern* equals [+OBJ, +OBL, +M, +PL].

The combination of "..." + *den* + *Bäckern* yields, however, an illicit combination since there is no way to combine a masculine singular determiner with a plural noun in order to realize a grammatical object in accusative case.

B.2.2 Parsing with no prior SP_{NOM}

Self-evidently, the three-element DPs from (80) also have to be tested by TMP without an a priori assumed SP_{NOM}. This section will allow to further strengthen the claim that no explicit SP_{NOM} features are necessary in order for TMP to predict an integrate grammatical structures.

B.2.2.1 Using Blevins' original features

B.2.2.1.1 Determiner position Table B.17 shows the rankings of the determiner candidates in the absence of an SP_{NOM} filter specification. It reveals that *der* in its dative feminine singular alternative is preferably predicted in comparison to the nominative masculine singular alternative. Furthermore, *den*$_{\text{DAT.PL}}$ ranks above *den*$_{\text{ACC.M.SG}}$. This means that for both the DPs in (80a–80b), *der* will be integrated in its dative feminine singular alternative while for (80c–80d), *den* will be integrated in its dative plural alternative. In addition to that, since there is no SP_{NOM}, none of the determiner candidates can introduce opposing features. Thus, no prior analysis has to be abandoned regardless of the determiner input.

Table B.17: Ranked determiner candidates after no SP_{NOM}.

rank	filter specification: [Ø] (by current material's lack of an SP_{NOM})		⚡	🔍−		🔍+
	determiner	specification		⇒	⇐	
1.	*die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[Ø]	0	0	0	0
2.	*der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL]	0	0	1	0
3.	*das*$_{\text{NOM/ACC.N.SG}}$	[−OBL, −F]	0	0	2	0
	des$_{\text{GEN.M/N.SG}}$	[+OBL, −F]	0	0	2	0
4.	*der*$_{\text{NOM.M.SG}}$	[−OBL, +M, −F]	0	0	3	0
	dem$_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL, −F]	0	0	3	0
	den$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	3	0
5.	*den*$_{\text{ACC.M.SG}}$	[+OBJ, −OBL, +M, −F]	0	0	4	0

B.2.2.1.2 Noun position Following the integration of *der* as *der*$_{\text{DAT.F.SG}}$ in (80a–80b) with its [+OBL] feature that acts as the filter specification, Table B.18 shows the ranked noun continuations. It exhibits TMP's preference to predict either *Bäckern*$_{\text{DAT.PL}}$ or *Bäckers*$_{\text{GEN.M.SG}}$ after *der*$_{\text{NOM.M.SG}}$ and not *Bäcker*$_{\text{NOM.M.SG}}$, *Bäcker*$_{\text{ACC.M.SG}}$ or *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$.

In case of the integration of *den* as *den*$_{\text{DAT.PL}}$ in (80c–80d) with its [+OBJ, +OBL, +PL] features that act as the filter specification, Table B.19 shows the ranked noun continuations. It exhibits TMP's preference to predict *Bäckern*$_{\text{DAT.PL}}$ after *den*$_{\text{DAT.PL}}$ and not *Bäcker*$_{\text{NOM/ACC.M/DAT.SG}}$:

B.2.2.2 Using Blevins' maximally underspecified features

B.2.2.2.1 Determiner position Table B.20 shows the rankings of the determiner candidates in the absence of an SP_{NOM} filter specification. It reveals that *der* in its dative feminine singular alternative is preferably predicted in comparison to the nominative masculine singular alternative. Furthermore, *den*$_{\text{DAT.PL}}$ ranks above *den*$_{\text{ACC.M.SG}}$.

Table B.18: Ranked noun candidates after *der*$_{\text{DAT.F.SG}}$.

rank	filter specification: [+OBL] (by current material's *der*$_{\text{DAT.F.SG}}$) noun	specification	⚡	🔍− ⇒	🔍− ⇐	🔍+
1.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	2	1
	Bäckers$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	0	0	2	1
2.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	1	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	1	1	0
3.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M, −F]	0	1	2	0
	Kundin$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[−M, +F]	0	1	2	0

Table B.19: Ranked noun candidates after *den*$_{\text{DAT.PL}}$.

rank	filter specification: [+OBJ, +OBL, +PL] (by current material's *den*$_{\text{DAT.PL}}$) noun	specification	⚡	🔍− ⇒	🔍− ⇐	🔍+
1.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	0	3
2.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	2	0	1
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	2	0	1
3.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M, −F]	0	3	2	0
	Kundin$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[−M, +F]	0	3	2	0
4.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	1	2	2	1

This means that for both the DPs in (80a–80b), *der* will be integrated in its dative feminine singular alternative while for (80c–80d), *den* will be integrated in its dative plural alternative. Furthermore, since there is no filter specification, none of the determiner candidates can introduce incompatible features. Thus, no prior analysis has to be abandoned regardless of the determiner input.

B.2.2.2.2 Noun position In the case of the integration of *der* as *der*$_{\text{DAT.F.SG}}$ in (80a–80b) with its [+OBL] feature that acts as the filter specification, Table B.21 shows the ranked noun continuations. It exhibits TMP's preference to predict either *Bäckern*$_{\text{DAT.PL}}$ or *Bäckers*$_{\text{GEN.M.SG}}$ after *der*$_{\text{NOM.M.SG}}$ and not *Bäcker*$_{\text{NOM.M.SG}}$, *Bäcker*$_{\text{ACC.M.SG}}$ or *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$.

Following the integration of *den* as *den*$_{\text{DAT.PL}}$ in (80c–80d) with its [+OBJ, +OBL, +PL] features that act as the filter specification, Table B.22 shows the ranked noun continuations. It exhibits TMP's preference to predict *Bäckern*$_{\text{DAT.PL}}$ after *den*$_{\text{DAT.PL}}$ and not *Bäcker*$_{\text{NOM/ACC.M/DAT.SG}}$.

Table B.20: Ranked determiner candidates after no SP$_{\text{NOM}}$.

rank	filter specification: [Ø] (by current material's lack of an SP$_{\text{NOM}}$)		⚡	🔍−		🔍+
	determiner	specification		⇒	⇐	
1.	*die*$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[Ø]	0	0	0	0
2.	*das*$_{\text{NOM/ACC.N.SG}}$	[−F]	0	0	1	0
	der$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL]	0	0	1	0
3.	*der*$_{\text{NOM.M.SG}}$	[+M, −F]	0	0	2	0
	des$_{\text{GEN.M/N.SG}}$	[+OBL, −F]	0	0	2	0
4.	*dem*$_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL, −F]	0	0	3	0
	den$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	3	0
5.	*den*$_{\text{ACC.M.SG}}$	[+OBJ, −OBL, +M, −F]	0	0	4	0

Table B.21: Ranked noun candidates after *der*$_{\text{DAT.F.SG}}$.

rank	filter specification: [+OBL] (by current material's *der*$_{\text{DAT.F.SG}}$)		⚡	🔍−		🔍+
	noun	specification		⇒	⇐	
1.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	2	1
	Bäckers$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	0	0	2	1
2.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	1	0
	Kundin$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	1	1	0
	Bäcker$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	1	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	1	1	0

Table B.22: Ranked noun candidates after *den*$_{\text{DAT.PL}}$.

rank	filter specification: [+OBJ, +OBL, +PL] (by current material's *den*$_{\text{DAT.PL}}$)		⚡	🔍−		🔍+
	noun	specification		⇒	⇐	
1.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	0	3
2.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	2	0	1
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	2	0	1
3.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M, −F]	0	3	2	0
	Kundin$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[−M, +F]	0	3	2	0
4.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	1	2	2	1

B.2.2.3 Using Wunderlich's features

B.2.2.3.1 Determiner position Table B.23 shows the rankings of the determiner candidates in the absence of an SP$_{\text{NOM}}$ filter specification. It reveals that *der* in its nominative masculine singular alternative is preferably predicted in comparison to the dative feminine singular alternative. Furthermore, *den*$_{\text{ACC.M.SG}}$ ranks above *den*$_{\text{DAT.PL}}$. This means that for both the DPs in (80a–80b), *der* will be integrated in its nominative masculine singular alternative while for (80c–80d), *den* will be integrated in its accusative masculine singular alternative. Moreover, since there is no SP$_{\text{NOM}}$, none of the determiner candidates can introduce opposing features. Thus, no prior analysis has to be abandoned regardless of the determiner input.

Table B.23: Ranked determiner candidates after no SP$_{\text{NOM}}$.

rank	filter specification: [Ø] (by current material's lack of an SP$_{\text{NOM}}$)		⚡	🔍−		🔍+
	determiner	specification		⇒	⇐	
1.	*das*$_{\text{NOM/ACC.N.SG}}$	[Ø]	0	0	0	0
2.	*der*$_{\text{NOM.M.SG}}$	[+M]	0	0	1	0
	die$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[+PL ∨ +F]	0	0	1	0
	den$_{\text{ACC.M.SG}}$	[+HR, +M]	0	0	2	0
4.	*des*$_{\text{GEN.M/N.SG}}$	[+HR, +N]	0	0	2	0
	dem$_{\text{DAT.M/N.SG}}$	[+HR, +LR]	0	0	2	0
5.	*der*$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+HR, [+LR ∨ +N], [+PL ∨ +F]]	0	0	3	0
6.	*den*$_{\text{DAT.PL}}$	[+HR, +LR, +PL, [+PL ∨ +F]]	0	0	4	0

B.2.2.3.2 Noun position Following the integration of *der* as *der*$_{\text{NOM.M.SG}}$ in (80a–80b) with its [+M] feature that acts as the filter specification, Table B.24 shows the ranked noun continuations. It exhibits TMP's preference to predict *Bäcker*$_{\text{NOM/ACC.M/DAT.SG}}$ after *der*$_{\text{NOM.M.SG}}$ and not *Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$. Furthermore, notice that, similar to the ranking of a present SP$_{\text{NOM}}$, none of the target candidates provides features that are incompatible with the filter specification. In the relevant Stages 2 and 3 of Paragraphs B.2.1.3.2.2 to B.2.1.3.2.3, for *Kundin*, both a compatibility and an incompatibility route were calculated. The latter case assumed a categorical incompatibility between the filter specification's [+M] and *Kundin*'s [+F]. The same scenario is applicable for the current case of a lacking SP$_{\text{NOM}}$: *Kundin* still provides [+F] which may be incompatible with the [+M] feature of the filter specification.

