Institut für Linguistik
Philosophische Fakultät
Universität zu Köln

Characteristics of German child-directed speech during book sharing and play activities in a standardized naturalistic setting

Masterarbeit
zur Erlangung des akademischen Grades
Master of Arts
im Fach Linguistik

vorgelegt von
Leonie Regina Twente
geb. in Dortmund

Tag der Abgabe: 17. März 2022
Erstgutachterin: Univ.-Prof. Dr. Birgit Hellwig

Köln, 2022

Acknowledgments

Despite requiring episodes of solitude, writing is a collaborative activity. I would like to extend my gratitude to friends, family and colleagues whose support, patience and proofreading skills have accompanied me through the process of writing this thesis. It is only with this support that I was able to finalize this work.

Thanks also goes out to Sonja Eisenbeiß and the members and guests of the Languages and Games Club who took time listening to me presenting my work and whose comments have shaped this thesis. In addition to being a collaborative activity, writing is an optimization problem. To know how and when to finish a piece of work is not one of my strengths (yet). I would like to thank my supervisor Birgit Hellwig for emphasizing the 'good enough approach', and for supervising a chronically non-supervisable student.

Finally, special thanks go to Gisela Szagun who not only sacrifices hours to transcribe recordings collected over twenty years ago but also readily shared information about her work.

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Where abbreviations are used in examples, they follow Leipzig Glossing Rules (Comrie et al., 2008).

1 Introduction[1]

Understanding how human beings become competent users of language is a fundamental topic in linguistic research. Beyond understanding the cognitive mechanisms enabling humans to acquire and use language in the first place, such an understanding presupposes a good grasp of the nature of children's natural language environments and how these factors interact in language development (Stoll, 2015, p. 141). Children learn language in interactions embedded in social environment (Hoff, 2006) and so the ways in which the broader societal context as well as aspects of the immediate situational environment shape communicative interaction with children has been part of investigations of characteristics of child-directed speech since their beginnings in Western academic tradition (e. g, Snow et al., 1976).

The primary goal of the study reported here is to contribute a descriptive analysis investigating how characteristics of German child-directed speech vary by activity. Previous research on German child-directed speech in different activities has examined effects of activity based on brief interactions observed in highly controlled settings (Doering et al., 2020; Nachtigäller & Rohlfing, 2011; Poulain & Brauer, 2018; Puccini et al., 2010). This thesis adds a study focusing on characteristics of speech directed to two-year old German-learning children observed during two-hour naturalistic 'free play' interactions in a playroom furnished with toys and books. Data was taken from a large corpus of German child-directed speech available from the CHILDES system (Szagun, 2004b).

Inspired by corpus studies of naturalistic observations in the home (Glas et al., 2018; Rosemberg et al., 2020), the present study analyzes speech as it occurs in three activities observed in the corpus. Activities (book sharing, social play, solitary play) are coded from transcript and audio data. Since the coded activities, functioning as independent variables, are not manipulated, the study is observational. I examine whether previous findings from studies that control and/or manipulate activity are also found in a sample collected in a standardized naturalistic setting.

This thesis presents yet another study focusing on a Western sample, analyzing caregiver-infant dyadic interactions during play and book reading, arguably one of the

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[1] Of course, not all language is spoken, and the terminus "child-directed speech" excludes the signed modality. In general terms, "child-directed language" is a better alternative (as suggested, for example, in Hellwig & Jung, 2020). Since this thesis is concerned with spoken language only, "child-directed speech" is used.

most frequently studied configurations of sample and setting in child language research. In this way, the novelty of the study is rather limited. However, research on variation of characteristics of German child-directed speech as a function of activity context is as of now limited, and some methodological implications emerge that are worth noting for future research. Beyond contributing a descriptive analysis of German child-directed speech in different activities, the present study illustrates how activity contexts may be considered in future work investigating child-directed speech based on CHILDES data.

The thesis is organized as follows. Chapter 2 gives an introduction to previous research on child-directed speech and reviews evidence on the impact of activity contexts on characteristics of child-directed speech. These theoretical and empirical foundations constitute the background for the study reported in this thesis. Chapter 3 outlines the methodology underlying the present study. The chapter describes the selection of data from the CHILDES database, presents the characteristics of the final analytical sample, and justifies coding and analysis procedures. Results of quantitative and qualitative analyses are presented in Chapter 4. Chapter 5 provides a summary and contextualization of the findings, discussing limitations and, finally, sketching implications and further directions.

2 Theoretical and empirical foundations

This chapter is intended to situate the present study in the broader research context. Chapter 2.1 gives an introduction to the study of speech addressed to children, with particular attention to how context shapes communication with children. Chapter **Error! Reference source not found.** reviews empirical research on the impact of activity on characteristics of child-directed speech. Chapter 2.3 presents the goal and scope of the present study.

2.1 Talking with children: child-directed speech in context(s)

What are the linguistic characteristics of speech addressed to the child, and how to they differ from speech addressed to adults? Research systematically addressing this

descriptive question by describing naturalistic samples of recorded speech dates back to the 1960s and 1970s (Snow & Ferguson, 1977) when, driven by emerging nativist models of language development, description of the input was gaining relevance within child language research: Models of language development are ultimately interested in the explanatory power of the language input with respect to language acquisition. Different models make different predictions on the role of features of the environment in child language development, but ultimately, any model aiming to explain how language is acquired requires a description of the communicative environment (Garnica, 1977).

Early studies primarily examined caregiver speech in samples from Western, North American English-speaking middle-class communities. As a result of this bias, earlier analyses examined predominantly mothers' (i. e., the primary caregivers') speech, so the term 'motherese' was coined (Snow, 1977) to denote mothers' speech characterized by a set of criteria that were repeatedly observed when analyzing input to young children.[2] Later, the term 'child-directed speech' became more frequent (Gallaway & Richards, 1994), reflecting the fact that the features of speech addressed to children observed in mothers extend to other members of language communities. It is now consensus that

> both the language addressed to infants (infant-directed speech), also known as motherese or baby talk, and the language addressed to small children, nowadays most often referred to as child-directed speech (CDS), differs significantly from the speech adults use among each other. (Stoll, 2015, p. 153)

But what are the characteristics that differentiate speech addressed to children[3] from speech addressed to adults? In a systematic review, Saint-Georges et al. (2013) include 144 articles in a review of the evidence on motherese, restricting the target child age to two years (infant-directed speech). They analyze the articles identified with respect to evidence on motherese characteristics, variations within those characteristics (cross-linguistic variation, variation by child- or parent-level variables) and evidence on the effect of motherese on infant development. In summary, the evidence reviewed suggests that infant-directed speech has prosodic, lexical and syntactic properties that distinguish it from speech directed to adults: exaggerated intonation contours, longer

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[2] Various terms are used to denote the same or similar concepts. Terms found in the literature include 'parentese', 'fatherese, 'caretaker talk', 'baby talk'.

[3] Following Fischer (2016, p. 86) speech addressed to children younger than 12 months is typically referred to as 'infant-directed', while speech to older children and children of unclear ages is referred to as 'child-directed.

pauses, higher pitch, a wider F0 range, a restricted lexicon and higher frequency of diminutives, higher proportions of questions and imperatives, reduced utterance length, exact and partial repetition (cf. also Soderstrom, 2007). There is also evidence that, while features persist in speech to toddlers, there are changes over developmental time, depending on the child's linguistic abilities (e.g., Poulain & Brauer, 2018).

The association of particular properties of speech directed to infants and children with child language outcomes has been investigated in many correlational studies. These are not further discussed here as the present study focuses on description of characteristics of child-directed speech (for a recent meta-analysis on the association between features of input and child language outcomes, cf. Anderson et al., 2021).

While "many Western middle-class adults speak to young children in some special ways […]" (Tomasello, 2003, p. 108), there is serious doubt about the universality of this special way of talking with children. In fact, there is ample evidence against the universality of any particular property or a particular configuration of properties in speech directed to infants and children (Lieven, 1994), and the frequency with which children are addressed directly varies substantially across cultures (Casillas et al., 2020).

The role of different aspects of the context in which language learning takes place has been studied extensively (Hoff, 2006; Rowe & Weisleder, 2020). Because the "communicative interactions among caregivers and children that lead to language learning are culturally constructed" (Rowe & Weisleder, 2020, p. 204), societal norms, language ideologies and political and economic systems all shape the language environments in which children learn language, that is, they shape the quantity and nature of the micro environment (the everyday experiences of communicative interaction). In fact, aspects of the broader environment (socio-economic status, cultural setting) appear to interact in complex ways with aspects of immediate situational contexts, such that "the activities children participate in may be an important mediator between aspects of the macroenvironment […] and the properties of the language they hear." (Rowe & Weisleder, 2020, p. 210). As a result, "apparent subcultural differences are maximized by focusing on single contexts and minimized by averaging across a variety of naturally occurring contexts" (Glas et al., 2018, p. 659). Similarly, differences in characteristics of child-directed speech that were observed as a function of socio-economic variables have been found to be moderated by particular communicative settings (Hoff-Ginsberg, 1991).

Describing the situational context and, ultimately, modeling the way in which situational context influences the characteristics of speech addressed to children in and across contexts is thus highly relevant understanding how human beings become competent users of language.

2.2 Impact of activities on child-directed speech

Attention to the impact of situational context on child-directed speech is not new. Studies that investigate the effect of kind of activity on measures of speech directed at children have been published since the description of child-directed speech became a central endeavor in child language research, with the goal to investigate whether characteristics of child-directed speech vary in strength or occurrence depending on the immediate, interactional context (Snow et al., 1976).

As a consequence, the number of empirical studies analyzing activities in relation to a variety of characteristics of child-directed speech is overwhelming. Systematic and scoping reviews offer comprehensive overviews of the available evidence. Holme, Harding, Roulstone, Lucas and Wren (2021) present a scoping review on caregivers' language use across activity contexts, collating primary studies written in English that compare linguistic measures across at least two activity contexts. The final set of 60 studies, reported in 59 publications, covers studies using within-participant designs comparing (a) measures across a variation of the same activity context (within-activity comparisons, such as playing with toys vs. playing without toys), and (b) comparing measures across activities (across-activity, e. g. bath time vs. play). Rather than a synthesis of findings, this review offers an insightful survey of the characteristics of studies published in the domain of activity context and parental language use. As expected, populations studied were homogenous (biased towards mothers as caregivers, US populations and mid to high SES background)[4]. Studies typically report a measure of quantity (e. g., total word or utterance counts), type-token-ratio and rate of speech. Other measures frequently reported are pragmatic function of utterances, conversational turns to index dialogue participation. Complexity is usually operationalized in terms of mean length of utterance (MLU). Syntactic measures are

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[4] It should be noted that search strategy and inclusion of the review were themselves not designed to counter bias, and studies were restricted to English publications.

less frequently observed (including frequencies of grammatical categories, Holme et al., 2021, pp. 6–7). Within the review, studies were counted with regard to study design and method. The survey reveals that most studies (more than half) use task-based or researcher-instructed designs to study the impact of activity on language use (Holme et al., 2021, p. 8). From their narrative synthesis, the authors conclude that "findings suggested that play activities provide opportunities for co-operative interaction, while book reading is a context in which children are exposed to complex linguistic input." (Holme et al., 2021, p. 11). As the authors note, the dominance of play and book reading in studies is indeed likely a reflection of cultural bias in research communies (p. 12), but also, I add, a reflection of practical constraints (these activities can easily be observed in the laboratory, or in home environments, while care-related activities are less amenable to observation by outsiders). What is missing from the review is a survey of the notion and operationalization of 'activity' in the included studies. In fact, studies have used a variety of taxonomies of activities. For example, Roy et al. (2015), investigating early word learning in an exceptionally large longitudinal corpus of one child, build on Bruner's notion of interaction format (Bruner, 1983). An interaction format is "a contingent interaction between at least two acting parties, contingent in the sense that the responses of each member can be shown to be dependent on a prior response of the other." (Bruner, 1983, p. 132) Abstracting from Bruner's extremely detailed and dense descriptions of interaction formats, they propose to model the environment in term of its spatial, physical and social dimensions, arriving at what they call activity contexts that can be identified automatically in their corpus by applying topic modeling to the data, and thus constructing activity context based on words. The predictability of the occurrence of particular words in specific social and physical settings (formats) is what, on this view, supports language learning. The approach to coding used in Roy et al. is not applicable to typical datasets, but the context-specificity of words has been demonstrated in studies that use inductive coding schemes on naturalistic data (Tamis-LeMonda et al., 2018). More recent studies tend to adapt activity categories that were used in previous works: For example, Rosemberg et al. (2020) refer to Glas et al. (2018)'s clusters for collapsing a variety of activities into broader categories based on whether they were concerned with the household or with the child, distinguishing further between social and solitary child-centered activities. Social child-centered activity types encompass interactions with children, including play, booksharing and conversational interactions between adult and child. In contrast, solitary child-centered activities do not involve scaffolding or guidance by

an adult, for example playing alone or exploring the environment (Glas et al., 2018, p. 643; Rosemberg et al., 2020, p. 22). Analyses are based on activity types, not individual subtypes, so book sharing, conversation and play activities with adults are collapsed into one analytical category (this is partly because of a lack of data for activity subtypes, see Glas et al., 2018, p. 656). Soderstrom and Wittebolle segmented recordings taken in the home and in the nursery into 5-minute blocks of observation, which were then classified into activity categories (2013, p. 4). Each block could be annotated for a single activity. Three distinct categories of playtime were defined (differentiating between organized play, child-directed play and outside play). Book sharing was coded separately as 'Storytime'. The coding system notably defined a 'transition' category (comparable to the category used in Tamis-LeMonda et al., 2018), in addition to other categories involving care, feeding etc. Adopting these scheme and the 5-minute block coding method, Clemens and Kegel annotated their sample for book reading, toy play, care activities and further distinguished "singing songs" as a separate activity (2021). In contrast to Soderstrom and Wittebolle though, they allowed assignment of multiple activities to a single 5-minute block when activities occurred in parallel.

None of these studies cited here offer a detailed discussion of the constructs they use to define activities. Instead, the currently dominant approach is, as Glas et al. (2018) write, an ethological one.

Turning to the findings of previous studies, the following review of evidence is limited to studies on German child-directed speech. The works I identified are focused on book reading and play contexts, which points to the cultural bias observed in the scoping review. Doering et al. (2020) present a cross-cultural study comparing the impact of activity on child-directed speech measures in a German (n=34) versus US-American sample of two-year-old children. This study analyzed samples of only four minutes per dyad, restricting play to a small set of researcher-provided toys, and book reading to a researcher-provided expository book. Dyads were videotaped at home, with the observer present. The following measure were entered into analysis: word types (nouns, verbs, pronouns), number of utterances, count of unique verbs, two measures of utterance complexity (mean length of utterance based on all versus on the three longest utterances), and wh-questions as an index of dialogue behavior. For the German sample, MLU was 3.56 in play, and 3.59 in book situations, and 11 % of utterances were wh-questions in play versus 9 % in book situations. A higher proportion of verb types were produced in the play versus book context (0.78 versus

0.61) while this was reversed for nouns (0.48 noun types per utterance in book versus 0.44 in play). However, the only statistically significant difference was found for utterance counts in the German sample: The number of utterances was higher in the book context (93 versus 73). This result is accounted for in reference to parental beliefs, such that German parents are assumed to emphasize exploration and child-guided play.

Poulain and Brauer (2018) analyze child-directed speech collected during joint picture book reading and joint play with toy blocks in the laboratory, measuring mothers' mean length of utterance in words, pitch variability, and pointing behavior. Target interactions were taped for around ten minutes. The verbal measure, MLU of mothers' utterances, was longer in picture book versus toy play activities. The study was primarily interested in the changing parameters of child-directed speech across contexts and developmental time such that these variables were analyzed in terms of their predictive power for outcomes in two groups of children.

Other studies report evidence on how types of activities shape caregiver-infant communication (Nachtigäller & Rohlfing, 2011; Puccini et al., 2010) but these do not compare play and book sharing activities (Nachtigäller and Rohlfing compare book sharing with looking at photographs, and Puccini et al. analyze language and gesture in two highly controlled contexts called Context of Action – manipulation of objects – and Context of Regard – looking at objects). In sum, the evidence on characteristics of German child-directed speech in books sharing and play activities is rather limited.

2.3 Goal and scope of the present study

The present study starts from the observation that studies investigating how characteristics of German child-directed speech vary as a function of activity are relatively scarce, and evidence is based on structured designs. The research questions this study seeks to address are: (1) Do characteristics of speech addressed to German-learning two-year old children vary as a function of activity in unstructured designs? and (2) What is the extent and nature of within-activity variation, both inter- and intra-individually?

Given the exploratory character and limited resources, these questions are approached in terms of a descriptive analysis.

To maximize comparability with previous studies, the age of target children for this study was determined to be two years (e. g. Doering et al., 2020). Activity coding scheme is informed by previous investigations. There is little consensus as to how the linguistic environment, i e. features of speech input, should be operationalized (Montag, 2020; Montag et al., 2018). Again, with the goal of maximizing comparability with previous studies, operationalization of measures of child-directed speech are adopted from previous research.

Results from previous studies on German child-directed speech in activity contexts (Doering et al., 2020; Poulain & Brauer, 2018; Puccini et al., 2010) do not lend themselves to any specific prediction for this study, in particular considering the mediating effect of methodological differences and other sources of variation that may moderate the magnitude of the impact of activity on verbal behaviors. However, within the scope of a descriptive study, I expect to observe evidence of differences in characteristics of German child-directed speech as a function of activity when comparing play with book sharing activities.

3 Research design and methodology

To examine the association between activity type and measures of child-directed speech, this study differs from previous studies (e. g., Doering et al., 2020) in that it uses a secondary observational approach involving inductive coding of activities from audio data and transcripts. Using existing drawn from the CHILDES database (MacWhinney, 2000b) and collected during longitudinal observational study conducted between 1996 and 2000 (Szagun, 2001, 2004b), the present study aims to supplement the currently limited evidence on whether and how child-directed speech measures vary as a function of activities in German samples. Further, it aims to "bring new insights into existing data" (Glas et al., 2018, p. 659) by detailed examination of patterns of activities observed during two-hour-long naturalistic 'free play' interactions recorded in a playroom furnished with a standard set of books and play materials (Szagun, 2001, 2004b). Descriptive statistics and qualitative analyses are designed to assess whether and how common measures of child-directed speech are associated with the ongoing activity, comparing book sharing with social solitary play.

This chapter justifies the research design and methodology underlying the present study. Chapter 3.1 outlines the methodological choices made in using CHILDES to construct a corpus for the current study. Chapter 3.2 describes the resulting sample. Coding, measures and analyses are outlined in Chapter 3.3.

3.1 Constructing a corpus for the current study

3.1.1 The CHILDES system

The Child Language Data Exchange System (CHILDES) originates in the 1980s. It is the oldest database of the TalkBank system, which is now the largest open repository of spoken language, comprising a variety of databases ('language banks') that each contain openly available resources, specialized for research into particular populations (e. g., Aphasia, second language acquisition), particular settings (e. g. classroom), or pertaining to particular research domains, including CHILDES for child language acquisition research (MacWhinney, 2022a).

The TalkBank system is devised with the goal to overcome some of the challenges that come with observational data in linguistics (e. g., lack of interoperability between transcription conventions). It comprises a standardized transcription system (built to ensure transparency and consistency), tools for automation of data analysis, and an infrastructure for compiling and publishing large amounts of linguistic data, including transcripts and original recordings, collected with diverse populations (MacWhinney, 2022a, p. 11).

The transcription format in TalkBank, called **C**odes for the **H**uman **A**nalysis of **T**ranscripts (CHAT), is specialized for transcription and coding of face-to-face conversational interactions (cf. MacWhinney, 2022a). A well-formed transcript is comprised of three components: file headers that specify metadata, main tiers which give the transcription of individual speakers, and dependent tiers which contain additional information about the main tier and can be used for annotations.

Transcripts that adhere to the rules of this format are interoperable with a set of open source programs called **C**omputerized **L**anguage **An**alysis (CLAN, cf. MacWhinney, 2022b). These programs facilitate data processing tasks and computational analysis. For example, the CLAN software allows the calculation of mean length of utterance in words (MLUw) for individual speakers. In addition, the

MOR component of the CHILDES system, built into CLAN, encompasses a program chain that add morphosyntactic annotation to CHAT transcripts (MacWhinney, 2022c). The output can then be used in analyses using CLAN tools, for example, to calculate mean length of utterance in morphemes (MLUm).

The CHILDES system is organized into collections of corpora that further organize files into folders. Corpora may comprise audio, video and text files (transcripts). Transcripts usually span one recording session. By convention, file names indicate the name and age of the target child for that session, e. g. the file rah020115.cha contains a CHAT-formatted transcript for the target child identified by the three-letter speaker ID (RAH) at age two years, one month and fifteen days (2;01;15).

To ensure automatic harvesting and indexing of CHILDES data in linguistic archives, the CHILDES system includes a metadata file called 0metadata.cdc for each corpus (MacWhinney, 2022a). This file specifies information about the corpus such as the source (creator), the language and recording context, the age of participants and information on the type of data (e. g., spontaneous vs. elicited).

A documentation file acts as a project description for each corpus. This file typically includes information about the goals and procedures of the project (citation information, funding, goals, sampling, transcription, coding, etc.), supplemented by information on the sample, for instance language background, age, gender, socio-economic background. The CHAT manual also recommends this documentation file include "descriptions of the contexts of the recordings, such as […] the nature of the activities being recorded" (MacWhinney, 2022a, p. 26). However, there are no strict requirements for the structure and content of the documentation. As a result, amount and type of information given varies for each corpus. Within the CHILDES system, more specific information about the context, including the activities captured during the recording of any particular session may be specified in each CHAT file. The following section will describe in more detail how this is done within CHILDES and, more specifically, within the German CHILDES corpora.

3.1.2 Representation of activities in the CHILDES system

CHAT conventions do require the inclusion of some file-specific metadata (e. g. on participants and languages) in initial headers. Strikingly, CHAT does not require information on activity contexts recorded in individual sessions. The CHILDES system does offer multiple methods to represent such information. In the following, to

ways of encoding will be described: (1) Encoding with constant headers, and (2) encoding with changeable headers.

(1) Encoding with constant headers

One way information on activities can be encoded in a transcript is by the use of constant headers, positioned at the beginning of a transcript. Information specified in constant headers will pertain to the entire transcript.

As a constant header, the @*Types*[5] header is designed to encode information on the design of the corpus the transcript belongs to (longitudinal vs. cross-sectional), the group membership of participants involved (e. g., typically developing children), and activities occurring in the session. CHAT pre-specifies a total of twelve values, or descriptors, to indicate activities (cf. Table 1).[6]

Table 1 overview of activities within the Types header (taken from MacWhinney, 2022a, p. 38)

toyplay	playing with toys
narrative	telling stories
meal	talk during meal time
pictures	describing actions in pictures
book	adult reading to the child
interview	asking questions of child
tests	structured tests
preverbal	adults talking to preverbal child
group	several children talking with each other
classroom	school classroom
reading	child reading
everyday	activities across the day

In addition to ensuring comparability and consistency across the CHILDES database, standardized descriptors facilitate retrieval and computerized analysis such that this information can be used to query, select and extract transcripts from CHILDES based on the desired activity as specified in the @Types header. In particular, the recently developed web interface TalkBankDB[7] (Kowalski & McWhinney, 2019) allows extraction from the TalkBank resources using activities specified in the @Types header.

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[5] Within CHAT, headers are denoted by the use of @ followed by the name of the header, followed by a colon and header entries. For instance: @Type: long, toyplay, TD.

[6] The information in the @Types header can also generically be determined for the entire corpus in a 0types.txt file.

[7] https://talkbank.org/DB/ (last accessed: 20 February, 2022)

(2) Encoding with changeable headers

Another method to indicate activities is to use changeable headers. In contrast to constant headers, these may be used multiple times at the beginning as well as within the body of the file, making it possible to segment the transcript into sections to which the information encoded applies. The @Situation header is designed for entries giving a "standard description of the situation" (MacWhinney, 2022a, p. 42). However, unlike the possible entries for the @Types header, CHAT does not prespecify values that are valid for entries of this header. Instead, the CHAT manual gives examples such as breakfast, working, etc. (MacWhinney, 2022a, p. 42). The @Situation header being intended for description of a situation, the @Activities header is recommended for more specific descriptions of "the activities involved in the situation", for instance "putting on coats" (MacWhinney, 2022a, p. 40). Thus, these headers are intended for complementary use.

A final method to include information on activities in transcripts is to use the headers @Bg and @Eg (MacWhinney, 2022a, pp. 40–41), called gem markers or gems. Their possible uses are outlined in the CHAT manual:

> One important and interesting use of gems is to facilitate later retrieval and analysis. For example, some studies with children make use of a fixed sets of activities such as MotherPlay, book reading, and story telling. For these gems, it can be useful to compare similar activities across transcripts. To support this, we have entered the possible gems in a corpus that uses gems in this way into the TalkBankDB facility in a pulldown menu. Descriptions of the gems used in a given corpus can be found on the homepage for that corpus.
> (MacWhinney, 2022a, p. 40)

As the manual indicates, the set of gems used in a corpus has to be specified and are retrievable from the project description. Analogous to the @Types header entries, gem markers are also accessible for retrieval via the TalkBankDB interface. Albeit lacking standardization, the availability of descriptions of the gems used should facilitate retrievability. Moreover, gems are interoperable with the GEM program in CLAN: "The GEM program is designed to allow you to pull out parts of a transcript for further analysis." (MacWhinney, 2022b, p. 86). Thus, this method has considerable advantages to the other changeable headers used for specifying activity information.

In sum, these methods appear to be designed for different purposes and complementary use. Entries of the @Types headers offer standardized activities describing entire transcripts while changeable headers offer the opportunity to describe the more general situation and activities within transcripts for human readers. Finally,

gems can be used for retrieving, comparing and analyzing segments with similar activities from within the same or from across transcripts.

All of these methods being optional, it cannot be expected that any of these methods are used in corpora or if they are, that they are used consistently. As the current study aims to compare characteristics of German child-directed speech during book sharing and play activities, I began the corpus construction process by exploring how information on activities is represented in the German subsection of the CHILDES database. To start with, I used the TalkBankDB query tool complemented by inspection of transcripts in the CHAT editor. As described above, the TalkBankDB query tool allows selection of transcript based on a prespecified set of activities from the @Types header (cf. Figure 1).

Figure 1 Query system in the TalkBankDB: querying CHILDES database by Activity Type
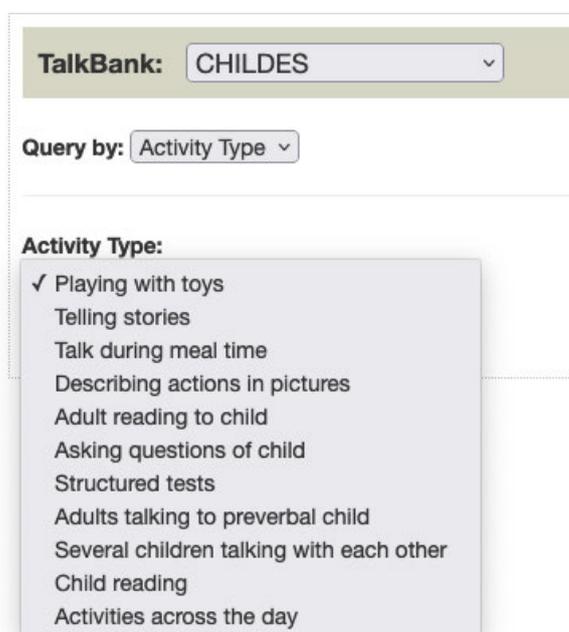
For the German corpora, the query renders results for three of the categories: "Describing actions in pictures", "Structured Tasks, and "Playing with toys". A closer look at the transcripts returned by these filters reveals some inconsistencies:

The activity "Describing actions in pictures" is used for all transcripts from the Caroline corpus while in fact this corpus includes a variety of activities, such as playing together with toys during a session recorded at age 2;6 (file PID 11312/c-00022803-1). Another transcript header specifies that mother and child were sharing a book during the session (PID 11312/c-00022810-1). Thus, in this corpus the

@Situation header is used to indicate the broader activity context but the @Types header is not used in the intended way.

The activity category „Playing with toys" is used as a generic category in the German subsection of the CHILDES database, and corpora deal differently with specifying situational information and activities within transcripts. For example, transcripts in the Rigol corpus elaborate on the specific situation using the @Situation header at the beginning of the transcript, providing a rather detailed description of what was happening during the recording. Transcripts in the Miller and Leo corpora specify information on the situation using the @Situation header as well as the more generic @Comment header (sometimes in combination) to indicate the general situation or what the child is doing. The Szagun corpus makes use of the @Situation header to specify the location (Playroom in a University) but does not further specify particular activities. The more recently added Koch corpus uses the @Activities header and the @Situation headers in combination, i.e., indicating the general situation in the @Situation header (e. g., playing at home) and provides a list of the specific activities that occur in the session in the @Activities header (e. g., playing, book sharing, painting, doing puzzles; see the file Koch/Marieke/ma020302.cha for an example of this).

However, none of these corpora specify activities or changes of activities that occur during the recorded session. An exception is the Wagner corpus which employs the @Activities header to denote changes of activities in the transcript, e. g. the transcript starts during a game involving tooth brushes, and then changes – as indicated by the @Activities header entry – to a conversation about football and back to play activities (see PID 11312/c-00024721-1 as an example). None of the German CHILDES corpora include any gem markers.

This survey has shown that – as a result of the optionality and lack of standardization of information about activities in corpora and transcripts – the selection of German CHILDES data by activity type will to some degree depend on reading through documentation files and transcripts to identify relevant material. Further, analyses of speech occurring during specific activities will require annotation of activities and activity changes that occur within transcripts.