In case of the integration of *den* as *den*$_{\text{ACC.M.SG}}$ in (80c–80d) with its [+HR, +M] features that act as the filter specification, Table B.25 shows the ranked noun continuations. It exhibits TMP's preference to predict *Bäcker*$_{\text{NOM/ACC.M/DAT.SG}}$ after *den*$_{\text{ACC.M.SG}}$ and not *Bäckern*$_{\text{DAT.PL}}$. In addition, notice again that, similar to the ranking of a present SP$_{\text{NOM}}$, none of the target candidates provides features that are incompatible with the filter specification. In the appropriate Stages 2 and 3 of Paragraphs B.2.1.3.4.2 to B.2.1.3.4.3, for *Bäckern*, both a compatibility and an incompatibility route were calculated. Similarly, the latter case assumed a categorical incompatibility between the filter specification's [+M] and *Bäckern*'s [+PL]. Therefore, the same pattern occurs for the present case of a non-present SP$_{\text{NOM}}$ filter specification: *Bäckern* still carries [+PL] which may be incompatible with the [+M] feature of the filter specification.

Table B.24: Ranked noun candidates after *der*$_{\text{NOM.M.SG}}$.

rank	filter specification: [+M] (by current material's *der*$_{\text{NOM.M.SG}}$)		⚡	🔍−		🔍+
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	0	0	1
2.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+M, +PL]	0	0	1	1
	Bäckers$_{\text{GEN.M.SG}}$	[+N, +M]	0	0	1	1
3.	*Bäckern*$_{\text{DAT.PL}}$	[+LR, +M, +PL]	0	0	2	1
4.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	1	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	1	1	0

Table B.25: Ranked noun candidates after *der*$_{\text{NOM.M.SG}}$.

rank	filter specification: [+HR, +M] (by current material's *den*$_{\text{ACC.M.SG}}$)		⚡	🔍−		🔍+
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	0	1
2.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+M, +PL]	0	1	1	1
	Bäckers$_{\text{GEN.M.SG}}$	[+N, +M]	0	1	1	1
3.	*Bäckern*$_{\text{DAT.PL}}$	[+LR, +M, +PL]	0	1	2	0
4.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	2	1	0
5.	*Kundinnen*$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	2	1	0

B.2.2.4 Using Wiese's features

B.2.2.4.1 Determiner position Table B.26 shows the rankings of the determiner candidates in the absence of an SP$_{\text{NOM}}$ filter specification. It reveals that *der* both in its nominative masculine singular as well as in its genitive plural alternative are equally preferably predicted. It further shows that both *den*$_{\text{ACC.M.SG}}$ and *den*$_{\text{DAT.PL}}$ are also equally preferably predicted. This means that for both the DPs in (80a–80b), *der* will either be integrated in its nominative masculine singular or genitive plural alternative while for (80c–80d), *den* will either be integrated in its accusative masculine singular or in its dative plural alternative. Also, since there is no filter specification, none of the determiner candidates can introduce incompatible features. Thus, no prior analysis has to be abandoned regardless of the determiner input.

Table B.26: Ranked determiner candidates after no SP_{NOM}.

rank	filter specification: [Ø] (by current material's lack of an SP_{NOM})		⚡	🔍−		🔍+
	determiner	specification		⇒	⇐	
1.	$die_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[Ø]	0	0	0	0
2.	$der_{\text{NOM.M.SG}}$	[+M]	0	0	1	0
	$der_{\text{GEN.PL}}$	[+OBL]	0	0	1	0
3.	$das_{\text{NOM/ACC.N.SG}}$	[+M, +F]	0	0	2	0
	$den_{\text{ACC.M.SG}}$	[+OBJ, +M]	0	0	2	0
	$des_{\text{GEN.M/N.SG}}$	[+OBL, +M]	0	0	2	0
	$der_{\text{DAT/GEN.F.SG}}$	[+OBL +F]	0	0	2	0
	$den_{\text{DAT.PL}}$	[+OBJ, +OBL]	0	0	2	0
4.	$dem_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL, +M]	0	0	3	0

B.2.2.4.2 Noun position Following the integration of *der* as $der_{\text{NOM.M.SG}}$ in (80a–80b) with its [+M] feature that acts as the filter specification, Table B.27 shows the ranked noun continuations. It exhibits TMP's preference to predict $Bäcker_{\text{NOM/ACC.M/DAT.SG}}$ after $der_{\text{NOM.M.SG}}$ and not $Kundin_{\text{NOM/ACC/DAT/GEN.F.SG}}$. Additionally, notice that, similar to the ranking of a present SP_{NOM}, none of the target candidates provides features that are incompatible with the filter specification. In Stages 2 and 3 of Paragraphs B.2.1.4.2.2 to B.2.1.4.2.3, for *Kundin*, both a compatibility and an incompatibility route were calculated. The latter case assumed a categorical incompatibility between the filter specification's [+M] and *Kundin*'s [+F]. The same scenario is applicable for the current case of a lacking SP_{NOM}: *Kundin* still provides [+F] which may be incompatible with the [+M] feature of the filter specification.

In case of the integration of *der* as $der_{\text{GEN.PL}}$ with its [+OBL] feature that acts as the filter specification, Table B.28 shows the ranked noun continuations. It exhibits TMP's preference to predict $Bäckern_{\text{DAT.PL}}$ after $der_{\text{GEN.PL}}$.

Following the integration of *den* as $den_{\text{ACC.M.SG}}$ in (80c–80d) with its [+OBJ, +M] features that act as the filter specification, Table B.29 shows the ranked noun continuations. It exhibits TMP's preference to predict $Bäcker_{\text{NOM/ACC.M/DAT.SG}}$ after $den_{\text{ACC.M.SG}}$ and not $Bäckern_{\text{DAT.PL}}$.

In case of the integration of *den* as $den_{\text{DAT.PL}}$ with its [+OBJ, +OBL] features that act as the filter specification, Table B.30 shows the ranked noun continuations. It exhibits

TMP's preference to predict *Bäcker*$_{\text{NOM/ACC.M/DAT.SG}}$ after *den*$_{\text{ACC.M.SG}}$ and not *Bäckern*$_{\text{DAT.PL}}$. Furthermore, notice again that, similar to the ranking of a present SP_{NOM}, none of the target candidates provides features that are incompatible with the filter specification. In Stages 2 and 3 of Paragraphs B.2.1.4.4.2 to B.2.1.4.4.3, for *Bäckern*, both a compatibility and an incompatibility route were calculated. Similarly, the latter case assumed a categorical incompatibility between the filter specification's [+M] and *Bäckern*'s [+PL]. Therefore, the same pattern occurs for the present case of a non-present SP_{NOM} filter specification: *Bäckern* still carries [+PL] which may be incompatible with the [+M] feature of the filter specification.

Table B.27: Ranked noun candidates after *der*$_{\text{NOM.M.SG}}$.

rank	filter specification: [+M] (by current material's *der*$_{\text{NOM.M.SG}}$)		ϟ	⊖		⊕
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	0	0	1
2.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	0	0	2	1
3.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	1	1	0
	Kundin$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	1	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	1	1	0
4.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	1	3	0

Table B.28: Ranked noun candidates after *der*$_{\text{GEN.PL}}$.

rank	filter specification: [+OBL] (by current material's *der*$_{\text{GEN.PL}}$)		ϟ	⊖		⊕
	noun	specification		⇒	⇐	
1.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	2	1
	Bäckers$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	0	0	2	1
2.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	1	0
	Kundin$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	1	1	0
	Bäcker$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	1	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	1	1	0

Table B.29: Ranked noun candidates after *den*$_{\text{ACC.M.SG}}$.

rank	filter specification: [+OBJ, +M] (by current material's *den*$_{\text{ACC.M.SG}}$) noun	specification	⚡	🔍− ⇒	🔍− ⇐	🔍+
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	0	1
2.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	1	2	1
3.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	2	1	0
	Kundin$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	2	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	2	1	0
4.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	1	1	2	1

Table B.30: Ranked noun candidates after *den*$_{\text{ACC.M.SG}}$.

rank	filter specification: [+OBJ, +OBL] (by current material's *den*$_{\text{DAT.PL}}$) noun	specification	⚡	🔍− ⇒	🔍− ⇐	🔍+
1.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	1	2
2.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	2	1	0
	Bäcker$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	2	1	0
	Kundin$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	2	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	2	1	0
3.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	1	1	2	2

C Feeding TMP with Grammatical Three-Element DPs

This chapter of the appendix continues the three-element analyses which have been initiated in Section 8.1.2. The DPs under investigation are repeated here in (81). In particular, it will lay out the parsing calculations for Bierwisch's approach without a preceding SP$_{\text{NOM}}$ filter specification.