3.1.3 Selecting data from the German CHILDES database

Sampling participants and transcripts from the database is a major methodological choice to be made when working with CHILDES data. One of the advantages of the conventions of the CHILDES system is that for any particular study, a new corpus can be derived using all relevant corpus data available (Behrens, 2012, p. 6). However, variation is not systematic within the CHILDES database. Comparability across corpora is not trivial as corpora are idiosyncratic across all stages of corpus creation (Stoll & Schikowski, 2020, p. 323). Thus, sources of variation should be examined carefully when constructing a corpus, considering the research question at hand.

For this study, the occurrence of certain types of activities (contextual variation) occurring in the transcripts constitutes a necessary criterion for inclusion into the study. Other sources of variation which may impact the outcome variables under investigation may be present in the corpora (Corrigan, 2012, p. 275). Such variables include but are not limited to individual variation (e. g. number of participants, age, gender, socioeconomic background) and distributional variation (length of recordings, size of the language samples, cf. Stoll, 2015, pp. 144–146). These should be considered at the stage of corpus construction; the sampling decisions presented here constitute an attempt to identify and control or keep constant those variables not analyzed in the study.

The German collection within CHILDES currently contains 13 corpora, the most recent addition being the Koch corpus which was added to CHILDES in late 2021 (recordings begin in 2013, see Koch, 2019, 2021). All other German corpora in CHILDES are considerably older, with recordings made in the 1970s, 1980s, 1990 s and early 2000s.[8] These corpora differ with respect to design (case study, cross-sectional, longitudinal), age, number and characteristics of participants, recording context (at home vs. in the lab), sampling density, duration of sessions, amount of transcribed data, setting (naturalistic and semi-naturalistic setting versus structured task), and range and kinds of activities recorded (e. g., structured tasks vs. spontaneous interaction).

A set of criteria were determined to select data from the German CHILDES database for the current study of characteristics of child-directed speech. Considering

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[8] For an overview of the German CHILDES corpora, see https://childes.talkbank.org/access/German/
(last accessed: 20 February, 2022)

the goal of this study, requirements for corpora to be considered as a source for the current study were

1) the target population: typically developing children at the age of two years,
2) the corpus design: naturalistic or semi-naturalistic recordings and involves spontaneous interactions between an adult and a child during book sharing and play activities,
3) transcripts must include child-directed speech and follow CHAT notations that allow semi-automatic morphosyntactic annotation using CLAN

After screening the German corpora for criteria 1) – 3), two corpora were considered as sources for the current study: (a) the Leo corpus (Behrens, 2010) and (b) the Szagun corpus (Szagun, 2004a). Data from the Caroline corpus, the Wagner corpus and the Miller corpus were not further considered because transcripts contain "eye-dialect" and do not consistently apply CHAT methods to represent phonological reductions in a way that allows use of German MOR (e. g., using replacement notation).[9] (a) The Leo corpus (Behrens, 2006, 2010) is a longitudinal case study of a boy named Leo. Data was collected between 1999 and 2002. The main study started at age 2;0 when data was sampled at a rate of five hourly recordings per week up until age three. Transcripts are supplemented by diary notes taken by the parents. Recordings took place in the home environment and encompasses a variety of everyday activities and play situations. (b) The Szagun corpus (Szagun, 2004a, 2004b) also uses a longitudinal design. Data was collected between 1996 and 2000. The goal of the project was to examine language acquisition in typically developing and hearing-impaired children with cochlear implants, analyzing the acquisition of morphological paradigms (Szagun, 2001, 2004b).[10] Recording sessions of two hours each were made at ages 1;4, 1;8, 2;1, 2;5 and 2;10. Of the 22 participating typically developing children, six children were recorded more frequently. Unlike recordings for the Leo corpus, sessions were taped in a playroom at the university, furnished with age-adequate toys and books, evoking activities such as book sharing and different

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[9] Note that the Rigol corpus is in principle a good candidate for analyses of German child-directed speech and child-surrounding speech. However, this corpus requires addressee coding because sessions typically include multiple speakers, including other children and adults. Thus, while not considered for the current study, the Rigol corpus might be of interest for future studies, in particular because video data is available upon request. Note that at the time the selection was carried out, the Koch corpus had not been uploaded yet and is thus not considered in this thesis.

[10] A second corpus of matched hearing-impaired children wearing cochlear implants is available via CHILDES (cf. Szagun, 2000)

play activities. Within this context, children and their caregivers could choose how to spend their time freely and interact spontaneously.

Constructing a corpus from both of these corpora would enable comparative analyses of the impact of activities in the home environment versus the laboratory (as previous studies have done, e. g. Belsky, 1980) as play and book sharing activities were observed in both of these studies. However, further sources of variation across the two corpora would need to be controlled when selecting data or to be accounted for in the analysis (e. g., materials, language sample size, transcription conventions). Thus, the final analytical sample for the current study was extracted from one corpus only, limiting analyses to one setting and one sample. The Szagun corpus was chosen because it is not restricted to one child, providing the opportunity to explore individual variation, and the standardized setting ensures comparability across sessions. From the total sample of 22 children in the Szagun corpus, three target children were selected for the current study. The final corpus is described below.

3.2 Data

3.2.1 Participants

A criteria-based sample (n=3) was drawn from the original sample (N=22) of typically developing children who are part of the Szagun corpus in CHILDES (Szagun, 2001). To limit the number of extraneous variables that are known to impact interactional and verbal behaviors, the present study is restricted to girls recorded interacting with their primary caretaker of the same sex. No sibling was to be present during the recordings. Since the study focuses on two-year old children, two recordings were chosen that had been taken during participants' third year of life. Children were aged 2;1 at the time of the first selected recording (data point 1 [DP 1]) and 2;5 at the time of the second recording (data point 2 [DP 2]). For all six sessions, transcripts and audio files were retrieved.[11]

Sampling in the original study was based on self-selection: potential participants were informed via brochures distributed in pediatricians' cabinets and daycare centers and interested parents took up contact with the research group (Szagun, 2001, p. 116).

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[11] While children were also observed at age 2;10, child-directed speech for these sessions has not been transcribed yet (Szagun, 2004a).

All participating children were monolingual and typically developing residents of Oldenburg whose parents speak the standard variety of High German (Szagun, 2001, 2004b; Szagun et al., 2007). Initial mean length of utterance calculated in morphemes per utterance (MLUm) is reported in the literature. For the entire sample (N=22) MLUm at age 1;4 , i.e., the first recording, was equal or below 1.25, ranging from 1.0 to 1.23 with a mean of 1.05 (cf. Szagun, 2001, p. 117). No developmental delays were reported. Further information on participants' background is not available; according to Gisela Szagun (personal correspondence, 20.11.2021) socioeconomic data was not systematically collected in the original project. From informal conversations with parents and conversations recorded during the sessions, some information on socio-economic background could be reconstructed.

Participant data including birth rank is reported in Table 2. The data is a first indication that participants come from middle to high socioeconomic backgrounds, but given the uncertainty of this information, it is not entered in any analysis.

Table 2 Participant data

	Celina	**Emely**	**Rahel**
Age at data point 1	2;01.04	2;01.26	2;01.15
Age at data point 2	2;05.04	2;05.18	2;05.12
Birth rank	1	2	1
Mother's education	unknown	high school	high school
Father's education	unknown	university	high school
Mother's profession	cosmetician	student (psychology)	student (psychology)
Father's profession	unknown	teacher	student (psychology)

Note. This data was not collected systematically but retrieved from transcripts and informal conversations.

At the time of the recordings analyzed here, all three children and their mothers had been to the university playroom at least twice (the first recordings had taken place at age 1;4). For Celina and her mother, the sessions included in this study correspond to the third and fourth visit, respectively. Both Rahel and Emely were part of the more frequent sampling regime, recorded every 5-6 weeks so data points 2;1 and 2;5 correspond to the eighth and eleventh visits.

Table 3 summarizes global measures of child's expressive language behavior at each data point.

Table 3 Children's linguistic measures at ages 2;1 (DP 1) and 2;5 (DP 2)

	Celina		Emely		Rahel	
	DP 1	DP 2	DP 1	DP 2	DP 1	DP 2[12]
Word count	699	772	1198	1049	757	1056
Utterance count	607	486	1061	647	492	444
MLUw	1.152	1.588	1.129	1.621	1.539	2.378
(Standard deviation)	(0.406)	(0.891)	(0.373)	(0.87)	(0.865)	(1.212)

Note. All measures were calculated using the MLU command in CLAN. Here, measures are based on utterances that contain no unintelligible speech. Word counts exclude retracing and phonological fragments. All counts exclude rehearsed material (singing routines, recitations from book texts).

Mean length of utterance (MLU) is a measure of language development and is calculated by dividing the number of morphemes by the number of utterances (Brown, 1973). In highly inflecting languages such as German, determining the number of morphemes can be problematic (Behrens, 2006). Since MLU based on words (MLUw) has been shown to correlate with MLUm (Parker & Brorson, 2005), MLU is often reported based on words instead of morphemes (e. g. Behrens, 2006; Clahsen et al., 1993; Doering et al., 2020; Poulain & Brauer, 2018). Here, the CLAN program was used to calculate children's MLUw. The ranges of MLUw calculated from this sample of child speech are unremarkable for the age group (comparable to MLU reported for two-year-old children in Behrens, 2006; Doering et al., 2020; Poulain & Brauer, 2018; Schmerse et al., 2013). Each child's MLUw increased in the four months between the recording sessions, which is evidence that their utterances became longer. However, these results need not reflect true differences in language ability between children and across sessions because longer utterances may differ from target language, thus not reflective of grammatical ability (Eisenbeiß, 2010, p. 7). Furthermore, MLU is susceptible to the influence of a variety of extraneous variables, including the behavior of interlocutors (DeMaris & Smith, 2017; Dethorne et al., 2005). Differences in segmentation decisions and transcription of repeated words may also influence MLU outcomes (Eisenbeiß, 2010, p. 20; MacWhinney, 2022a). Children's MLU is reported here primarily to allow comparability with other studies and to give some indication of children's expressive language behavior at the two data points.

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[12] RAH's session at data point 2 was only partially transcribed (approx. 100 minutes). All other sessions were fully transcribed (i. e. approx. 120 minutes)

3.2.2 Description of data collection, sessions and transcription

Each two-hour session was taped at a playroom at the University of Oldenburg (Szagun, 2001, p. 117).[13] Caregivers and children were audio- and videotaped during "free play" for which a standard set of play materials and books was provided (for a list of the materials, see Section 4.2.3 below). In the literature, the term 'free play' refers to child-directed forms of play, meaning adults do not structure or intervene with the child's activity (cf. Wasik & Jacobi-Vessels, 2017). In the original project, 'free play' refers to the absence of task-structure during recordings. Sessions were not researcher-directed and parents did not receive any instruction as how to engage with their children. Children were allowed to choose freely from the toys and books available in the playroom. Caregiver-child dyads were free to play with toys, share books together or interact without using play materials. Parents were also free to let their children play by themselves.

The documentation file in CHILDES defines the type of the study as 'naturalistic' (Szagun, 2004b), reflecting the fact that interactions were spontaneous and unstructured (cf. Eisenbeiß, 2010, p. 1). While investigators did engage with participants to varying degrees, their spontaneous interactions with participants (playing with the child and having coffee with the caregiver) allowed participants to familiarize themselves with the situation, reducing observer effects that may initially be reinforced by the presence of an investigator. However, as in any naturalistic study, participants were not oblivious to the fact they were being recorded, necessarily affecting their behaviors (Eisenbeiß, 2010, p. 1). By not disclosing that caregivers' speech would be analyzed, researchers attempted to minimize the effect of observation on parental behavior (cf. Szagun, 2001, p. 117).

Samples collected in naturalistic studies "have a high ecological validity as the recording situation closely approximates the real-life situation under investigation." (Eisenbeiß, 2010, p. 1).

Regarding the child-directed speech samples collected in this setting compared to a real-life play situation in the home environment, two aspects of the design pose a threat to the representativeness of the data: (1) A set of standardized play materials was used, limiting the ecological validity of the study but enhancing comparability across samples. Features of the play context, notably the number and types of toys available,

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[13] Only audio data has been archived.

have been shown to affect interactive and verbal behavior in complex ways (see Caldera et al., 1989 for a study on the impact of sex-stereotyped toys on parent-child interactions; O'Brien & Nagle, 1987 reporting effects of toys on child-directed speech measures; O'Neill et al., 2019 for a study on the association between visual toy design and specificity of parents' reference to aspects of the toy; Sosa, 2016 for a study assessing the impact of electronic versus traditional toys on child and parent verbal behavior). Hence, keeping play materials constant by providing a standardized set of toys results in a reduction of variation in language samples that occurs due to extraneous variation in naturalistic settings (Bornstein & Haynes, 1998). (2) Study location limits the ecological validity of the data collected, since data was not collected in the home environment but in a university playroom. Location (laboratory room versus home environment) is known to have an influence on interactive and language measures (O'Brien et al., 1989; Stevenson et al., 1986). However, the factors that cause such variation are varied (Belsky, 1980; Stevenson et al., 1986), and their impact may be alleviated (e. g. by enhancing familiarity in studies set outside the home environment, cf. Stevenson et al., 1986). In fact, differential effect of location (lab vs. home) have been shown to exist for some measures of parental verbal behavior but not for others (O'Brien et al., 1989; Stevenson et al., 1986), and comparative studies have demonstrated that particular interactional contexts reduce differential effects of location to the extent that observing interactions in a typical context, that is, contexts such as toy play and book sharing which occur naturally in the home environment, results in comparable behaviors in both laboratory and home environments (cf. Study 2 in O'Brien et al., 1989). As a consequence, recording interactions in specific activities in an environment outside the home may not necessarily be less representative of interactions in these activities than when they are recorded in the home:

Having researchers prompt these activities, often directly following one another, and observing each context for very short stretches of time (e.g., four minutes per activity in Doering et al., 2020), raises the question whether really capture characteristics of interactions as they would occur in the same location but under unstructured and uninstructed conditions (as noted in Doering et al., 2020, p. 16).

Analyses of activity occurrence have revealed that book reading is not a very frequent activity in the non-manipulated everyday life of a child (Clemens & Kegel, 2021; Soderstrom & Wittebolle, 2013). This is one of the reasons why studies tend to use task-based and researcher-directed designs to record specific activities (Holme et

al., 2021, p. 12). This is changing due to new technologies (e.g., 'longform audio' Soderstrom, 2021) that allow dense observations from maximally unintrusive recordings at home, lasting from 45 minutes (Tamis-LeMonda et al., 2018) to the entire day (Soderstrom & Wittebolle, 2013). Still, these procedures are very costly, and comparability is compromised. Thus, in studies aiming to compare book sharing and other contexts, inducing book reading activities through minimal intervention may be a way to gain control over the activities while maintaining a high degree of ecological validity. In a recent study, Clemens and Kegel compare data from completely parent-directed recordings with data collected after parents had been prompted to engage in book reading and toy play (Clemens & Kegel, 2021). Both recordings were collected by parents in their homes, using a minimally intrusive recording device. Toys but not books were supplied by the researchers. Analysis of activities revealed that during uninstructed recording, only half of parents engaged in book reading, and 80% in toy play. The study showed that while adult word count, conversational turns and child vocalizations differed by activity, there was no impact of prompting parents to do reading and play with the toys provided. This suggests that "small instructions do not influence the language used by parents" (Clemens & Kegel, 2021, p. 384), indicating that the degree of instruction or prompting matters.

Different interacting aspects of study design shape the impact location has on observed behaviors. Considering the task-free, unstructured recording conditions of the Szagun corpus project, I argue that this setting is best characterized in terms of a 'standardized naturalistic setting' since it combines minimal instruction with a standardized environment, allowing researchers to balance practicability and comparability (Bornstein & Haynes, 1998, originally use the term 'standardized naturalistic situation' to describe data collection involving observations of free play interactions with standardized toys in the home environment).

Since transcription decisions affect outcomes of linguistic analyses, I now describe the transcription procedures. Gisela Szagun and her graduate assistants transcribed speech from audio and video recordings following CHAT notations. Transcripts were not time locked to media data. Audio tapes included these segments and showed some cutting errors so the exact duration of sessions in minutes cannot be inferred from their length (sessions were scheduled to last two hours). All transcribers were trained to use CHAT (Szagun, 2001, p. 118). Due to later updates, reliability checks given in early publications (Szagun, 2004b, pp. 9–10) are not applicable to the current versions. Reliability checks on updated transcripts are not available.

Transcripts have been updated at least once to facilitate use of German MOR (see the documentation file in Szagun, 2004a). A second update is pending; it concerns the completion of transcription of all child-directed speech. Originally, children's language was transcribed in its entirety but only a subset of child-directed speech was transcribed at data points 1;4, 1;8, 2;1 and 2;5 (a minimum of 500 utterances per adult per session).[14] Comments on the %com tiers in the transcripts indicate the point after which child-directed speech was transcribed only to facilitate understanding children's productions. Gisela Szagun is currently completing transcription of all child-directed speech at all data points. Pending upload to CHILDES, four of the transcripts already finalized were supplied by Gisela Szagun for inclusion in the current study (target children: Celina, Emely). An additional two transcripts were retrieved from the CHILDES system in October 2021 (target child: Rahel). These transcripts have not yet been subjected to completion of transcription of child-directed speech. Despite this, one of these transcripts has already been fully transcribed (rah020115.cha). The other transcript exported from CHILDES (rah020512.cha) however does not contain all child-directed speech recorded, resulting in a lower quantity of child-directed utterances available from that session (missing approximately 20 minutes of recording).

For the current study, this transcript was abridged, deleting all transcription following the final child-directed utterance transcribed verbatim. Consistency of segmentation into utterances was not checked but adopted from the original transcripts. Changes to the included transcripts were made in the coding and analysis process of the current study to facilitate morphosyntactic annotation and analyses using CLAN. First, utterances clearly not directed at the child (judged by content and intonational cues using the audio files) were marked using the postcode [+ bch]. Inconsistencies were found in transcriptions of recited speech and verbatim reading. To differentiate spontaneous speech from rehearsed speech, utterances reciting nursery songs and rhymes were marked with the postcode [+ R] (e. g., the well-known rhyme cited when drawing a smiley face *Punkt Punkt Komma Strich, fertig ist das Mondgesicht* ['Dot, dot, comma, dash, smiley face in a flash']). In order to be able to differentiate extratextual speech from reading during book sharing, the postcode [+ txt] was appended to all verbatim reading, including children's recitals of book passages.

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[14] Note that adult speech (including that of the investigator) not directed at the child is not transcribed verbatim (Szagun, 2011, p. 738) so that the addressee of any adult speech can be expected to be the child.

Postcodes can be used in CLAN programs to automatically exclude or include utterances for analyses. CHAT notation inconsistencies such as missing replacements as well as spelling errors were corrected, and inconsistently transcribed words were standardized. In accordance with CHAT notations, fixed phrases, including acronyms and book titles, were transcribed as one phrase using _ (e. g., *L_K_W* for *LKW,* 'truck'). Other transcription inconsistencies related to transcription of vocalizations or onomatopoeic sounds. These were also normalized using special form markers (@o for onomatopoeic sounds, @i for vocalizations). Alphabet letters were transcribed using the special form marker @l. When necessary, the audio recording was consulted to aid in determining the correction to be made. Reliability of transcripts and codes was not be evaluated formally.

Although there was some interaction between participants and investigators in each session, the time investigators spent interacting with the child, the mother, or both, varied depending on the child's behavior and mood. The quantity of transcribed child-directed utterances investigators produced ranges from 28 to 197 per session. Variation in the amount of investigators' involvement notwithstanding, the quantity of child-directed speech produced by the mother always exceeded the amount of speech produced by the investigator. Because of the high variation in amount and quality of interaction between the child and the investigator, analyses are restricted to mothers' child-directed utterances.

3.2.3 Description of play materials

Participants in this study were offered a variety of age-appropriate toys and books supplied by the researchers that carried out the data collection. None of the materials were manipulated by the researchers, and the same materials were used at all time points. Since the toys and books were chosen based on popularity, most children and parents were familiar with at least a subset of the materials provided. For instance, some families owned copies of some of the books provided, and toys were recognized from the children's homes or their friends' homes.

Because the original study did not intend to analyze effects of toys on linguistic measures, there is no systematic documentation of the specific toys and objects used (personal correspondence with Gisela Szagun, 20.11.2021). Some information about the toys is given in the literature (e. g. Szagun, 2001, pp. 117–118). Similarly, there is no systematic documentation of the picture books that were offered during sessions.

Additional information on the materials could be recovered from transcripts and recordings. An overview of play materials given in Table 4.

Table 4 Overview of play materials in the university playroom

Functional toys	Wooden hammer, chalkboard, puzzles, music instruments, wind-up toys
Representational toys	Toy cooking set including a tea set, toy phone, shop (*Kaufmannsladen*), toy car, doll, doll's medical kit
Model toys	Model farm and farm animals, model school house, model doll's house, miniature figures, miniature cars and vehicles, parking-deck (garage), model train
Construction-play toys	Stacking sets (pearls, rings, cups)

This list is not exhaustive as it only includes materials that could be identified from recordings, transcripts, and earlier publications. The typology of toys is based on Creaghe et al. (2021).

Typical children's picture books belong to the narrative (storytelling) or expository genre (factual texts, including early concept books that depict and label objects). They differ with respect to the presence and complexity of text and illustrations (cf. Kurwinkel, 2020 for a comprehensive account of picture books). Children's books vary with respect to the amount of text they contain; hidden objects typically do not contain text but very busy pictures, while narrative books for this age group are usually illustrated and contain a few short sentences per page. Expository books for young children may include text but typically contain one word per page.

The selection of picture books in the university playroom included narrative books, expository books, and *Wimmelbücher* (hidden object books). One of the hidden object books was *Rundherum in meiner Stadt* ['All around my town'] by Ali Mitgutsch. Hidden object books encourage the child to discover and talk about the scenes depicted. Most of the narrative books that were read in the recordings are part of a series of very popular picture books for young children published by Ravensburger. They include but are not limited to the following titles: *Ich bin der kleine Bär* ['I am the little bear'], *Ich bin der kleine Hund* ['I am the little dog'], *Ich bin die kleine Katze* ['I am the little cat'], *Ich bin die kleine Maus* ['I am the little mouse'], *Ich bin der kleine Löwe* ['I am the little lion']. Other storybooks popular with participants were *Puck und seine Tiere* ['Puck and his animals'] and *Zwerg Putz hat gute Freunde* ['Dwarf Putz has good friends'] published by Pestalozzi, as well as *Mein kleiner Bruder* ['My little brother'], and *Ich habe ein Dreirad* ['I have a tricycle']. Expository books included exemplars of the series *dies und das* ['this and that'] published by

Finken, for instance *heiß und kalt* ['hot and cold']. Other books might have been present in the playroom but could not be identified because they were not talked about in the sessions analyzed.

3.3 Coding, measures and analyses

3.3.1 Morphosyntactic coding

To identify nouns and verbs all child-directed utterances produced by mothers were annotated using CLAN's MOR program (MacWhinney, 2000a)

MOR is specialized for part-of-speech tagging of CHAT data. The program relies on language-specific lexical entries (lemmas) and a set of rules that specify allomorph rules, concatenation and rules for special CHAT notation forms, e. g. for onomatopoeia or neologisms (for an overview of POS tags for special form markers, see MacWhinney, 2022a, p. 45).[15] Using these resources, inflected forms are derived at run time.

For German, the MOR grammar was recently developed by Nikolas Koch (for a description of the German MOR grammar, see Koch, 2019; MacWhinney, 2008, for descriptions of the MOR program, see 2022c). The MOR program chain executes three commands (MOR, POST, POSTMORTEM) which work together to generate the %mor tier on which each unit is structured as follows:

Prefix#
part-of-speech|
stem&fusionalsuffix-
suffix

The %mor tier has a one-to-one correspondence with the main line (see Example (1)). Each word on the main line has a corresponding MOR tag which provides information about the part-of-speech, lemma, and morphosyntactic structure.

(1)   *MOT: wo is(t) das Auto, Emely ?

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[15] For example, the POS tag for onomatopoeia is "on" so MOR will output on|brmmm for the string *brmmm@*.

%mor: pro:int|wo cop|sein&PRES&3s
              det:art|das&n&sg&nom&acc n|Auto&n&sg&nom&acc
              cm|cm n:prop|Emely ?
              'Where is the car, Emely ?'   [eme020126][16]

MOR automatically ignores phonological fragments, unknown or untranscribed forms (*xxx*), retracings (marked [/]). As can be seen in the example above, MOR relies on correct use of CHAT standards to parse transcribed speech containing phonological reductions.

After successfully running check on all transcripts, I ran MOR with options +xb and +xc ("lexicon mode"), using the German MOR grammar (version from October, 2021).[17] This resulted in a list of words that are either unrecognized (e. g., because of spelling errors) or not yet in the MOR lexicon. The next step was correcting any misspellings or CHAT errors, and entering missing words to the lexicon in order for automatic annotation to succeed. After correcting spelling errors and normalizing unnormalized strings or applying CHAT notation to transcripts where they had been missing (e. g., when transcribing phonological reductions), MOR was run a second time using the +xl option (lexicon mode). This facilitates adding entries to the MOR lexicon by outputting types not recognized by MOR. Unrecognized words were added to the lexicon files contained in the German MOR by adding the file 0added-twente.cut to the MOR folder CLAN was accessing [18]

In order to add new entries to the lexicon, it is recommended to enter the citation form supplemented by syntactic category information, for the determination of which I relied on context from transcripts.

Finally, I ran MOR without options on the mothers' speaker tier in each transcript. Upon inspection, there are some issues with the automatic annotation, which is to be expected as no tagger is 100 % accurate. Accuracy of the current German MOR grammar has been reported to be ca. 90 % (Koch, 2019, p. 170; MacWhinney, 2022c, p. 14). However, it remains unclear how tagging accuracy was evaluated so this evaluation outcome is not verifiable.

In this case, I examined the output to assess the amount and types of errors made. In a post-MOR manual coding pass, I corrected the errors identified (using the kwal

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[16] Transcripts from the Szagun corpus are referenced in the format id_targetchildyearsmonthsdays.

[17] The +xb option allows to localize an unrecognized word in the transcripts so that it can be easily accessed and corrected by double-clicking. The option +xc includes capitalized words (MacWhinney, 2022c, pp. 17–18, 28).

[18] All files, including outputs of MOR can be consulted in the supplemental materials. These also contain a copy of the German MOR grammar.

command which allows finding and replacing strings in CLAN). One type of error was caused by unnormalized strings, such as evident in Example (2).

> (2) *MOT: das find ich angenehmer.
> %mor: pro|das vimp|finden&IMP&2s pro:per|ich adj|angenehm-cp.
>   'I like that better.' [rah020512]

Here the string *find* should have been standardized to *find(e)* in the update of the corpus as specified in the corpus description file on CHILDES.[19] The main line should read *das find(e) ich angenehmer* ('I find that more agreeable') so MOR could parse it as *find-e* (tag: v|finden-PRES&1s). In fact, such cases were numerous. Even after attempting to correct them in the process of this annotation, it should be noted that errors in the transcripts remain. Given the planned usage of the morphosyntactic annotation for retrieval of nouns and verbs, and calculation of measures of lexical diversity from lemmas, errors pertaining to inflection were exempted from any corrections.

A problem more relevant to this study is of the type in example 3a. Here, as marked in bold, the possessive pronoun *meine* ('my') was assigned to the verb lemma *meinen* ('to mean'), reflecting disambiguation problems during tagging (indeed, the form *meine* is an instance of the verb *meinen* inflected for first person singular). The tagger relies on contextual information to disambiguate forms – which in this case should have resulted in the correct assignment (as seen in Example (3), which was the manual correction to the category 'adjm' based on rules specified in the MOR grammar).

> (3) *MOT: oh, **meine** Nase is(t) ab .
> %mor: co|oh cm|cm **v|meinen-PRES&1s** n|Nase&f&sg
>   cop|sein&PRES&3s adv|ab.
>   'Oh, my nose is gone' [rah 020115]

> Manual correction: **adjm|mein-e n|Nase&f&sg**

Further, contrary to what is discussed in Koch (2019, p. 169), MOR did not execute disambiguate verbal prefixes, prepositions, and adverbs. Disambiguation of these categories is difficult as for some of the prefixes there are homonym verb particles (e. g., *um* 'around'), and further, particles may also occur in other syntactic contexts, functioning as adverbs or prepositions (e. g., *weg* 'away'). Prefix verbs consist of a root and an inseparable unaccented verbal prefix, e. g., *versuchen* ('to try'). In contrast,

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particle verbs consist of a verbal root and separable particles (Eisenberg, 2020, p. 265f.). Verb particles are separated from the base form in finite forms, as shown in Examples (4)-(5) (*weglegen* 'to put away'), and Example (6) (*umkippen*, 'to tip something over'). These types of word formation are highly productive in German, and complex verbs (specifically separated particle verbs) have been found to be frequent in German child-directed speech over developmental time (Behrens, 2005).

(4)   *MOT: den hab(e) ich **weggelegt**, Celina.
      %mor: pro|den aux|haben-PRES&1s pro:per|ich
          w**eg#ge#part|legen-PASTP2** cm|cm n:prop|Celina .
         'I put that away, Celina.'   [cel020104]

(5)   *MOT: dann **legen** wir das erstmal wieder **weg**.
      %mor: adv|dann **v|legen-PRES&13p** pro:per|wir pro|das adv|erst-
          MAL adv|wieder **adv|weg** .
         'then let's put that away for now'   [cel020104]

(6)   *MOT: nein, ich &+tr ich **kippe** mein Trinken nich(t) **um**.
      %mor: co|nein cm|cm pro:per|ich pro:per|ich **v|kippen-PRES&1s**
          adj|mein n|Trinken&n&sg adv|nicht **prep|um .**
         'No I am not tipping over my drink.' [rah020512]

Inspecting the output of MOR (Examples (4)-(6)) it is clear that the rule was not applied: *um* was coded as a preposition ('prep') instead of a (separable) verbal prefix. In any case, particles are not linked to the verb lemma, resulting in base lemmas for instances of separated particle verbs. Separated particle verbs pose problems for tagging in general and many taggers do not link separated particles to verbs, resulting in verb lemmas that do not include the particle when it is separated (Smolka & Eulitz, 2018, p. 1542).