(81)	a.	der	kleine	Bäcker
		the.NOM.M, DAT.F	small.NOM.M, NOM/ACC.N/F	baker.NOM.M
	b.	der	kleinen	Kundin
		the.NOM.M, DAT.F	small.ACC.M, DAT, GEN, PL	customer.DAT.F
	c.	den	kleinen	Bäcker
		the.ACC.M, DAT.PL	small.ACC.M, DAT, GEN, PL	baker.ACC.M
	d.	den	kleinen	Bäckern
		the.ACC.M, DAT.PL	small.ACC.M, DAT, GEN, PL	bakers.DAT.PL

This section will allow to further strengthen the claim that no explicit SP$_{\text{NOM}}$ features are necessary in order for TMP to predict an integrate grammatical structures.

C.1 Determiner Position

Since the determiner position of this investigation—*der*$_{\text{NOM.M.SG}}$, *der*$_{\text{DAT.F.SG}}$, *den*$_{\text{ACC.M.SG}}$ and *den*$_{\text{DAT.PL}}$—is identical with the initial analysis for Bierwisch's features in Section 5.2.2, the determiners here are ranked exactly as in Table 5.7.

C.2 Adjective Position

Following the integration of *der* as *der*$_{\text{NOM.M.SG}}$ in (81a–81b) with its [+M] feature that acts as the filter specification, Table C.1 shows the ranked adjective continuations. It exhibits TMP's preference to predict *kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$ after *der*$_{\text{NOM.M.SG}}$ and not *kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$. For the preceding integration of *den* as *den*$_{\text{ACC.M.SG}}$ in (81c–81d) with its [+OBJ, +M] features that act as the filter specification, Table C.2 shows the ranked adjective continuations. It exhibits TMP's preference to predict *kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$ after *den*$_{\text{ACC.M.SG}}$ and not *kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$.

Table C.1: Ranked adjective candidates after *der*$_{\text{NOM.M.SG}}$.

rank	filter specification: [+M] (by current material's *der*$_{\text{NOM.M.SG}}$)		ϟ	⊖		⊕
	adjective	specification		⇒	⇐	
1.	*kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[Ø]	0	1	0	0
2.	*kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$	[[+OBJ, +M] ∨ +OBL ∨ +PL]	0	3	3	1

Table C.2: Ranked adjective candidates after *den*$_{\text{ACC.M.SG}}$.

rank	filter specification: [+OBJ, +M] (by current material's *den*$_{\text{ACC.M.SG}}$)		ϟ	⊖		⊕
	adjective	specification		⇒	⇐	
1.	*kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$	[[+OBJ, +M] ∨ +OBL ∨ +PL]	0	0	2	2
2.	*kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[Ø]	0	2	0	0

C.3 Noun Position

For the third DP position, one has to look not only at the continuation after *kleine* versus *kleinen* but rather at the different filter specifications for the structures that have developed until the position under investigation. Since only the DP (81a) is the remaining structure to realize a nominative context after the adjective, the noun continuation of *kleine* after *der*$_{\text{NOM.M.SG}}$ has to be investigated.

Following the integration of *der kleine* in (81a) with its [−OBJ, −OBL, +M, −PL] features that act as the filter specification, Table C.3 shows the ranked noun continuations. It exhibits TMP's preference to predict *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$. For the preceding integration of *der kleinen* in (81b) with its [+OBL, +F] features that act as the filter specification, Table C.4 shows the ranked noun continuations. It exhibits TMP's preference to predict *Kundin*$_{\text{DAT.PL}}$. Finally, following the integration of *den kleinen* in (81c–81d) with its [+OBJ, +M] features that act as the filter specification, Table C.5 shows the ranked noun continuations. It exhibits TMP's preference to predict *Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$.

Table C.3: Ranked noun candidates after *der*$_{\text{NOM.M.SG}}$ + *kleine*$_{\text{NOM.M.SG, NOM/ACC.N.F.SG}}$.

rank	filter specification: [+M] (by current material's *der*$_{\text{NOM.M.SG}}$ *kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$)		⚡	zoom-out		zoom-in
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	0	0	1
2.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	0	0	2	1
	Kundin$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	1	1	0
3.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	1	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	1	1	0
4.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	1	3	0

Table C.4: Ranked noun candidates after *der*$_{\text{DAT.F.SG}}$ + *kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$.

rank	filter specification: [+OBL, +F] (by current material's *der*$_{\text{DAT.F.SG}}$ + *kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$)		⚡	zoom-out		zoom-in
	noun	specification		⇒	⇐	
1.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	1	0	1
2.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	1	1	2	0
3.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	1	2	1	0
4.	*Bäcker*$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	1	2	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	1	2	1	0
5.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	2	1	2	1

Table C.5: Ranked noun candidates after *den*$_{\text{ACC.M.SG}}$ + *kleinen*$_{\text{ACC.M.SG, DAT, EN, PL}}$.

rank	filter specification: [+OBJ, +M] (by current material's *den*$_{\text{ACC.M.SG}}$ + *kleinen*$_{\text{ACC.M.SG, DAT, GEN, PL}}$)		⚡	zoom-out		zoom-in
	noun	specification		⇒	⇐	
1.	*Bäcker*$_{\text{NOM/ACC/DAT.M.SG}}$	[+M]	0	1	0	1
2.	*Bäckern*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	1	2	1
	Bäcker$_{\text{NOM/ACC/GEN.M.PL}}$	[+PL]	0	2	1	0
3.	*Kundin*$_{\text{NOM/ACC/DAT/GEN.F.SG}}$	[+F]	0	2	1	0
	Kundinnen$_{\text{NOM/ACC/GEN.F.PL}}$	[+PL]	0	2	1	0
4.	*Bäckers*$_{\text{GEN.M.SG}}$	[−OBJ, +OBL, +M]	1	1	2	1

D Feeding TMP with Ungrammatical Three-Element DPs

This chapter of the appendix continues the three-element analyses which have been initiated in Section 9.1.1. The DPs under investigation are repeated here in (82). In particular, it will lay out the parsing calculations for Bierwisch's approach without a preceding SP_{NOM} filter specification.

(82)	a.	der	kleine	Bäcker
		the.NOM.M, DAT.F	small.NOM.M, NOM/ACC.N/F	baker.NOM.M
	b.	der	*kleine	Bäcker
		the.NOM.M, DAT.F	small.ACC.M, DAT, GEN, PL	baker.NOM.M
	c.	den	*kleine	Bäcker
		the.ACC.M, DAT.PL	small.ACC.M, DAT, GEN, PL	baker.NOM.M

This section will allow to further strengthen the claim that no explicit SP_{NOM} features are necessary in order for TMP to predict an integrate grammatical structures. However, again, as it was pointed out in Section 9.1.1, only the determiner and the subsequent adjective that introduces the ungrammaticality will be part of the investigation.

D.1 Determiner Position

Table D.1 shows the rankings of the determiner candidates in the absence of an SP_{NOM} filter specification. It reveals that *der* in its nominative masculine singular alternative is preferably predicted in comparison to the dative feminine singular alternative if not SP_{NOM} is assumed. Furthermore, $den_{ACC.M.SG}$ ranks above $den_{DAT.PL}$. The third relevant determiner—$dem_{DAT.M/N.SG}$—ranks below the aforementioned preferred *der* and *den* alternatives. This means that for the DP in (82a), *der* will be integrated in its nominative masculine singular, in (82b) *den* will be integrated in its accusative masculine singular variant while, in (82c), *dem* will be analyzed in its dative masculine/neuter singular alternative.

Table D.1: Ranked determiner candidates after no SP_{NOM}.

rank	filter specification: [Ø] (by current material's lack of an SP_{NOM})		⚡	🔍−		🔍+
	determiner	specification		⇒	⇐	
1.	*das*$_{\text{NOM/ACC.N.SG}}$	[Ø]	0	0	0	0
	der$_{\text{NOM.M.SG}}$	[+M]	0	0	1	0
2.	*des*$_{\text{GEN.M/N.SG}}$	[+OBL]	0	0	1	0
	die$_{\text{NOM/ACC.F.SG, NOM/ACC.PL}}$	[+PL ∨ +F]	0	0	1	0
	dem$_{\text{DAT.M/N.SG}}$	[+OBJ, +OBL]	0	0	2	0
3.	*den*$_{\text{ACC.M.SG}}$	[+OBJ, +M]	0	0	2	0
	der$_{\text{DAT/GEN.F.SG, GEN.PL}}$	[+OBL, [+PL ∨ +F]]	0	0	2	0
4.	*den*$_{\text{DAT.PL}}$	[+OBJ, +OBL, +PL]	0	0	3	0

D.2 Adjective Position

Following the integration of *der* as *der*$_{\text{NOM.M.SG}}$ in (82a) with its [+M] feature that acts as the filter specification, Table D.2 shows the ranked adjective continuations. It exhibits TMP's preference to predict *kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$ after *der*$_{\text{NOM.M.SG}}$ and not *kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$. For the preceding integration of *den* as *den*$_{\text{ACC.M.SG}}$ in (82b) with its [+OBJ, +M] features that act as the filter specification, Table D.3 shows the ranked adjective continuations. It exhibits TMP's preference to predict *kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$ after *den*$_{\text{ACC.M.SG}}$ and not *kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$. Finally for the integration of *dem* as *dem*$_{\text{DAT.M/N.SG}}$ in (82c) with its [+OBJ, +OBL] features that act as the filter specification, Table D.4 shows the ranked adjective continuations. It exhibits TMP's preference to predict *kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$ after *dem*$_{\text{DAT.M/N.SG}}$ and not *kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$.

Table D.2: Ranked adjective candidates after *der*$_{\text{NOM.M.SG}}$.

rank	filter specification: [+M] (by current material's *der*$_{\text{NOM.M.SG}}$)		⚡	🔍−		🔍+
	adjective	specification		⇒	⇐	
1.	*kleine*$_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[Ø]	0	1	0	0
2.	*kleinen*$_{\text{ACC.M.SG, DAT/GEN, PL}}$	[[+OBJ, +M] ∨ +OBL ∨ +PL]	0	3	3	1

Table D.3: Ranked adjective candidates after $\textit{den}_{\text{ACC.M.SG}}$.

rank	filter specification: [+OBJ, +M] (by current material's $\textit{den}_{\text{ACC.M.SG}}$)		⚡	🔍−		🔍+
	adjective	specification		⇒	⇐	
1.	$\textit{kleinen}_{\text{ACC.M.SG, DAT/GEN, PL}}$	[[+OBJ, +M] ∨ +OBL ∨ +PL]	0	0	2	2
2.	$\textit{kleine}_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[Ø]	0	2	0	0

Table D.4: Ranked adjective candidates after $\textit{dem}_{\text{DAT.M/N.SG}}$.

rank	filter specification: [+OBJ, +OBL] (by current material's $\textit{dem}_{\text{DAT.M/N.SG}}$ from prior step)		⚡	🔍−		🔍+
	adjective	specification		⇒	⇐	
1.	$\textit{kleinen}_{\text{ACC.M.SG, DAT/GEN, PL}}$	[[+OBJ, +M] ∨ +OBL ∨ +PL]	0	0	2	1
2.	$\textit{kleine}_{\text{NOM.M.SG, NOM/ACC.N/F.SG}}$	[Ø]	0	2	0	0

E Sentence Material

E.1 Experiment 1

1. Gestern hat der Bäcker aus Mainz den Konditor aus Kassel ausgelacht.
2. Gestern hat der Kundin aus Mainz der Konditor aus Kassel zugeflüstert.
3. Gestern hat den Bäcker aus Mainz der Konditor aus Hürth ausgelacht.
4. Gestern hat den Bäckern aus Mainz der Konditor aus Hürth zugeflüstert.
5. Neulich hat der Rentner aus Moskau den Bettler aus Minsk angelächelt.
6. Neulich hat der Russin aus Moskau der Bettler aus Minsk zugelächelt.
7. Neulich hat den Rentner aus Moskau der Bettler aus Grosny angelächelt.
8. Neulich hat den Rentnern aus Moskau der Bettler aus Grosny zugelächelt.
9. Beim Vortrag hat der Sprecher aus Oslo den Hörer aus Dover fixiert.
10. Beim Vortrag hat der Greisin aus Oslo der Hörer aus Dover gelauscht.
11. Beim Vortrag hat den Sprecher aus Oslo der Hörer aus Ashford fixiert.
12. Beim Vortrag hat den Sprechern aus Oslo der Hörer aus Ashford gelauscht.
13. Im Park hat der Gärtner aus Brighton den Butler aus York gegrüßt.
14. Im Park hat der Lady aus Brighton der Butler aus York gedient.
15. Im Park hat den Gärtner aus Brighton der Butler aus Cardiff gegrüßt.
16. Im Park hat den Gärtnern aus Brighton der Butler aus Cardiff gedient.
17. Gerade hat der Geiger aus Bern den Schneider aus Basel zurechtgewiesen.
18. Gerade hat der Diva aus Bern der Schneider aus Basel nachgegeben.
19. Gerade hat den Geiger aus Bern der Schneider aus Lausanne zurechtgewiesen.
20. Gerade hat den Geigern aus Bern der Schneider aus Lausanne nachgegeben.
21. Endlich hat der Kellner aus München den Gast aus Passau bewirtet.
22. Endlich hat der Wirtin aus München der Gast aus Passau gewinkt.
23. Endlich hat den Kellner aus München der Gast aus Freising bewirtet.
24. Endlich hat den Kellnern aus München der Gast aus Freising gewinkt.
25. Letztlich hat der Schmuggler aus Bodrum den Rentner aus İzmir getäuscht.
26. Letztlich hat der Türkin aus Bodrum der Rentner aus İzmir verziehen.
27. Letztlich hat den Schmuggler aus Bodrum der Rentner aus Bursa getäuscht.
28. Letztlich hat den Schmugglern aus Bodrum der Rentner aus Bursa verziehen.
29. Letztendlich hat der Kläger aus Köln den Richter aus Bonn beachtet.
30. Letztendlich hat der Schöffin aus Köln der Richter aus Bonn zugestimmt.
31. Letztendlich hat den Kläger aus Köln der Richter aus Duisburg beachtet.
32. Letztendlich hat den Klägern aus Köln der Richter aus Duisburg zugestimmt.
33. Alsbald hat der Täter aus Danzig den Anwalt aus Warschau kontaktiert.
34. Alsbald hat der Erbin aus Danzig der Anwalt aus Warschau geantwortet.

35. Alsbald hat den Täter aus Danzig der Anwalt aus Krakau kontaktiert.
36. Alsbald hat den Tätern aus Danzig der Anwalt aus Krakau geantwortet.
37. Am Montag hat der Maler aus Genf den Künstler aus Dijon angerufen.
38. Am Montag hat der Muse aus Genf der Künstler aus Dijon applaudiert.
39. Am Montag hat den Maler aus Genf der Künstler aus Mailand angerufen.
40. Am Montag hat den Malern aus Genf der Künstler aus Mailand applaudiert.
41. Im Hafen hat der Angler aus Jever den Fischer aus Emden getroffen.
42. Im Hafen hat der Friesin aus Jever der Fischer aus Emden nachgeschaut.
43. Im Hafen hat den Angler aus Jever der Fischer aus Lübeck getroffen.
44. Im Hafen hat den Anglern aus Jever der Fischer aus Lübeck nachgeschaut.
45. Inzwischen hat der Spitzel aus Langley den Freund aus London erspäht.
46. Inzwischen hat der Freundin aus Langley der Freund aus London verziehen.
47. Inzwischen hat den Spitzel aus Langley der Freund aus Cambridge erspäht.
48. Inzwischen hat den Spitzeln aus Langley der Freund aus Cambridge verziehen.
49. Im Sommer hat der Poet aus Dublin den Dichter aus Bristol besucht.
50. Im Sommer hat der Irin aus Dublin der Dichter aus Bristol geschrieben.
51. Im Sommer hat den Poet aus Dublin der Dichter aus Kingston besucht.
52. Im Sommer hat den Poeten aus Dublin der Dichter aus Kingston geschrieben.
53. Im Waisenhaus hat der Wärter aus Erfurt den Jüngling aus Jena geschlagen.
54. Im Waisenhaus hat der Tante aus Erfurt der Jüngling aus Jena zugewinkt.
55. Im Waisenhaus hat den Wärter aus Erfurt der Jüngling aus Weimar geschlagen.
56. Im Waisenhaus hat den Wärtern aus Erfurt der Jüngling aus Weimar zugewinkt.
57. Im Garten hat der Kumpel aus Gießen den Schwager aus Marburg unterhalten.
58. Im Garten hat der Nichte aus Gießen der Schwager aus Marburg vorgelesen.
59. Im Garten hat den Kumpel aus Gießen der Schwager aus Fulda unterhalten.
60. Im Garten hat den Kumpeln aus Gießen der Schwager aus Fulda vorgelesen.
61. Am Flughafen hat der Pförtner aus Frankfurt den Mörder aus Kusel überwältigt.
62. Am Flughafen hat der Geisel aus Frankfurt der Mörder aus Kusel gedroht.
63. Am Flughafen hat den Pförtner aus Frankfurt der Mörder aus Schwollen überwältigt.
64. Am Flughafen hat den Pförtnern aus Frankfurt der Mörder aus Schwollen gedroht.
65. Am Bahnhof hat der Schaffner aus Glasgow den Pendler aus Belfast begleitet.
66. Am Bahnhof hat der Schottin aus Glasgow der Pendler aus Belfast nachgesehen.
67. Am Bahnhof hat den Schaffner aus Glasgow der Pendler aus Bradford begleitet.
68. Am Bahnhof hat den Schaffnern aus Glasgow der Pendler aus Bradford nachgesehen.
69. Im Postamt hat der Leiter aus Metz den Zöllner aus Lyon getadelt.
70. Im Postamt hat der Botin aus Metz der Zöllner aus Lyon nachgestellt.
71. Im Postamt hat den Leiter aus Metz der Zöllner aus Marseille getadelt.
72. Im Postamt hat den Leitern aus Metz der Zöllner aus Marseille nachgestellt.
73. Im Spa hat der Schwimmer aus Madrid den Masseur aus Palma verletzt.
74. Im Spa hat der Dame aus Madrid der Masseur aus Palma nachgepfiffen.
75. Im Spa hat den Schwimmer aus Madrid der Masseur aus Cadiz verletzt.
76. Im Spa hat den Schwimmern aus Madrid der Masseur aus Cadiz nachgepfiffen.
77. Im Forsthaus hat der Förster aus Landshut den Jäger aus Erding beleidigt.
78. Im Forsthaus hat der Ex-Frau aus Landshut der Jäger aus Erding wehgetan.