These limitations of the current MOR grammar have implications for measures that rely on the %mor tier and must be considered carefully in analyses.

3.3.2 Activity coding

Identifying and coding book sharing, play and other activities in the corpus required defining a coding scheme and actual annotation of the data using those categories. Two sources informed this process, namely coding systems used in previous studies, and

evidence from studies that investigate the impact of variables of the activity context on linguistic measures of child-directed speech.

Naturalistic studies that use activities as units of analysis adjust the level of granularity of the category system to the research question and sample. Glas et al. (2018) and Rosemberg et al. (2020) first coded inductively to identify descriptive fine-grained activities in the data and then clustered activities into more abstract sets of activity types entered into analysis. As a result, each child-directed utterance was assigned to one of the coarser activity types that subsume a variety of different activities.

Adopting an inductive approach, I began by reading through transcripts while listening to audio recordings, noting down recurring patterns of activities. Mothers and children were engaged in a variety of play-oriented and care -oriented activities during the sessions. Examples of activities are doing a puzzle, drawing, making music, playing with model cars, sharing a book, exploring the room, but also blowing the child's nose, tidying up the room, having a snack or drink. Based on these observations and considering category systems from previous studies, I established a final set of activities to be analyzed (cf. Table 5). Book sharing is defined as every kind of talk about stories, including pre-, reading and post-phases (cf. Melzi et al., 2011). Play-oriented activities subsume both toy play and play without toys (including physical play and singing). Socially structured play activities (social play) are distinguished from solitary activities (solitary play). The decisive criterion for a playful activity to be considered solitary is that it is mainly not scaffolded. For example, the child is hammering using the toy toolset while the adults are having a conversation, or the child is exploring the room by herself. The mother may comment on the child's behavior, for instance directing the child to stop doing something, or she may try getting the child's attention without success.

Further, care-related activities (i.e., nourishment, grooming, chores) were distinguished from play-oriented activities. This seemed important since evidence from both naturalistic and quasi-experimental studies suggests differences between play, book sharing and care-related types of activities (Glas et al., 2018; Hoff-Ginsberg, 1991; Walker & Armstrong, 1995). These activities were clustered into a category 'other', together with conversations (topic-developing conversations between adult and child during at least five successive turns). The 'other' category also comprises activities which did not clearly match any of the categories defined, including when the investigator acted as the salient interlocutor, for example, when the

mother had left the room. Coding was done from transcripts (which offer some comments on the ongoing activities) and audio recordings. This coding procedure assigns all utterances to one ongoing activity (the activity that mainly structures the interaction at that time) so periods of silence are not coded for activities.

Table 5 Activity category system

Activity	Definition and scope	Examples
Book sharing	Mother and child are sharing a picture book. Includes pre-, reading and post-phases	Choosing a book to read, discussing pictures, reading, talking about the book
Social play	Socially structured playful activity between mother and child. The focus of the interaction is play-oriented, including pretense and functional play, play with and without toys.	Dressing the doll, playing with the toy phone, playing with the toy shop and tea set, drawing on the chalkboard, stacking cups, playing miniature vehicles, doing a puzzle, playing with musical instruments, Singing a nursery song together
Solitary play	Play activities that are not predominantly socially structured. The mother mainly does not share the child's focus.	The child is exploring the environment, or playing alone.
Other (Care, Conversation, play with investigator)	Conversations between mother and target child, care-related activities	Conversations about past experience (e. g., what happened in kindergarten), blowing the child's nose, dressing the child for play (putting on socks), playing with the investigator during mother's leave

To apply this coding scheme to the data, I used a method already built into the CHILDES system: gems (see Chapter 3.1.2). The CHILDES manuals explicitly mention the use of gems in comparison of similar activities across transcripts, and they have been used in some corpora included in CHILDES for this very purpose (MacWhinney, 2022a, p. 40). The CHAT notation specifies how gems are marked within CHAT transcripts. In essence, a gem is defined as the section of a transcript between a beginning gem header (@Bg) and an ending gem header (@Eg). These headers can be tagged with user-defined code words to facilitate selection or exclusion in retrieval of gems. For instance, to retrieve parts of the transcripts during which participants were engaged in book sharing, those parts are marked as follows:

```
@Bg:   booksharing
*MOT: Puck und seine Tiere . [+ txt]
...
*MOT: Celina .
@Eg:   booksharing
```

The code word is used in the CLAN command gem with the +sbooksharing switch to retrieve only gems tagged with that code from across transcripts. As each gem header can be tagged with multiple code words, the *gem* program can be customized

to require all specified tags to appear in the headers for a match (Boolean AND), or just one of the words (Boolean OR). This function was used with play activities which subsume social and solitary play-oriented activities (cf. Table 5) which were tagged "social play" and "solitary play", respectively. Using this method, a new gem was inserted when the ongoing activity switched to another category. Therefore, all utterances were assigned to one of the categories, and coding did not allow nesting activities. For descriptive purposes, additional code words were used to capture aspects of the activities, e. g. the topic of a conversation. These are not entered into analyses. Using the *gem* program, separate files were generated for each activity.

3.3.3 Measures and analyses

Quantitative measures were intended to examine the characteristics of child-directed speech by activity, and were operationalized with the intent to maximize comparability with previous studies.

Since transcripts are not available in sonic CHAT format, time duration analyses are not possible. Thus, it is not known, for example, how much time participants spent without talking, how much time was spent in different activities, or what the rate of speech was for each activity. Note that verbatim reading or recitations of nursery rhymes were not included in quantitative measures (as is common practice, e. g. Doering et al., 2020).

Given the variation in amount of speech produced during each session and in different activities, frequency measures are calculated as proportions over total CDS in each activity submitted to analysis. The analysis starts with an examination of the amount and proportion of child-directed speech produced during sessions, and the proportions of CDS assigned to the different activity categories.

Next, separate analyses were carried out on to examine CDS during book sharing, social and solitary play activities. They include utterance complexity, lexical diversity, use of nouns and verbs, and use of wh-questions.

Utterance complexity was operationalized in terms of mean length of utterance by dividing the number of words by the number of utterances (MLUw).

Lexical diversity is commonly measured in type-token-ratio. However, this ratio is known to be sensitive sample size, varying nonlinearly with the amount of tokens analyzed because the frequency distribution of words is not a normal distribution (rather, a few words are highly frequent and most words are infrequent, cf. Montag et

al., 2018 for a study on the relation between tokens and types in simulated environments using child-directed speech samples from CHILDES). One alternative method to measure lexical diversity less sensitive to sample size is the D measure (Malvern et al., 2004).[20] Calculation of the D measure takes into account the fact that type-token ratio decreases when the total number of words analyzed increases because the count of unique words increases more slowly with increased sample size (Montag et al., 2018, p. 379). Here, the D measure was calculated using the VOCD command in CLAN.[21] The measure was calculated using lemmatized types generated by the MOR program (MacWhinney, 2022b, pp. 110–111). Note that due to limitations in morphosyntactic coding (cf. Chapter 4.3.1) verb lemmas of prefix verbs and particle verbs do not encompass verbal prefixes and particles.

Following Kauschke and Klann-Delius (2007), who study the lexical characteristics of German child-directed speech to children aged 1;1 to 3;0, onomatopoeic forms and interjections are counted as words and included in analyses.

The FREQ program was utilized to obtain a measure of noun and verb usage. A number of studies have investigated whether noun and verb usage differs in child-directed speech as a function of context (Altınkamış et al., 2014; Choi, 2000; Goldfield, 1993; Ogura et al., 2006; Rosemberg et al., 2020; Stoll et al., 2012). In line with these studies, the noun category included all common nouns and proper names except the child's own name.[22] Verbs include all main verbs and modal verbs, excluding auxiliaries and copulas. Following previous studies and Kauschke and Klan-Delius' study on word class distribution in German child-directed speech (2007), attention-getters were excluded from counts (certain highly frequent imperatives like *guck* 'look'*)*. A noun-to-verb ratio was obtained by dividing the number of noun tokens by the number of verb tokens plus noun tokens (Altınkamış et al., 2014; Rosemberg et al., 2020; Stoll et al., 2012). When this measure rises above 0.5, the number of noun tokens is higher than the number of verb tokens.

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[20] Albeit not independent of it. See Montag et al. (2018) for a discussion on the limitation of this measure, in particular the role of context the D measure does not account for (the fact that the likelihood of a particular word being produced increases with its occurrence in the same context).

[21] The VOCD program requires a minimum sample size of 50 tokens and results are less reliable for smaller samples (MacWhinney, 2022b, p. 113).

[22] Mothers used a variety of diminutives/diminutive forms (endearment terms) as attention-getting devices, too (e. g., *Bärchen*, 'little bear', *Mäuschen*, 'little mouse'). These were tagged with the category co on the %mor tier, differentiating them from other usages of those words, precluding a need to specify them for exclusion here.

Finally, the proportion of wh-questions in relation to all utterances was assessed. Wh-questions are open-ended questions .The use of wh-questions has been related to language development (Hoff, 2006; Rowe et al., 2017) and is a common index of dialogue behavior in child-directed speech analyses (e. g., Doering et al., 2020). Wh-questions were defined as all questions (transcribed as utterances ending in a question mark) containing a wh-question word (annotated pro:int on the %mor line). The phrase *Wie bitte?* ('Come again?') was excluded, but single-word wh-questions (*Warum?* 'Why?'), and constructions without verbs ([Wh] denn$_{part}$? '…') were included. A proportion score was calculated by dividing the frequency of wh-questions by the total utterances produced.

A qualitative analysis complements the quantitative analysis, offering insight into what mothers and children actually did and how they used language to co-act during different activities.

All measures were generated using CLAN programs (MacWhinney, 2000a). The *tidyverse* (Wickham et al., 2019) package in R (R Core Team, 2020) was used for data manipulation. Plots were generated using *ggplot2* (Wickham, 2016).

4   Results

Variation of different measures of child-directed speech according to activity context has been demonstrated for a range of measures, activities, and populations, most often comparing child-directed speech in play and book sharing activities (cf. Holme et al., 2021 for a scoping review on this topic). However, evidence from studies on German child-directed speech is relatively scarce (e. g. Doering et al., 2020).

Building on previous research, the goal of this study was to examine whether characteristics of German child-directed speech vary as a function of play and book sharing activities. Samples were collected in recordings of 'free play' (i. e., unstructured) interactions. Participants (three mothers and their daughters) were observed at two time points four months apart (when children were 2;1 and 2;5, respectively). Recordings took place in a playroom furnished with play materials and books at a university in Germany in the years between 1996 and 2000 (Szagun, 2001, 2004b).

In this chapter, I first present the characteristics and size of the analytical sample and examine differences between language samples by session (Chapter 4.1). Next, I describe the patterns of activity that occur during the two-hour-long sessions by analyzing the distribution of activities and child-directed speech in activities, first across play-oriented versus non-play-oriented activities and across the coded play-oriented activities (Chapter 4.2). Chapter 4.3 then presents results from analyses of characteristics of child-directed speech compared across three play-oriented activities: book sharing, socially structured play, and solitary play, during which the child's play or exploration is mainly not scaffolded by the mother. Given the small sample size (n=3), inferential statistics is inappropriate. Thus, descriptive statistics are presented. Building on the quantitative results, a qualitative analysis offers insight into how participants organized and negotiated their activities (Chapter 4.4).

4.1 The raw data

Table 6 gives an overview of the entire speech sample, indicating the quantity of mothers' speech transcribed, represented in word token and utterance count. In roughly 12 hours of recordings, the three mothers produced a total of 18,797 word tokens and 5015 utterances, of which 17,908 word tokens (in 4837 utterances) were spontaneous speech and 889 word tokens (in 178 utterances) were verbatim reading or recitations of nursery rhymes or songs (<5 % of word tokens and <4 % of utterances).

Table 6 Size of the child-directed speech corpus

	DP1	DP2	Total
Word count (tokens)			
Spontaneous speech	9913	7995	17908
Recited speech	317	572	889
Total	10230	8567	18797
Utterance count			
Spontaneous speech	2855	1982	4837
Recited speech	68	110	178
Total	2923	2092	5015

Note. Spontaneous speech includes extra-textual speech during book sharing. Recited speech includes verbatim reading and song lines or rhyme routines. Utterance counts include utterances with unintelligible material. Word counts (tokens) include words in utterances with unintelligible material and exclude unintelligible items, retracing and phonological fragments.

Table 7 displays counts for each session, revealing that the number of utterances and word tokens of child-directed speech produced by mothers varies substantially across sessions of comparable length. (The low number of utterances in Rahel's second recording can be traced back to the as of yet incomplete transcription of the recording; transcription is short of ca. 20 minutes.)

Table 7 CDS word tokens and utterances by session

	Celina		Emely		Rahel	
	DP 1	DP 2	DP 1	DP 2	DP 1	DP 2[23]
Word count (tokens)						
Spontaneous speech	3731	3807	3674	2153	2508	2035
Recited speech	105	17	86	0	126	555
Total	3836	3824	3760	2153	2634	2590
Utterance count						
Spontaneous speech	1157	1012	1039	550	659	420
Recited speech	26	5	20	0	22	105
Total	1183	1017	1059	550	681	525

Speech samples from Rahel's first and Emely's second recordings were produced over roughly the same amount of time as Emely's first and both of Celina's sessions. The differences in mothers' speech productions are at least partly explained by

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[23] The transcript of session 2 covers approximately 100 minutes of the recorded 120 minutes. All other sessions were fully transcribed (i. e., 120 minutes).

variation in the observer's role during the sessions (investigators' speech was excluded from this study). The investigators' interactions with the child, with the mother and the child, and with the mother, were not standardized across recordings, and thus varied considerably, impacting interactions between the mother and the child in complex ways. For example, in Celina's first session, the investigator retreated from the room for most of the session because the child was shy. As a result, the mother had more opportunity for dyadic interaction with her child. An observer's presence reduces the quantity of child-directed speech either because of a reduction of mother-child interactions or because of a reduction of dyadic interactions in favor of triadic interaction, as is the case in Rahel's first and Emely's second recordings. Note that the quantity of adult-adult conversations is not quantifiable for this dataset because adult-adult conversations were not transcribed and transcripts are not time locked.

Considering that a variety of picture books were offered in the room, verbatim reading plays a tangential role in the data. Recited speech accounts for 0 % (Emely, DP2) up to just over 20 % (Rahel, DP2) of the word tokens produced per session. This points to differences in frequency of reading but also differences in reading practices – in Emely's second session, book sharing was in fact observed, but the mother did not read the text printed. Celina's first session is the only session during which book sharing was not observed; instead, mother and child engaged in a comparatively long joint singing session during which nursery songs and rhymes were recited. In the following section, a more detailed quantitative analysis of the distribution of coded activities and child-directed speech across activities is presented.

4.2 Distribution of child-directed speech across activities

4.2.1 Frequency and distribution of activity codes

I start the analysis by examining how the quantity of child-directed speech distributes across ongoing activities. Activities were annotated using gems (a header type in CHAT transcripts). Each gem functions as a container for an ongoing activity such that a new gem represents the discontinuation of one activity to begin another ongoing activity, e. g. stopping to play to turn to book sharing (see Chapter 3.3.2 for the coding procedure).

A visualization of the distribution of the number of utterances by play-oriented activity and data points reveals that most of the gems (i. e., ongoing activities) include lower numbers of mothers' child-directed utterances (including recited speech, see Figure 2 and Figure 3). Fewer coded activities contain larger numbers of mothers' child-directed speech. The general trend that solitary play gems contain fewer utterances compared to book sharing and social play is observed across data points. Calculated for the entire sample, the maximum number of utterances in an ongoing activity is 293 in book sharing, while the gem with the lowest number of utterances (n=1) was coded solitary play.

Figure 2 Distribution of the number of CDS utterances at data point 1, by coded activity
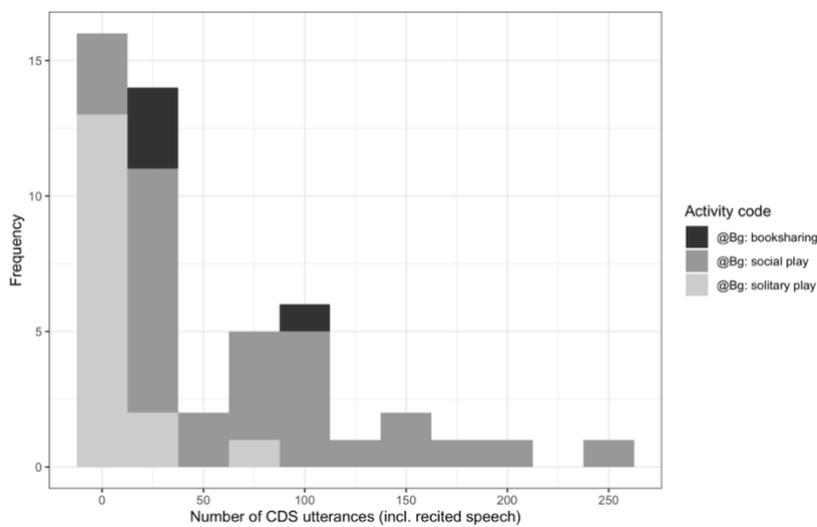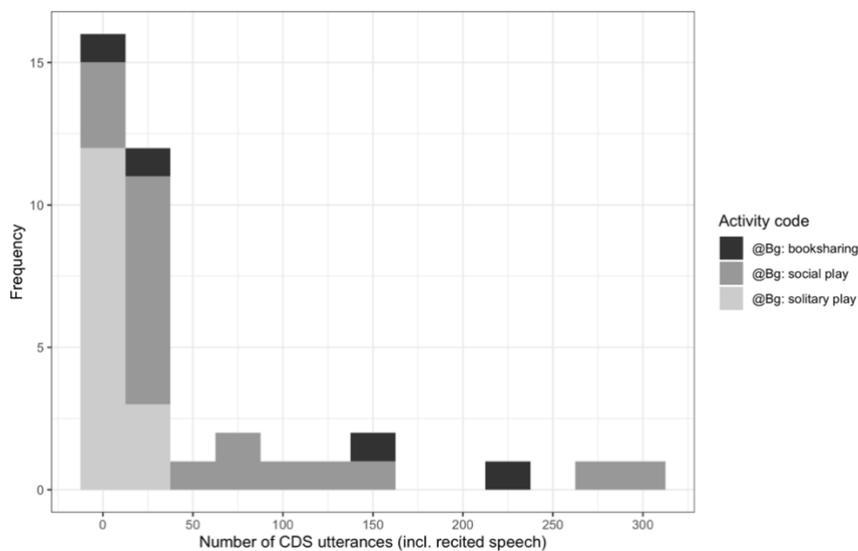

Figure 3 Distribution of the number of CDS utterances at data point 2, by coded activity

Turning to an examination of the distribution of activity coding across children, book sharing was not coded in all sessions: in Celina's first recording, the mother did not direct any speech at her child when engaging with a book (see Table 8). This does not necessarily mean that this participant did not spend time engaging with the picture books offered in the playroom: it is possible that the child looked at a book in silence. Activities were only coded when speech was produced; since video data is not available and unless noted in the transcript comments, any activity the participants engage in during silent periods could not be determined. For all other participants, book sharing was coded in both sessions. Both types of play (social and solitary play) were coded in all sessions.

Table 8 Frequency of activity codes by session

|	Celina		Emely		Rahel	
	DP1	DP2	DP1	DP2	DP1	DP2
Number of times an activity was coded	28	26	28	21	29	14
Frequency of code "Book sharing"	0	1	3	2	1	1
Frequency of code "Social Play"	12	8	8	8	9	3
Frequency of code "Solitary Play"	5	7	4	6	7	2

Note. Counts include those coded segments that contain mothers' child-directed speech

Across the transcripts that cover the entirety of the two-hour-sessions, the frequency of activity codes is relatively stable, and in sessions where less speech was directed at the child, less activities were coded (most notably, Emely's second session). This indicates that participants did not differ substantially with respect to how frequently ongoing activities were interrupted, for example discontinuing an ongoing play activity, having a snack, and returning to play. Rahel's first and second session stand out in that for the first session, the number of times an activity was coded was roughly the same as in sessions during which more utterances were produced (DP1, n=29) and for the second session, it was half of that of the other sessions (DP2, n=14). The lower frequency of activity codes in session 2 can be traced back to the incomplete transcription and as a result, a reduction of data. In addition, the number of utterances in ongoing activities (i. e., within one gem) is higher, lowering the number of gems:

the reading activity in Rahel's second session includes 293 utterances, which is the highest number of utterances in any gem coded for play and book sharing activities.[24]

Figure 4 and Figure 5 plot the number of utterances for each gem by activity and child. The graphs show that the number of utterances per gem is variable for all coded activities for all children, but variability is more pronounced for social play. During Celina's sessions, there is more variability in the number of utterances per ongoing activity compared to the other children (cf. the distribution in solitary play gems in session 1). However, the general trend is confirmed that social play gems are most variable with respect to the number of utterances contained but tended to contain more utterances, while solitary play gems are least variable, and tended to contain very few utterances.

Figure 4 Number of CDS utterances in ongoing activities at data point 1, by child and activity code

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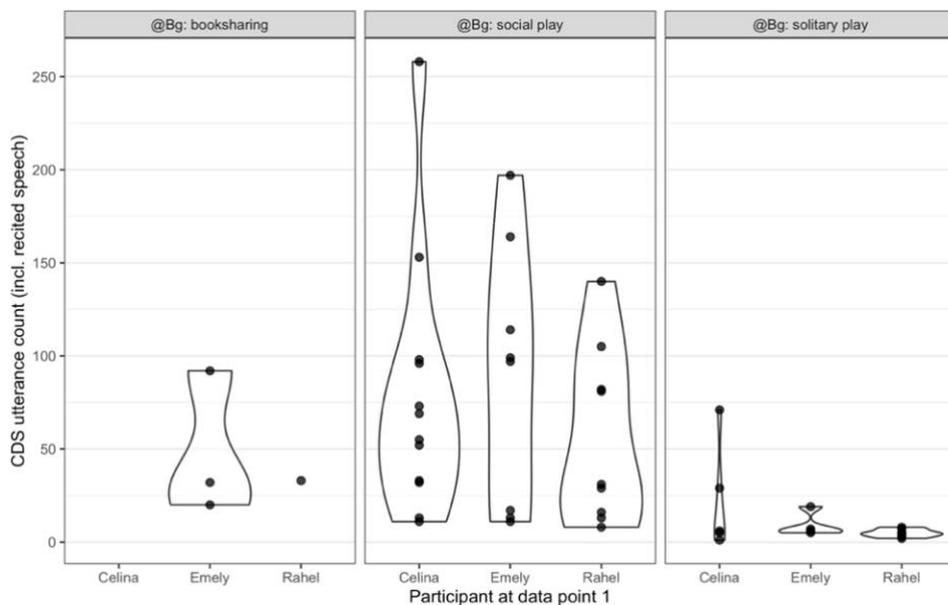
Figure 5 Number of CDS utterances in ongoing activities at data point 2, by child and activity code
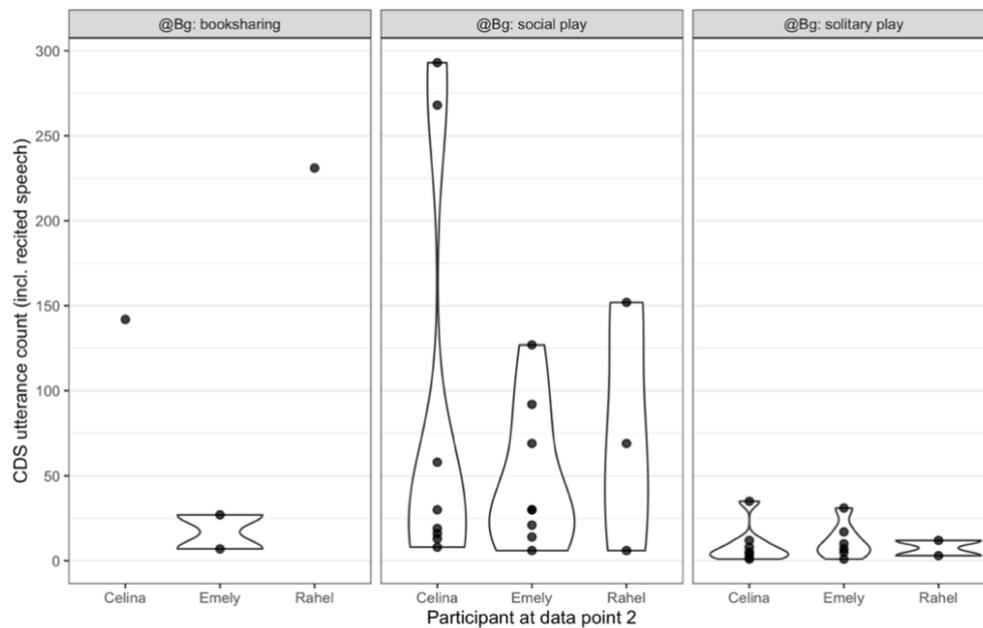
While a higher number of utterances within one gem could mean that more time was spent in an ongoing activity before switching to another one, it could also mean that the rate of speech was higher such that more utterances were produced per same unit of time. Since transcripts are not time locked, this cannot be quantified, which is a major limitation of this study. However, it is plausible that during solitary play there were more silences, and the rate of speech was lower compared to the other types of activities.

For the analysis of characteristics of child-directed speech, utterances across gems were pooled by activity code to assess if measures of child-directed speech differed as a function of play or book sharing activities.

Before reporting measures of child-directed speech in book sharing, social and solitary play activities, the following section offers insight into how the quantity of spontaneous child-directed speech produced distributes across activities (excluding verbatim reading and recited speech).

4.2.2 Child-directed speech quantities by activity

Table 9 gives an overview of mothers' utterances heard by children in play or book sharing activities versus other activities observed during the recording sessions. The majority of child-directed utterances in the analytical sample (86.21 %) was assigned to play and book sharing activities. The proportion of child-directed utterances

produced during play and book activities versus other activities is relatively stable across the data points (consistently over 80 %).

Table 9 Number of CDS utterances by activity types

	DP1	DP2	Total
Total CDS	2855 (100 %)	1982 (100 %)	4837 (100 %)
Activity types			
CDS in play or book activities	2412 (84.48 %)	1758 (88.70 %)	4170 (86.21 %)
CDS in other activities	443 (15.52 %)	224 (11.30 %)	667 (13.79 %)

Note. All utterances are spontaneous speech (recited speech is excluded). For each data point and the total, percentages (in brackets) over total amount of CDS utterances at each data point were calculated.

Calculated per session, the proportions of child-directed utterances produced during play and book sharing activities versus other activities range from ca. 82 % to almost 90 % (cf. Table 10). It is worth noting that in this dataset, in each session at least 10 % of the mothers' child-directed utterances were produced when participants were engaged in non-play-oriented activities.

Table 10 Number of CDS utterances by activity types by session

	Celina		Emely		Rahel	
	DP1	DP2	DP1	DP2	DP1	DP2
Total CDS	1157 (100 %)	1012 (100 %)	1039 (100 %)	550 (100 %)	659 (100 %)	420 (100 %)
Activity types						
CDS in play or book activities	1017 (87.90 %)	898 (88.74 %)	847 (81.52 %)	493 (89.64 %)	548 (83.16 %)	367 (87.38 %)
CDS in other activities	140 (12.10 %)	114 (11.26 %)	192 (18.48 %)	57 (10.36 %)	111 (16.84 %)	53 (12.62 %

Note. All utterances are spontaneous speech (recited speech is excluded). For each participant and data point, percentages (in brackets) over the total amount of CDS in sessions were calculated.

Having established the quantity and proportion of child-directed utterances which were heard in play-oriented compared to other activities, the focus now shifts to child-directed speech heard in *different* play-oriented activities (book sharing, social play, solitary play).

Since differences in utterance lengths are expected as a function of activity, word tokens are reported as a measure of quantity of child-directed speech in Table 11.

Table 11 Number of CDS word tokens in play and book sharing activities by session

	Celina		Emely		Rahel	
	DP1	DP2	DP1	DP2	DP1	DP2
Total CDS	3237 (100 %)	3310 (100 %)	2922 (100 %)	1912 (100 %)	2061 (100 %)	1771 (100 %)
Activities						
Book sharing	0 (0 %)	589 (17.8 %)	465 (15.9 %)	137 (7.2 %)	33 (1.6 %)	595 (33.6 %)
Social Play	2839 (87.7 %)	2397 (72.4 %)	2338 (80.0 %)	1484 (77.6 %)	1937 (94.0 %)	1121 (63.3 %)
Solitary Play	398 (12.3 %)	324 (9.8 %)	119 (4.1 %)	291 (15.2 %)	91 (4.4 %)	55 (3.1 %)

Note. Only spontaneous speech is counted (recited speech is excluded). For each participant and data point, percentages (in brackets) over the total amount of CDS in those three activities were calculated.