79. Im Forsthaus hat den Förster aus Landshut der Jäger aus Salzburg beleidigt.
80. Im Forsthaus hat den Förstern aus Landshut der Jäger aus Salzburg wehgetan.
81. Im Stadion hat der Stürmer aus Oxford den Schiri aus Sheffield angerempelt.
82. Im Stadion hat der Britin aus Oxford der Schiri aus Sheffield zugepfiffen.
83. Im Stadion hat den Stürmer aus Oxford der Schiri aus Norwich angerempelt.
84. Im Stadion hat den Stürmern aus Oxford der Schiri aus Norwich zugepfiffen.
85. Beim Meeting hat der Helfer aus Dresden den Leiter aus Chemnitz informiert.
86. Beim Meeting hat der Chefin aus Dresden der Leiter aus Chemnitz gekündigt.
87. Beim Meeting hat den Helfer aus Dresden der Leiter aus Cottbus informiert.
88. Beim Meeting hat den Helfern aus Dresden der Leiter aus Cottbus gekündigt.
89. Am Geburtstag hat der Onkel aus Schwerin den Vater aus Dortmund beschenkt.
90. Am Geburtstag hat der Tochter aus Schwerin der Vater aus Dortmund gratuliert.
91. Am Geburtstag hat den Onkel aus Schwerin der Vater aus Limbach beschenkt.
92. Am Geburtstag hat den Onkeln aus Schwerin der Vater aus Limbach gratuliert.
93. Letztes Jahr hat der Schüler aus Bremen den Spion aus Celle überführt.
94. Letztes Jahr hat der Schmiedin aus Bremen der Spion aus Celle nachspioniert.
95. Letztes Jahr hat den Schüler aus Bremen der Spion aus Ramstein überführt.
96. Letztes Jahr hat den Schülern aus Bremen der Spion aus Ramstein nachspioniert.
97. Vorgestern hat der Pfleger aus Trier den Arzt aus Bonn überrascht.
98. Vorgestern hat der Schwester aus Trier der Arzt aus Bonn zugehört.
99. Vorgestern hat den Pfleger aus Trier der Arzt aus Mülheim überrascht.
100. Vorgestern hat den Pflegern aus Trier der Arzt aus Mülheim zugehört.
101. Im Dom hat der Priester aus Luzern den Gemahl aus Innsbruck verheiratet.
102. Im Dom hat der Gattin aus Luzern der Gemahl aus Innsbruck zugerufen.
103. Im Dom hat den Priester aus Luzern der Gemahl aus Davos verheiratet.
104. Im Dom hat den Priestern aus Luzern der Gemahl aus Davos zugerufen.
105. Beim Wettbewerb hat der Ringer aus Athen den Boxer aus Korinth bejubelt.
106. Beim Wettbewerb hat der Griechin aus Athen der Boxer aus Korinth nachgeeifert.
107. Beim Wettbewerb hat den Ringer aus Athen der Boxer aus Boston bejubelt.
108. Beim Wettbewerb hat den Ringern aus Athen der Boxer aus Boston nachgeeifert.
109. An Weihnachten hat der Gauner aus Halle den Pastor aus Leipzig betrogen.
110. An Weihnachten hat der Diebin aus Halle der Pastor aus Leipzig vergeben.
111. An Weihnachten hat den Gauner aus Halle der Pastor aus Bochum betrogen.
112. An Weihnachten hat den Gaunern aus Halle der Pastor aus Bochum vergeben.
113. An Ostern hat der Enkel aus Neuss den Opa aus Köln beglückwünscht.
114. An Ostern hat der Oma aus Neuss der Opa aus Köln widersprochen.
115. An Ostern hat den Enkel aus Neuss der Opa aus Essen beglückwünscht.
116. An Ostern hat den Enkeln aus Neuss der Opa aus Essen widersprochen.
117. Am Rhein hat der Gegner aus Boppard den Krieger aus Worms gedemütigt.
118. Am Rhein hat der Nymphe aus Boppard der Krieger aus Worms vertraut.
119. Am Rhein hat den Gegner aus Boppard der Krieger aus Bürstadt gedemütigt.
120. Am Rhein hat den Gegnern aus Boppard der Krieger aus Bürstadt vertraut.
121. Am Wochenende hat der Mieter aus Paris den Makler aus Nizza beschimpft.
122. Am Wochenende hat der Ärztin aus Paris der Makler aus Nizza geschmeichelt.

123. Am Wochenende hat den Mieter aus Paris der Makler aus Bordeaux beschimpft.
124. Am Wochenende hat den Mietern aus Paris der Makler aus Bordeaux geschmeichelt.
125. Im Restaurant hat der Ober aus Brüssel den Saucier aus Brügge gelobt.
126. Im Restaurant hat der Köchin aus Brüssel der Saucier aus Brügge gehorcht.
127. Im Restaurant hat den Ober aus Brüssel der Saucier aus Tilburg gelobt.
128. Im Restaurant hat den Obern aus Brüssel der Saucier aus Tilburg gehorcht.
129. Letzten Winter hat der Pendler aus Krakau den Fahrer aus Breslau gesehen.
130. Letzten Winter hat der Polin aus Krakau der Fahrer aus Breslau geholfen.
131. Letzten Winter hat den Pendler aus Krakau der Fahrer aus Lublin gesehen.
132. Letzten Winter hat den Pendlern aus Krakau der Fahrer aus Lublin geholfen.
133. Im Mittelalter hat der Kleriker aus Idstein den Ritter aus Mainz angeklagt.
134. Im Mittelalter hat der Hexe aus Idstein der Ritter aus Mainz geglaubt.
135. Im Mittelalter hat den Kleriker aus Idstein der Ritter aus Koblenz angeklagt.
136. Im Mittelalter hat den Klerikern aus Idstein der Ritter aus Koblenz geglaubt.
137. Vorigen Dienstag hat der Jäger aus Malmö den Winzer aus Stuttgart getötet.
138. Vorigen Dienstag hat der Schwedin aus Malmö der Winzer aus Stuttgart abgesagt.
139. Vorigen Dienstag hat den Jäger aus Malmö der Winzer aus Münster getötet.
140. Vorigen Dienstag hat den Jägern aus Malmö der Winzer aus Münster abgesagt.
141. Im Kloster hat der Maler aus Krakau den Mönch aus Sanok bewundert.
142. Im Kloster hat der Nonne aus Krakau der Mönch aus Sanok gedankt.
143. Im Kloster hat den Maler aus Krakau der Mönch aus Stettin bewundert.
144. Im Kloster hat den Malern aus Krakau der Mönch aus Stettin gedankt.
145. An Karfreitag hat der Fischer aus Husum den Pilger aus Berlin begrüßt.
146. An Karfreitag hat der Witwe aus Husum der Pilger aus Berlin hinterhergerufen.
147. An Karfreitag hat den Fischer aus Husum der Pilger aus Flensburg begrüßt.
148. An Karfreitag hat den Fischern aus Husum der Pilger aus Flensburg hinterhergerufen.
149. An Heiligabend hat der Bettler aus Prag den Sänger aus Pilsen aufgeheitert.
150. An Heiligabend hat der Tschechin aus Prag der Sänger aus Pilsen vorgesungen.
151. An Heiligabend hat den Bettler aus Prag der Sänger aus Budweis aufgeheitert.
152. An Heiligabend hat den Bettlern aus Prag der Sänger aus Budweis vorgesungen.
153. Am Strand hat der Trainer aus Aarhus den Jogger aus Kiel instruiert.
154. Am Strand hat der Dänin aus Aarhus der Jogger aus Kiel zugezwinkert.
155. Am Strand hat den Trainer aus Aarhus der Jogger aus Stralsund instruiert.
156. Am Strand hat den Trainern aus Aarhus der Jogger aus Stralsund zugezwinkert.
157. Im Schloss hat der Kaiser aus Rom den Herrscher aus Tula bedrängt.
158. Im Schloss hat der Herrin aus Rom der Herrscher aus Tula gehuldigt.
159. Im Schloss hat den Kaiser aus Rom der Herrscher aus Kursk bedrängt.
160. Im Schloss hat den Kaisern aus Rom der Herrscher aus Kursk gehuldigt.

E.2 Experiment 2

1. Gestern hat der dicke Bäcker aus Mainz den Konditor aus Kassel ausgelacht.
2. Gestern hat der dicken Kundin aus Mainz der Konditor aus Kassel zugeflüstert.

3. Gestern hat den dicken Bäcker aus Mainz der Konditor aus Hürth ausgelacht.
4. Gestern hat den dicken Bäckern aus Mainz der Konditor aus Hürth zugeflüstert.
5. Neulich hat der frohe Rentner aus Moskau den Bettler aus Minsk angelächelt.
6. Neulich hat der frohen Russin aus Moskau der Bettler aus Minsk zugelächelt.
7. Neulich hat den frohen Rentner aus Moskau der Bettler aus Grosny angelächelt.
8. Neulich hat den frohen Rentnern aus Moskau der Bettler aus Grosny zugelächelt.
9. Beim Vortrag hat der leise Sprecher aus Oslo den Hörer aus Dover angeschaut.
10. Beim Vortrag hat der leisen Greisin aus Oslo der Hörer aus Dover gelauscht.
11. Beim Vortrag hat den leisen Sprecher aus Oslo der Hörer aus Ashford angeschaut.
12. Beim Vortrag hat den leisen Sprechern aus Oslo der Hörer aus Ashford gelauscht.
13. Im Park hat der süße Gärtner aus Brighton den Butler aus York angelacht.
14. Im Park hat der süßen Lady aus Brighton der Butler aus York gedient.
15. Im Park hat den süßen Gärtner aus Brighton der Butler aus Cardiff angelacht.
16. Im Park hat den süßen Gärtnern aus Brighton der Butler aus Cardiff gedient.
17. In der Aula hat der barsche Geiger aus Bern den Bläser aus Basel zurechtgewiesen.
18. In der Aula hat der barschen Diva aus Bern der Bläser aus Basel vorgespielt.
19. In der Aula hat den barschen Geiger aus Bern der Bläser aus Lausanne zurechtgewiesen.
20. In der Aula hat den barschen Geigern aus Bern der Bläser aus Lausanne vorgespielt.
21. Endlich hat der faule Kellner aus München den Gast aus Passau bewirtet.
22. Endlich hat der faulen Wirtin aus München der Gast aus Passau gewunken.
23. Endlich hat den faulen Kellner aus München der Gast aus Freising bewirtet.
24. Endlich hat den faulen Kellnern aus München der Gast aus Freising gewunken.
25. Im Biergarten hat der derbe Biker aus Bayern den Rentner aus Mannheim getäuscht.
26. Im Biergarten hat der derben Barfrau aus Bayern der Rentner aus Mannheim zugeprostet.
27. Im Biergarten hat den derben Biker aus Bayern der Rentner aus Viernheim getäuscht.
28. Im Biergarten hat den derben Biker aus Bayern der Rentner aus Viernheim zugeprostet.
29. Letztendlich hat der dreiste Kläger aus Köln den Richter aus Bonn akzeptiert.
30. Letztendlich hat der dreisten Schöffin aus Köln der Richter aus Bonn zugestimmt.
31. Letztendlich hat den dreisten Kläger aus Köln der Richter aus Duisburg akzeptiert.
32. Letztendlich hat den dreisten Klägern aus Köln der Richter aus Duisburg zugestimmt.
33. Hastig hat der fiese Täter aus Danzig den Anwalt aus Warschau kontaktiert.
34. Hastig hat der fiesen Erbin aus Danzig der Anwalt aus Warschau geantwortet.
35. Hastig hat den fiesen Täter aus Danzig der Anwalt aus Krakau kontaktiert.
36. Hastig hat den fiesen Tätern aus Danzig der Anwalt aus Krakau geantwortet.
37. Bei der Gala hat der reiche Gründer aus Genf den Banker aus Dijon angerufen.
38. Bei der Gala hat der reichen Muse aus Genf der Banker aus Dijon applaudiert.
39. Bei der Gala hat den reichen Gründer aus Genf der Banker aus Mailand angerufen.
40. Bei der Gala hat den reichen Gründern aus Genf der Banker aus Mailand applaudiert.
41. Im Hafen hat der raue Angler aus Jever den Fischer aus Emden getroffen.
42. Im Hafen hat der rauen Friesin aus Jever der Fischer aus Emden nachgeschaut.
43. Im Hafen hat den rauen Angler aus Jever der Fischer aus Lübeck getroffen.
44. Im Hafen hat den rauen Anglern aus Jever der Fischer aus Lübeck nachgeschaut.
45. Inzwischen hat der schlechte Spitzel aus Langley den Freund aus London erspäht.
46. Inzwischen hat der schlechten Freundin aus Langley der Freund aus London verziehen.

47. Inzwischen hat den schlechten Spitzel aus Langley der Freund aus Cambridge erspäht.
48. Inzwischen hat den schlechten Spitzeln aus Langley der Freund aus Cambridge verziehen.
49. Im Sommer hat der sanfte Sänger aus Dublin den Dichter aus Bristol besucht.
50. Im Sommer hat der sanften Irin aus Dublin der Dichter aus Bristol geschrieben.
51. Im Sommer hat den sanften Sänger aus Dublin der Dichter aus Kingston besucht.
52. Im Sommer hat den sanften Sängern aus Dublin der Dichter aus Kingston geschrieben.
53. Im Waisenhaus hat der alte Wärter aus Erfurt den Knaben aus Marburg geschlagen.
54. Im Waisenhaus hat der alten Tante aus Erfurt der Knabe aus Marburg zugewunken.
55. Im Waisenhaus hat den alten Wärter aus Erfurt der Knabe aus Weimar geschlagen.
56. Im Waisenhaus hat den alten Wärtern aus Erfurt der Knabe aus Weimar zugewunken.
57. Im Garten hat der laute Kumpel aus Gießen den Schwager aus Jena unterhalten.
58. Im Garten hat der lauten Nichte aus Gießen der Schwager aus Jena vorgelesen.
59. Im Garten hat den lauten Kumpel aus Gießen der Schwager aus Fulda unterhalten.
60. Im Garten hat den lauten Kumpeln aus Gießen der Schwager aus Fulda vorgelesen.
61. Am Flughafen hat der stille Pförtner aus Frankfurt den Mörder aus Kusel überwältigt.
62. Am Flughafen hat der stillen Geisel aus Frankfurt der Mörder aus Kusel gedroht.
63. Am Flughafen hat den stillen Pförtner aus Frankfurt der Mörder aus Schwollen überwältigt.
64. Am Flughafen hat den stillen Pförtnern aus Frankfurt der Mörder aus Schwollen gedroht.
65. Am Bahnhof hat der müde Schaffner aus Glasgow den Pendler aus Belfast begleitet.
66. Am Bahnhof hat der müden Schottin aus Glasgow der Pendler aus Belfast nachgesehen.
67. Am Bahnhof hat den müden Schaffner aus Glasgow der Pendler aus Bradford begleitet.
68. Am Bahnhof hat den müden Schaffnern aus Glasgow der Pendler aus Bradford nachgesehen.
69. Im Postamt hat der kühle Leiter aus Metz den Zöllner aus Lyon getadelt.
70. Im Postamt hat der kühlen Botin aus Metz der Zöllner aus Lyon nachgestellt.
71. Im Postamt hat den kühlen Leiter aus Metz der Zöllner aus Marseille getadelt.
72. Im Postamt hat den kühlen Leitern aus Metz der Zöllner aus Marseille nachgestellt.
73. Im Spa hat der schöne Schwimmer aus Madrid den Masseur aus Palma verletzt.
74. Im Spa hat der schönen Dame aus Madrid der Masseur aus Palma nachgepfiffen.
75. Im Spa hat den schönen Schwimmer aus Madrid der Masseur aus Cadiz verletzt.
76. Im Spa hat den schönen Schwimmern aus Madrid der Masseur aus Cadiz nachgepfiffen.
77. In der Gaststätte hat der forsche Jäger aus Landshut den Förster aus Bayreuth beleidigt.
78. In der Gaststätte hat der forschen Ex-Frau aus Landshut der Förster aus Bayreuth wehgetan.
79. In der Gaststätte hat den forschen Jäger aus Landshut der Förster aus Salzburg beleidigt.
80. In der Gaststätte hat den forschen Jägern aus Landshut der Förster aus Salzburg wehgetan.
81. Im Stadion hat der lahme Stürmer aus Oxford den Schiri aus Sheffield angerempelt.
82. Im Stadion hat der lahmen Britin aus Oxford der Schiri aus Sheffield zugepfiffen.
83. Im Stadion hat den lahmen Stürmer aus Oxford der Schiri aus Norwich angerempelt.
84. Im Stadion hat den lahmen Stürmern aus Oxford der Schiri aus Norwich zugepfiffen.
85. Beim Meeting hat der deutsche Helfer aus Dresden den Leiter aus Chemnitz informiert.
86. Beim Meeting hat der deutschen Chefin aus Dresden der Leiter aus Chemnitz gekündigt.
87. Beim Meeting hat den deutschen Helfer aus Dresden der Leiter aus Cottbus informiert.
88. Beim Meeting hat den deutschen Helfern aus Dresden der Leiter aus Cottbus gekündigt.
89. Am Geburtstag hat der sture Onkel aus Schwerin den Vater aus Dortmund beschenkt.
90. Am Geburtstag hat der sturen Tochter aus Schwerin der Vater aus Dortmund gratuliert.