While the quantity of word tokens varies substantially across sessions, a pattern emerges such that the greatest proportion of word tokens was heard during social play, visualized in Figure 6. The proportion of word tokens in book sharing and solitary play is more variable across sessions. The lowest proportion of word tokens was heard in solitary play across sessions except for Rahel's first session during which almost 80 % of the speech produced in book sharing was verbatim reading and is excluded from these counts.[25]

Figure 6 Proportion of CDS word tokens by data point, child, and activity

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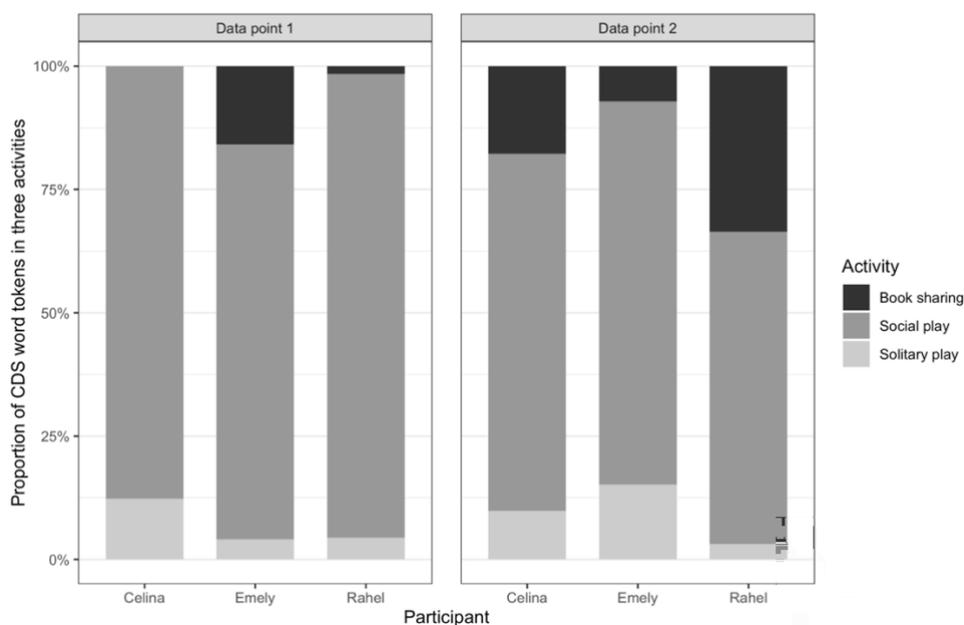
[25] Compare the token counts of recited speech in Table 7: In Rahel's first session, 126 tokens were produced during verbatim reading versus 33 tokens in extra-textual speech (as evident in Table 11). Summing these two counts, 159 tokens were produced during the book sharing activity in Rahel's first session, but only 21 % of those are extra-textual speech.

Analyses of the frequency of activities and the quantity of speech in those activities have revealed that across sessions, despite variation in the total amount of speech directed at the children, general patterns emerge when examining activities and distribution of speech in these activities. Having demonstrated the *distribution* of child-directed speech, the next chapter examines the *characteristics* of child-directed speech in book sharing, social play and solitary play activities.

4.3 Quantitative analysis of variation across play and book sharing activities

To examine whether and to what extent activities are associated with common linguistic measures of child-directed speech, descriptive statistics of common measures of child-directed speech across the three activities are presented as a function of child and data point. Book sharing was not observed in Celina's first session such that book sharing outcomes are restricted to Emely and Rahel's mothers' speech at data point 1. All data underlying these analyses is available from the supplemental material.

4.3.1 Lexical diversity (VOCD)

The D measure is an indicator of lexical diversity less sensitive to sample size than the type-token ratio (Malvern et al., 2004) and as such more adequate to compare lexical diversity in the present analysis that is based on samples of different sizes. However, the VOCD program in CLAN requires a minimum of 50 word tokens for calculation of the D measure. As a result, the measure could not be computed for all activities in all sessions, since there was not enough data from the book sharing activity in Rahel's first session (cf. Table 11 for the token counts). Available VOCD measures, calculated based on lemmatized types, are shown in Figure 8.

Figure 7 Lexical diversity (VOCD) of CDS by data point, child, and activity
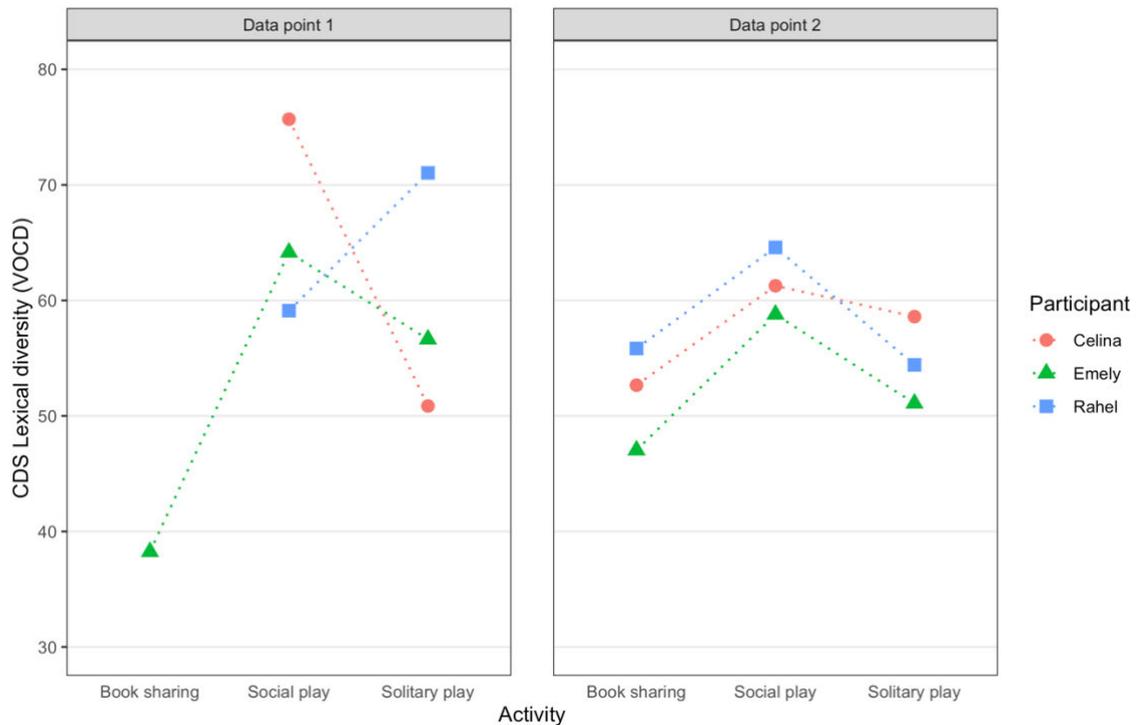
The D values computed for speech samples by activity, child, and data point range between 38 and 76 (rounded values). Both the highest and lowest value were measured at data point 1, the lowest one during book sharing in Emely's first session, and the highest one during social play in Celina's session. At data point 2, MLUw ranges between 47 and 65 (rounded values), again highest in social play (Rahel) and lowest in book sharing (Celina). This indicates that there was no increase in lexical diversity at the second data point. In fact, for two of the three activities, the highest lexical diversity is observed at data point 1 (D=76 for social play, and D= 71 for solitary play). Lexical diversity in speech during the book sharing activity is higher at data point 2 for Emely's mother (D=56) but this is to be interpreted with caution due to the missing data for two children in book sharing at data point 1.

Both Celina's and Emely's input was most lexically diverse in social play, even if one disregards the outlier in Celina's first session. In contrast, lexical diversity in Rahel's mothers' speech is highest in solitary play (data point 1, D=71). This also may be an outlier since at data point 2, Rahel's mother's data follows the pattern observed for the lexical diversity measures of the other children, specifically, that D is highest in social play, followed by solitary play and comparable or even lower values in book sharing.

The finding that emerges from the data is that lexical diversity is highest for mothers' speech in social play, while lexical diversity in solitary play and book sharing is more variable.

4.3.2 Mean length of utterance (MLUw)

Mean length of utterances was calculated in words (MLUw), based on all complete and intelligible child-directed utterances. Standard deviations of MLU measures are very high across activities and children, suggesting that all mothers produced both longer and shorter utterances within each activity (cf. Figure 8).

Figure 8 MLUw of CDS by data point, child, and activity

Note. Error bars indicate standard deviation
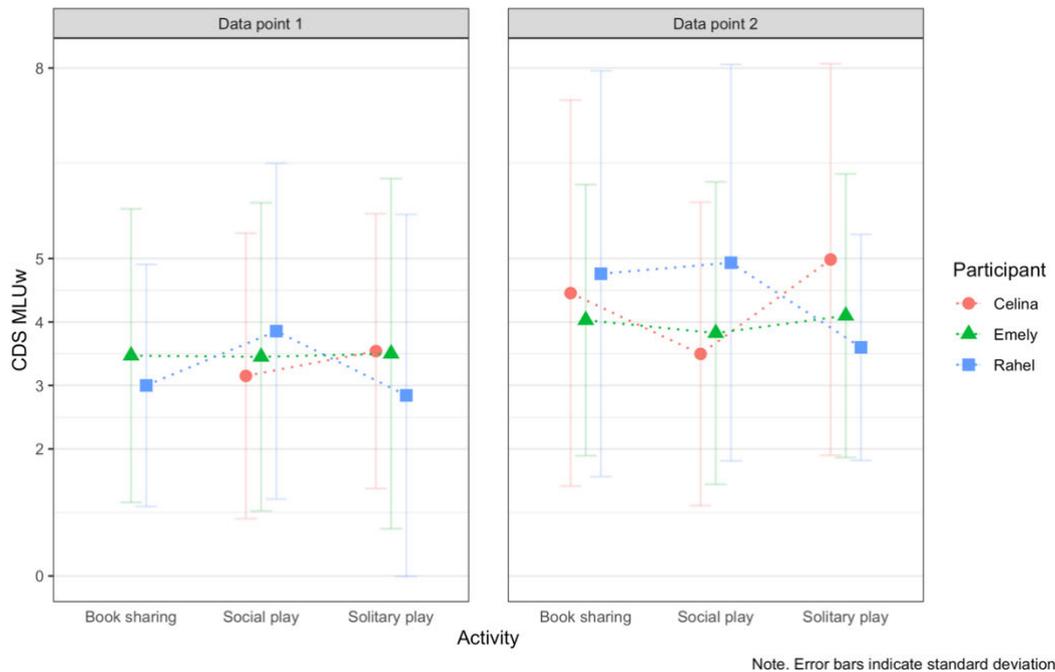
MLUw measures range between 2.844 (data point 1, Rahel, solitary play) and 4.984 (data point 2, Celina, solitary play). The range for data point 1 is between 2.844 and 3.856, while at data point 2, MLUw ranges between 3.497 and 4.984. Thus, there is an increase in MLUw measures from data point 1 to data point 2. When comparing MLUws of speech directed to different children, different patterns of how MLUw varies as a function of activity emerge. These patterns are stable over the two sessions: Variation by activity shows inverse pattern for Celina's and Rahel's mothers: Celina's mother's lowest MLUw was measured during social play at data point 1, the highest during solitary play at data point 2. For book sharing, data is not available at data point 1 but based on available data at data point 2, Celina's mother's MLUw is consistently lowest in social play, and highest in solitary play, MLUw during book sharing falling between the two. In contrast, for Rahel's mother's speech, MLUw was *highest* in social

play, and *lowest* in solitary play, book sharing falling between the two. For both mothers, the lowest MLUw at data point two is lower than the highest measurement at data point 1, suggesting true variation as a function of activity.

Emely's mother's MLUw has a flat profile such that differences between activities are negligible, showing more pronounced but still very minor variation in data point 2 where a variation by activity follows that found in Celina's data (MLUw is highest in solitary play and lowest in social play).

As a consequence of this inter-individual variation, activities differ in terms of how much within-activity-variability there is: social play and solitary play show higher within-variability compared with book sharing.

4.3.3 Noun-to-verb ratio

The noun-to-verb ratio was measured by dividing the total count of noun word tokens by the sum of the count of noun tokens and verb tokens ($n_{tok}/(n_{tok}+v_{tok})$). An outcome higher than 0.5 indicates that more noun tokens than verb tokens were used while a value of 1 indicates that only nouns were used. All instances of the children's own names as well as attention-getting devices (imperatives of the verbs *schauen* and *gucken* 'to look') were removed from counts. Figure 9 plots the results by data point, child, and activity.

Figure 9 Noun-to-verb ratio in CDS by data point, child, and activity
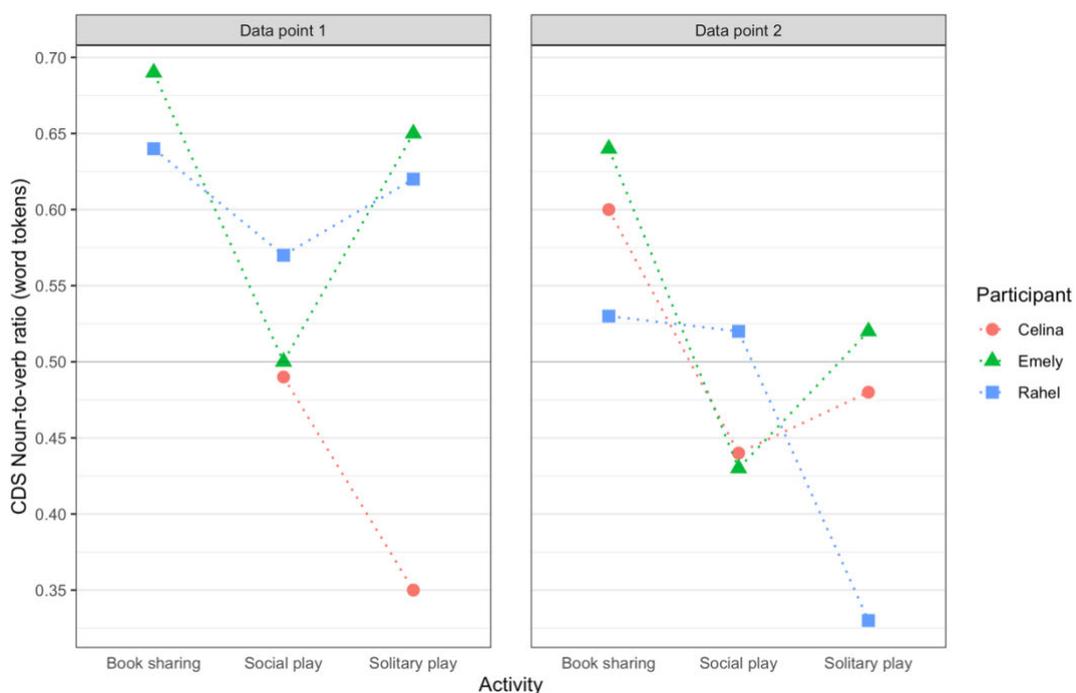
Across the two time points, there is a slight tendency for ratios to approximate 0.5 at the second data point compared to the first such that the noun dominance evident in most data at data point 1 is weakened across measures at the second data point. Comparing outcomes by activity across the two sessions, Celina's mother's speech during solitary play at data point 2 is the only observed increase (albeit from a very low outcome at data point 1; 0.35), indicating less pronounced verb bias at data point 2 (0.48). On the contrary, solitary play at the second data point is the only measure indicating a clear verb bias in Rahel's mother's speech (0.33). This outcome and the measure taken during solitary play at Celina's first session are the lowest ratios in the sample. Emely's and Rahel's mothers' speech at data point 1 is characterized by a noun dominance for solitary play (the highest outcome is 0.65).

The two other activities yield a clearer pattern, although book sharing is the only activity during which speech directed to all children is characterized by a noun dominance (the highest outcome during book sharing is 0.69, which is also the highest measure overall). In social play, nouns were dominant in speech addressed to Rahel at both data points. In contrast, nouns and verbs were balanced for Emely and Celina at the first data point and verbs were more dominant in social play at the second data point.

Taken together, results indicate high variability within play activities but a clear noun preference for the book sharing activities, and a general trend to less pronounced preference for nouns or verbs at the second data point.

4.3.4 Use of wh-questions

Figure 10 displays the proportion of wh-questions relative to all child-directed speech utterances, by data point, child, and activity.