91. Am Geburtstag hat den sturen Onkel aus Schwerin der Vater aus Limbach beschenkt.
92. Am Geburtstag hat den sturen Onkeln aus Schwerin der Vater aus Limbach gratuliert.
93. Im Kalten Krieg hat der ernste Späher aus Bremen den Spion aus Celle überführt.
94. Im Kalten Krieg hat der ernsten Schmiedin aus Bremen der Spion aus Celle nachgejagt.
95. Im Kalten Krieg hat den ernsten Späher aus Bremen der Spion aus Ramstein überführt.
96. Im Kalten Krieg hat den ernsten Spähern aus Bremen der Spion aus Ramstein nachgejagt.
97. Vorgestern hat der grobe Pfleger aus Trier den Arzt aus Bonn überrascht.
98. Vorgestern hat der groben Schwester aus Trier der Arzt aus Bonn zugehört.
99. Vorgestern hat den groben Pfleger aus Trier der Arzt aus Mülheim überrascht.
100. Vorgestern hat den groben Pflegern aus Trier der Arzt aus Mülheim zugehört.
101. Im Dom hat der fromme Priester aus Luzern den Gemahl aus Innsbruck angesehen.
102. Im Dom hat der frommen Gattin aus Luzern der Gemahl aus Innsbruck zugerufen.
103. Im Dom hat den frommen Priester aus Luzern der Gemahl aus Davos angesehen.
104. Im Dom hat den frommen Priestern aus Luzern der Gemahl aus Davos zugerufen.
105. Beim Wettbewerb hat der junge Ringer aus Athen den Segler aus Korinth bejubelt.
106. Beim Wettbewerb hat der jungen Griechin aus Athen der Segler aus Korinth zugeblinzelt.
107. Beim Wettbewerb hat den jungen Ringer aus Athen der Segler aus Boston bejubelt.
108. Beim Wettbewerb hat den jungen Ringern aus Athen der Segler aus Boston zugeblinzelt.
109. An Weihnachten hat der dürre Gauner aus Halle den Pastor aus Leipzig betrogen.
110. An Weihnachten hat der dürren Diebin aus Halle der Pastor aus Leipzig nachgebrüllt.
111. An Weihnachten hat den dürren Gauner aus Halle der Pastor aus Bochum betrogen.
112. An Weihnachten hat den dürren Gaunern aus Halle der Pastor aus Bochum nachgebrüllt.
113. An Ostern hat der fesche Enkel aus Neuss den Opa aus Pisa beglückwünscht.
114. An Ostern hat der feschen Oma aus Neuss der Opa aus Pisa gemailt.
115. An Ostern hat den feschen Enkel aus Neuss der Opa aus Essen beglückwünscht.
116. An Ostern hat den feschen Enkeln aus Neuss der Opa aus Essen gemailt.
117. Beim Turnier hat der starke Sieger aus Boppard den Erzfeind aus Worms gedemütigt.
118. Beim Turnier hat der starken Nymphe aus Boppard der Erzfeind aus Worms vertraut.
119. Beim Turnier hat den starken Sieger aus Boppard der Erzfeind aus Bürstadt gedemütigt.
120. Beim Turnier hat den starken Sieger aus Boppard der Erzfeind aus Bürstadt vertraut.
121. Am Wochenende hat der neue Mieter aus Paris den Makler aus Nizza beschimpft.
122. Am Wochenende hat der neuen Ärztin aus Paris der Makler aus Nizza geschmeichelt.
123. Am Wochenende hat den neuen Mieter aus Paris der Makler aus Bordeaux beschimpft.
124. Am Wochenende hat den neuen Mietern aus Paris der Makler aus Bordeaux geschmeichelt.
125. Im Restaurant hat der strikte Ober aus Brüssel den Saucier aus Brügge gelobt.
126. Im Restaurant hat der strikten Köchin aus Brüssel der Saucier aus Brügge gehorcht.
127. Im Restaurant hat den strikten Ober aus Brüssel der Saucier aus Tilburg gelobt.
128. Im Restaurant hat den strikten Obern aus Brüssel der Saucier aus Tilburg gehorcht.
129. Letzten Winter hat der schicke Pendler aus Krakau den Fahrer aus Breslau gesehen.
130. Letzten Winter hat der schicken Polin aus Krakau der Fahrer aus Breslau geholfen.
131. Letzten Winter hat den schicken Pendler aus Krakau der Fahrer aus Lublin gesehen.
132. Letzten Winter hat den schicken Pendlern aus Krakau der Fahrer aus Lublin geholfen.
133. Auf der Spielemesse hat der coole Zocker aus Idstein den Gamer aus Mainz angeklagt.
134. Auf der Spielemesse hat der coolen Mutter aus Idstein der Gamer aus Mainz geglaubt.

135. Auf der Spielemesse hat den coolen Zocker aus Idstein der Gamer aus Koblenz angeklagt.
136. Auf der Spielemesse hat den coolen Zockern aus Idstein der Gamer aus Koblenz geglaubt.
137. Vorigen Dienstag hat der irre Killer aus Malmö den Winzer aus Stuttgart getötet.
138. Vorigen Dienstag hat der irren Schwedin aus Malmö der Winzer aus Stuttgart abgesagt.
139. Vorigen Dienstag hat den irren Killer aus Malmö der Winzer aus Münster getötet.
140. Vorigen Dienstag hat den irren Killern aus Malmö der Winzer aus Münster abgesagt.
141. Im Kloster hat der dünne Maler aus Krakau den Mönch aus Sanok bewundert.
142. Im Kloster hat der dünnen Nonne aus Krakau der Mönch aus Sanok gedankt.
143. Im Kloster hat den dünnen Maler aus Krakau der Mönch aus Stettin bewundert.
144. Im Kloster hat den dünnen Malern aus Krakau der Mönch aus Stettin gedankt.
145. An Karfreitag hat der kranke Fischer aus Husum den Koch aus Berlin begrüßt.
146. An Karfreitag hat der kranken Witwe aus Husum der Koch aus Berlin hinterhergerufen.
147. An Karfreitag hat den kranken Fischer aus Husum der Koch aus Flensburg begrüßt.
148. An Karfreitag hat den kranken Fischern aus Husum der Koch aus Flensburg hinterhergerufen.
149. An Heiligabend hat der arme Bettler aus Prag den Sänger aus Pilsen aufgeheitert.
150. An Heiligabend hat der armen Tschechin aus Prag der Sänger aus Pilsen vorgesungen.
151. An Heiligabend hat den armen Bettler aus Prag der Sänger aus Budweis aufgeheitert.
152. An Heiligabend hat den armen Bettlern aus Prag der Sänger aus Budweis vorgesungen.
153. Auf dem Sportplatz hat der fremde Sprinter aus Asbach den Jogger aus Kiel instruiert.
154. Auf dem Sportplatz hat der fremden Dänin aus Asbach der Jogger aus Kiel zugezwinkert.
155. Auf dem Sportplatz hat den fremden Sprinter aus Asbach der Jogger aus Stralsund instruiert.
156. Auf dem Sportplatz hat den fremden Sprintern aus Asbach der Jogger aus Stralsund zugezwinkert.
157. Im Schloss hat der kühne Kaiser aus Rom den Herrscher aus Tula bedrängt.
158. Im Schloss hat der kühnen Herrin aus Rom der Herrscher aus Tula gehuldigt.
159. Im Schloss hat den kühnen Kaiser aus Rom der Herrscher aus Kursk bedrängt.
160. Im Schloss hat den kühnen Kaisern aus Rom der Herrscher aus Kursk gehuldigt.

E.3 Experiment 3

1. In der Pause hat der schwere Boxer aus Nippes den Trainer aus Zollstock angeschrien.
2. In der Pause hat den schwere Boxer aus Nippes der Trainer aus Zollstock angeschrien.
3. In der Pause hat dem schwere Boxer aus Nippes der Trainer aus Zollstock beigestanden.
4. Gestern Vormittag hat der schroffe Brauer aus Erding den Landwirt aus Freising vertrieben.
5. Gestern Vormittag hat den schroffe Brauer aus Erding der Landwirt aus Freising vertrieben.
6. Gestern Vormittag hat dem schroffe Brauer aus Erding der Landwirt aus Freising aufgelauert.
7. Zuhause hat der hübsche Bruder aus Bangkok den Cousin aus Hanoi geärgert.
8. Zuhause hat den hübsche Bruder aus Bangkok der Cousin aus Hanoi geärgert.
9. Zuhause hat dem hübsche Bruder aus Bangkok der Cousin aus Hanoi zugetuschelt.
10. An Weiberfastnacht hat der kesse Kölner aus Poll den Bauern aus Hessen empfangen.
11. An Weiberfastnacht hat den kesse Kölner aus Poll der Bauer aus Hessen empfangen.
12. An Weiberfastnacht hat dem kesse Kölner aus Poll der Bauer aus Hessen missfallen.
13. Am Strand hat der blonde Surfer aus Sydney den Hipster aus Brisbane gerügt.
14. Am Strand hat den blonde Surfer aus Sydney der Hipster aus Brisbane gerügt.

15. Am Strand hat dem blonde Surfer aus Sydney der Hipster aus Brisbane nachgespürt.
16. Letzte Nacht hat der schnelle Raser aus Neustadt den Bürger aus Bensheim angefahren.
17. Letzte Nacht hat den schnelle Raser aus Neustadt der Bürger aus Bensheim angefahren.
18. Letzte Nacht hat dem schnelle Raser aus Neustadt der Bürger aus Bensheim vergeben.
19. Bei der Olympiade hat der freche Fechter aus Sachsen den Turner aus Hamburg geohrfeigt.
20. Bei der Olympiade hat den freche Fechter aus Sachsen der Turner aus Hamburg geohrfeigt.
21. Bei der Olympiade hat dem freche Fechter aus Sachsen der Turner aus Hamburg zugeschmunzelt.
22. Letztens hat der kahle Fleischer aus Potsdam den Schlachter aus Limburg eingeladen.
23. Letztens hat den kahle Fleischer aus Potsdam der Schlachter aus Limburg eingeladen.
24. Letztens hat dem kahle Fleischer aus Potsdam der Schlachter aus Limburg ausgeholfen.
25. Im Labor hat der schlaue Forscher aus Gera den Streber aus Görlitz verflucht.
26. Im Labor hat den schlaue Forscher aus Gera der Streber aus Görlitz verflucht.
27. Im Labor hat dem schlaue Forscher aus Gera der Streber aus Görlitz nachgestrebt.
28. An Karneval hat der schrille Frisör aus Köln-Kalk den Jecken aus Köln-Porz hereingebeten.
29. An Karneval hat den schrille Frisör aus Köln-Kalk der Jeck aus Köln-Porz hereingebeten.
30. An Karneval hat dem schrille Frisör aus Köln-Kalk der Jeck aus Köln-Porz imponiert.
31. In der Firma hat der stumme Schweißer aus Darmstadt den Lehrling aus Rostock gemustert.
32. In der Firma hat den stumme Schweißer aus Darmstadt der Lehrling aus Rostock gemustert.
33. In der Firma hat dem stumme Schweißer aus Darmstadt der Lehrling aus Rostock zugearbeitet.
34. Am Sonntagabend hat der harte Trinker aus Mühlheim den Gastwirt aus Hahnwald angetippt.
35. Am Sonntagabend hat den harte Trinker aus Mühlheim der Gastwirt aus Hahnwald angetippt.
36. Am Sonntagabend hat dem harte Trinker aus Mühlheim der Gastwirt aus Hahnwald heimgeholfen.
37. Auf dem Rasen hat der fesche Golfer aus Zwickau den Reiter aus Rondorf angepöbelt.
38. Auf dem Rasen hat den fesche Golfer aus Zwickau der Reiter aus Rondorf angepöbelt.
39. Auf dem Rasen hat dem fesche Golfer aus Zwickau der Reiter aus Rondorf nachgespuckt.
40. Beim Elternsprechtag hat der blöde Lehrer aus Siegen den Vater aus Aachen angebrüllt.
41. Beim Elternsprechtag hat den blöde Lehrer aus Siegen der Vater aus Aachen angebrüllt.
42. Beim Elternsprechtag hat dem blöde Lehrer aus Siegen der Vater aus Aachen widersprochen.
43. Am See hat der miese Paddler aus Godorf den Taucher aus Braunsfeld angeschimpft.
44. Am See hat den miese Paddler aus Godorf der Taucher aus Braunsfeld angeschimpft.
45. Am See hat dem miese Paddler aus Godorf der Taucher aus Braunsfeld nachgetreten.
46. In der Bar hat der doofe Bowler aus Remscheid den Sportler aus Witten angeschnauzt.
47. In der Bar hat den doofe Bowler aus Remscheid der Sportler aus Witten angeschnauzt.
48. In der Bar hat dem doofe Bowler aus Remscheid der Sportler aus Witten nachgegafft.
49. Nach dem Spiel hat der faire Kegler aus Heilbronn den Barmann aus Pforzheim angeschmunzelt.
50. Nach dem Spiel hat den faire Kegler aus Heilbronn der Barmann aus Pforzheim angeschmunzelt.
51. Nach dem Spiel hat dem faire Kegler aus Heilbronn der Barmann aus Pforzheim zugelacht.
52. Beim Arbeitsamt hat der treue Klempner aus Würzburg den Flüchtling aus Homs gegrüßt.
53. Beim Arbeitsamt hat den treue Klempner aus Würzburg der Flüchtling aus Homs gegrüßt.
54. Beim Arbeitsamt hat dem treue Klempner aus Würzburg der Flüchtling aus Homs zugenickt.
55. Am Filmset hat der zähe Stuntman aus Krefeld den Doktor aus Herne gerufen.
56. Am Filmset hat den zähe Stuntman aus Krefeld der Doktor aus Herne gerufen.
57. Am Filmset hat dem zähe Stuntman aus Krefeld der Doktor aus Herne assistiert.
58. Vor Weihnachten hat der strenge Mentor aus Freiburg den Neuling aus Hagen gepiesackt.

59. Vor Weihnachten hat den strenge Mentor aus Freiburg der Neuling aus Hagen gepiesackt.
60. Vor Weihnachten hat dem strenge Mentor aus Freiburg der Neuling aus Hagen vorgejammert.
61. Seit langem hat der hippe Blogger aus Weiden den Leser aus Seeberg inspiriert.
62. Seit langem hat den hippe Blogger aus Weiden der Leser aus Seeberg inspiriert.
63. Seit langem hat dem hippe Blogger aus Weiden der Leser aus Seeberg nachgeeifert.
64. Auf dem Anwesen hat der feine Diener aus Yorkshire den Hauswirt aus Preston gestört.
65. Auf dem Anwesen hat den feine Diener aus Yorkshire der Hauswirt aus Preston gestört.
66. Auf dem Anwesen hat dem feine Diener aus Yorkshire der Hauswirt aus Preston gefallen.
67. Auf der Baustelle hat der schlanke Maurer aus Augsburg den Schmied aus Braunschweig angegriffen.
68. Auf der Baustelle hat den schlanke Maurer aus Augsburg der Schmied aus Braunschweig angegriffen.
69. Auf der Baustelle hat dem schlanke Maurer aus Augsburg der Schmied aus Braunschweig zugeschaut.
70. Beim Rodeo hat der schmale Farmer aus Utah den Cowboy aus Texas bezwungen.
71. Beim Rodeo hat den schmale Farmer aus Utah der Cowboy aus Texas bezwungen.
72. Beim Rodeo hat dem schmale Farmer aus Utah der Cowboy aus Texas zugejubelt.
73. Im Atelier hat der kleine Schneider aus Auweiler den Näher aus Urbach missverstanden.
74. Im Atelier hat den kleine Schneider aus Auweiler der Näher aus Urbach missverstanden.
75. Im Atelier hat dem kleine Schneider aus Auweiler der Näher aus Urbach zugeguckt.
76. Nach dem Rennen hat der bleiche Geher aus Peru den Läufer aus Chile gehauen.
77. Nach dem Rennen hat den bleiche Geher aus Peru der Läufer aus Chile gehauen.
78. Nach dem Rennen hat dem bleiche Geher aus Peru der Läufer aus Chile hinterhergepfiffen.
79. In der Kirche hat der greise Pfarrer aus Tallinn den Pilger aus Lima gesegnet.
80. In der Kirche hat den greise Pfarrer aus Tallinn der Pilger aus Lima gesegnet.
81. In der Kirche hat dem greise Pfarrer aus Tallinn der Pilger aus Lima nachgeweint.
82. Auf der Convention hat der stolze Goldschmied aus Zündorf den Piercer aus Elsdorf angelernt.
83. Auf der Convention hat den stolze Goldschmied aus Zündorf der Piercer aus Elsdorf angelernt.
84. Auf der Convention hat dem stolze Goldschmied aus Zündorf der Piercer aus Elsdorf zugesehen.
85. Beim TÜV hat der böse Prüfer aus Gremberg den Prüfling aus Heumar belästigt.
86. Beim TÜV hat den böse Prüfer aus Gremberg der Prüfling aus Heumar belästigt.
87. Beim TÜV hat dem böse Prüfer aus Gremberg der Prüfling aus Heumar beigepflichtet.
88. Zu Beginn des Vortrags hat der weise Redner aus Vaduz den Dekan aus Zagreb erwähnt.
89. Zu Beginn des Vortrags hat den weise Redner aus Vaduz der Dekan aus Zagreb erwähnt.
90. Zu Beginn des Vortrags hat dem weise Redner aus Vaduz der Dekan aus Zagreb zugehorcht.
91. Im Gespräch hat der große Rektor aus Neubrück den Schüler aus Merheim verwirrt.
92. Im Gespräch hat den große Rektor aus Neubrück der Schüler aus Merheim verwirrt.
93. Im Gespräch hat dem große Rektor aus Neubrück der Schüler aus Merheim nachgegeben.
94. In der Mittagspause hat der gute Schuster aus Belgrad den Lehrling aus Riga beobachtet.
95. In der Mittagspause hat den gute Schuster aus Belgrad der Lehrling aus Riga beobachtet.
96. In der Mittagspause hat dem gute Schuster aus Belgrad der Lehrling aus Riga vorgearbeitet.
97. Beim Baseball hat der flinke Pitcher aus Ostheim den Catcher aus Buchforst herausgefordert.
98. Beim Baseball hat den flinke Pitcher aus Ostheim der Catcher aus Buchforst herausgefordert.
99. Beim Baseball hat dem flinke Pitcher aus Ostheim der Catcher aus Buchforst zugebrüllt.
100. Vor der Halfpipe hat der tolle Skater aus Kiew den Poser aus Skopje belächelt.
101. Vor der Halfpipe hat den tolle Skater aus Kiew der Poser aus Skopje belächelt.
102. Vor der Halfpipe hat dem tolle Skater aus Kiew der Poser aus Skopje nachgerufen.

103. In der Fußgängerzone hat der taube Händler aus Irland den Tänzer aus Ungarn beneidet.
104. In der Fußgängerzone hat den taube Händler aus Irland der Tänzer aus Ungarn beneidet.
105. In der Fußgängerzone hat dem taube Händler aus Irland der Tänzer aus Ungarn vorgetanzt.
106. Beim Konzert hat der wilde Trommler aus Stammheim den Streicher aus Dünnwald irritiert.
107. Beim Konzert hat den wilde Trommler aus Stammheim der Streicher aus Dünnwald irritiert.
108. Beim Konzert hat dem wilde Trommler aus Stammheim der Streicher aus Dünnwald nachgespottet.
109. Im Fitnessstudio hat der breite Schnösel aus Island den Schwächling aus Schweden angesprochen.
110. Im Fitnessstudio hat den breite Schnösel aus Island der Schwächling aus Schweden angesprochen.
111. Im Fitnessstudio hat dem breite Schnösel aus Island der Schwächling aus Schweden nachgeblickt.
112. Beim Workshop hat der wirre Zeichner aus Polen den Künstler aus England abgelenkt.
113. Beim Workshop hat den wirre Zeichner aus Polen der Künstler aus England abgelenkt.
114. Beim Workshop hat dem wirre Zeichner aus Polen der Künstler aus England zugeredet.
115. Auf dem Bauernhof hat der brüske Züchter aus Estland den Tierarzt aus Lettland aufgeregt.
116. Auf dem Bauernhof hat den brüske Züchter aus Estland der Tierarzt aus Lettland aufgeregt.
117. Auf dem Bauernhof hat dem brüske Züchter aus Estland der Tierarzt aus Lettland zugesprochen.
118. Auf dem Fußballplatz hat der träge Kicker aus Deutschland den Torwart aus Russland ausgebuht.
119. Auf dem Fußballplatz hat den träge Kicker aus Deutschland der Torwart aus Russland ausgebuht.
120. Auf dem Fußballplatz hat dem träge Kicker aus Deutschland der Torwart aus Russland entgegengebrüllt.

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