Figure 10 Proportion scores of wh-questions in CDS by data point, child, and activity
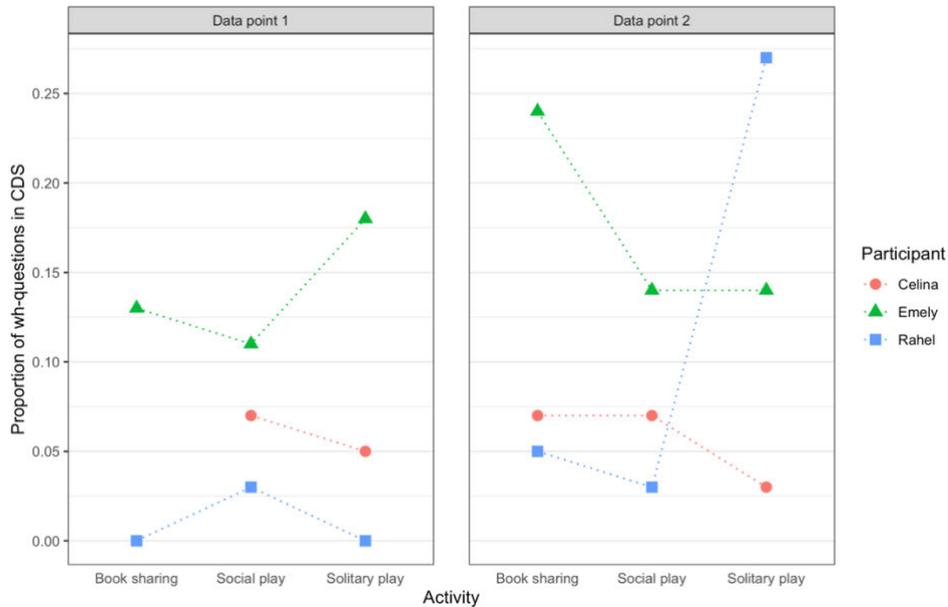
The most prominent trend in the data is the between-subject variation such that Emely's mother uses proportionally more wh-questions across both data points compared to both Celina's and Rahel's mothers (except for Rahel's mother during solitary play at the second data point). The highest proportion of wh-questions was observed in speech directed to Rahel at data point 2 (27 %, Rahel's mother during solitary play). This is likely an outlier since Rahel's mother otherwise makes less frequent use of wh-questions, and at data point 1 used zero questions during both book sharing and solitary play. 3 % of her utterances are wh-questions during social play across both sessions, such that at this data point, social play was the activity with the smallest proportion of wh-questions directed to Rahel (5 % during book sharing, 27 % during solitary play). At data point 2, the proportion of questions directed to Celina during book sharing was similar (7 %) but in contrast to Rahel's mother, Celina's mother's use of wh-questions did not show a different pattern across the two data points but across activities such that solitary play was the activity with least proportion of questions (3-5 %) while during social activities (book sharing and social play) 7 % of utterances were wh-questions. For Emely's mother, the most frequent use of wh-questions is observed during book sharing at data point 2 (24 %), and the lowest at data point 1 during social play (11 %), not indicating a clear variation by activity.

Overall, there is no clear association between activity and frequency of wh-questions. However, it is noteworthy that during social play the proportion of wh-questions was more stable for all participants while there was more within-subject variability in book sharing and solitary play.

4.4 Qualitative analysis of variation within and across play and book sharing activities

This analysis starts from the results of the quantitative analysis (Chapter 4.3) but takes a qualitative approach to the data, aiming to gain insight into how within-activity variation of linguistic measures may be linked with differences in mothers' organization of activities. For this purpose, I present a detailed discussion of a number of selected examples, focusing on the most salient within-activity variation reported in the quantitative analysis. The report of the findings is organized in terms of activities: book sharing (Chapter 4.4.1), social play (Chapter 4.4.2), and solitary play (Chapter 4.4.3).

4.4.1 Qualitative analysis of book sharing activities

Book sharing is highly routinized activity, and book reading routines have been shown to be linked with specific parental verbal behaviors which function to recruit attention, to elaborate, to elicit speech, and to provide feedback, depending on the age and linguistic competence of the child (Sénéchal et al., 1995; Snow & Goldfield, 1983). Questions have been shown to be essential parts of reading routines (Sénéchal et al., 1995).

The qualitative analysis of child-directed speech during book sharing activities will focus on the proportion of wh-questions. Outcomes varied substantially, both inter- and intra-individually: During the first session, Rahel's mother did not ask any wh-questions while in Emely's mother's speech, 13 % of utterances were wh-questions. At session 2, the proportion of wh-questions increased in the speech of both mothers, up to 5 % for Rahel's mother and 24 % for Emely's mother.[26] Here, the analysis is restricted to Emely and Rahel because for both of them, book sharing was observed at both data points.

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[26] Celina's mother falls in between the two, with 7 % of her utterances being wh-questions.

Before diving into the analysis of reading routines, a note about the kind of books mothers and children chose to read is in order, since the books were chosen from a wide variety of books offered in the room (Chapter 3.2.3). A series of richly illustrated storybooks published by Ravensburger was particularly popular across the board; the picture books contain short sentences that tell the story of a day in the life from the perspective of a young animal (including a bear, a dog, a mouse, a cat). One of the books from this series was read at both data points by the same child (Rahel, *Ich bin der kleine Hund* ['I am the little dog']. Another book from the same series was read by both Rahel and Emely during their second sessions (*Ich bin die kleine Katze* ['I am the little cat']). Both children also read other books from the series: Rahel's third book from the Ravensburger series was (*Ich bin der kleine Bär* ['I am the little bear']); Emely also read a total of three Ravensburger series books (including *Ich bin der kleine Löwe* ['I am the little lion'], *Ich bin die kleine Maus* ['I am the little mouse']). Further, Rahel read a hidden object book (without printed text) at data point 2, and Emely read a storybook about a boy riding a tricycle at data point 2.

I begin by investigating the roots of intra-individual variation observed in Rahel's mother's data: At the first data point, Rahel's mother did not ask any wh-questions during book sharing, while at the second data point, 5 % of her utterances are wh-questions.

Recall that there is considerable variation with respect to how much of the printed text the mothers actually read verbatim; Rahel's mother read a lot more of the text provided in the books compared to Emely's mother (who at data point 2 did not read any printed text verbatim despite reading a storybook that contains text). However, Rahel's mother does not just read the text. During the first session, the storybook seems to be unfamiliar to both participants. Picture and text interact in complex ways; and the mother rephrases the text from the book to make it more accessible to the child, and she draws the child's attention to particular aspects of the pictures, helping her make the connections between the story and the illustrations. Example (7) illustrates how she draws the child's attention to the boy holding a leash and the boy's intention to put the dog on the leash. She then proceeds reading verbatim, and no further extra-textual speech is produced in this reading routine.[27]

(7) *MOT: er will mich fangen . [+ txt]

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[27] The postcode [+ txt] indicates verbatim reading. In CHAT transcripts, speaker tiers are marked with an asterisk followed by a three-letter ID. Mothers' speaker tiers are marked *MOT by convention. Children's speaker tiers are marked *CHI.

'he wants to catch me'
*MOT: ich reiße aus. [+ txt]
'I am running away'
*MOT: der läuft ganz schnell weg .
'he is running away very quickly'
*CHI: ja .
'yes'
*MOT: denn ich will nicht an die Leine . [+ txt]
'because I do not want to be put on the leash'
*MOT: guck, der Jan hat (ei)ne Leine .
'look, Jan has a leash'
*MOT: und der will den Hund fang(e)n .
'and he wants to catch the dog'

[rah020115]

The focus of this book sharing routine thus seems to be having the child attend to and understand the story, and because the mother is unfamiliar with the book, she prefers to read it verbatim.

At the second session, Rahel and her mother read the same book again; the book was thus familiar to both of them. During the pre-reading phase, the mother draws the child's attention to the fact that they own a copy from the same book, thereby establishing a personal reference and activating the child's memory (Example (8)).

(8)   *MOT: das Buch kenns(t) du, ne ?
'you know this book, right?
…
*MOT: unser Buch is(t) kaputt, ne ?
‚our book is damaged, isn't it?'   [rah020512]

She then proceeds reading verbatim, but in contrast to the reading activity at data point 1, the mother and child engage in a completion routine, Rahel completing parts of the sentences the mother reads out aloud. The mother then corrects the child's completion, thereby providing feedback (on a phonological level: pronunciation of *Durst*, 'thirst'; or on the level of syntax and lexicon, substitution of *bisschen* 'little' by *frisches*, 'fresh', cf. Example (9)).

(9)   *MOT: vom Spielen und Jagen habe ich +... [+ txt]
*CHI: dut [: Durst] (b)ekommen . [+ txt|
*MOT: Durst bekommen . [+ txt]
*MOT: Jan bringt mir noch +... [+ txt]
*CHI: bisschen Wasser . [+ txt]
*MOT: frisches Wasser . [+ txt]

Next, after finishing reading the text, mother and child further engage in a discussion of the pictures. It is in this text-independent activity that the mother uses a wh-question to prompt the child to talk about her perception, see Example (10). Note that the use of the discourse particle *denn* commonly used in wh-questions. It serves a variety of functions, and here is used to relate the question to the child's utterance (cf. Steinkrauss, 2017 for an analysis of the use of wh-questions, and the particle *denn* in particular, in German child-directed speech).

(10) *CHI: oh, ein Mond .
            'oh, a moon'
     *MOT: was siehs(t) du denn noch ?
            'what else do you see?'
     *CHI: ein [: einen] Mond .
            'a moon'
     *CHI: und eine Sonne .
            'and a sun'
     *CHI: und ein Haus .
            'and a house'
     *CHI: noch eine Sonne .
            'another sun'
     *CHI: ein &+wor [/] ein Haus .
            'a house'   [rah020512]

A similar use of wh-question (including the particle *denn*, following a child's utterance that directs the mother's attention to a depicted object) can be observed later during the session, when mother and child look at an unfamiliar hidden object book. In contrast to the example above, in the example given here (11), the mother does not prompt the child to label the depicted objects but prompts her to elaborate on the actions the entity is performing.

(11) *CHI: oha oh.
            'oh, oh.'
     *CHI: ein Bagger .
            'a digger'
     *MOT: hm .
     *MOT: was mach(t) der denn der Bagger ?
            'what is the digger doing?'   [rah020512]

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²⁸ The text translates as follows: Jumping and running made me thirsty. Jan fetches me fresh water.

As illustrated in these examples, Rahel's mother is focused on the storybook text, engaging the child in a completion routine when sharing familiar texts and mostly sticking to the text when reading novel books, directing the child's attention to important aspects of the plot, thereby facilitating the mutual following of the story line. She uses questions to elicit action and object descriptions from the child when discussing pictures, which is a reading routine observed during session 2 but not session 1, resulting in the within-activity variation observed for this participant.

Emely's mother is much less text-focused, although she does read from the storybook during session 1 (*Ich bin die kleine Maus* ['I am the little mouse']). However, the child frequently interrupts her reading, so she joins the child in attending to the pictures, as illustrated in Example (12) which demonstrates a sequence of utterances that serves to exchange information on the label of the entities depicted (here: bees).

> (12) *MOT: im Kleefeld sehe ich den fleißigen Bienen zu . [+ txt]
> ,in the clover field I am watching the zealous bees
> *CHI: ja .
> 'yes'
> *CHI: ja .
> 'yes'
> *MOT: Biene, ne ?
> 'bee, right?'   [eme020126]

In contrast to Rahel's mother, Emely's mother uses wh-questions of the type "where is X" that can be answered by pointing or a simple deictic expression, which the child indeed resorts to (see Example (13)). The mother here starts out producing an embedded wh-question, but when the child fails to answer correctly, she provides the correct label, returning to her question about the lady bug later (again, using the particle *denn* signaling the relation of the question to previous parts of the conversation). This exchange continues until the child identifies the correct referent.

> (13) *MOT: weiß(t) du denn auch, wo der Marienkäfer is(t) ?
> Do you know where the lady bug is?'
> (child points to picture)
> *MOT: nee, das is(t) (ei)ne Biene .
> 'No, that is a bee'
> …
> *MOT: wo is(t) denn der Marienkäfer ?
> 'Where is the lady bug?'
> *CHI: hier .
> 'Here'
> *MOT: das is(t) die Schnecke .

'That is the snail.'
*CHI: &+ə ?
(child points out the lady bug)
*MOT: ja genau .
        'Yes exactly'   [eme020126]

By using this kind of wh-question and the corresponding pointing and labeling routine, the mother elicits the child's vocabulary knowledge and helps her daughter identify the referent of labels she does not know. At the second session, the mother is also observed eliciting a label from the child shortly after the child had provided the correct label, cf. Example (14), giving the child an opportunity for repetition and demonstration of her knowledge.

(14) *CHI: hier Igel .
             'here hedgehog'
             …
    *MOT: wo is(t) denn der Igel nochmal ?
           'where is the hedgehog again?'   [eme020518]

This short analysis is an attempt to show that the frequency of wh-questions in this sample is linked with particular reading routines that involve discussion of pictures rather than following the story from printed text. How the activity is organized depends on availability of text, familiarity with the book, and ability or willingness of the child to follow the story: Rahel and her mother organize reading mostly around text and the story plot, while Emely and her mother organize the book sharing activity in terms of a labeling routine during which the child identifies the referent by using a deictic expression. The outcomes of the quantitative measure at stake (frequency of wh-questions) reflects these differences in organization of the book sharing activity.

4.4.2 Qualitative analysis of social play activities

In this section, I examine differences in the organization of social play that may be linked to the different outcomes with respect to MLUw in speech directed to Celina and Rahel at data point 2. Both mothers' MLUw measures clearly vary as a function of activity but patterns are contradictory: While Celina's mother's MLUw is higher in book sharing and solitary play, Rahel's mother's MLUw is highest in social play, across both data points. During social play at data point 2, Rahel's mother's MLUw is 4.934, while Celina's mother's MLUw is 3.497. Both outcomes have aa high standard

deviation, indicating that both used shorter and longer utterances. Two factors contribute to the difference observed: Rahel's mother's longest utterances were longer than Celina's (as is evident from the standard deviation), and Celina's mother's utterances were more frequently shorter. 72 % of utterances directed to Celina during social play at this data point were shorter than three words (the majority of those being one-word utterances), while the same was true for only 39 % of Rahel's mother's utterances (ca. half of them being one-word utterances).

For the present purposes, I selected two interaction sequences that illustrate how the same toys result in different uses of language by caregivers. The examples are extracts from play episodes around a toy shop which includes a variety of goods, a cashier, and a shopping cart.

In the following example (15), Celina and her mother are finishing up their shopping, and are putting their goods on the counter. The mother asks Celina about the reasons for buying such amounts of drinks (cacao, coca cola, milk). The child then claims that she bought alcohol. The mother reacts by negating that the items they buy represent alcohol (it is worth pointing out that the mother's first reaction is a metadiscursive one, i. e. reaction on linguistic form (pronunciation), not a conversational one, which follows. See Kilani-Schoch et al., 2009 for a paper on this distinction in the context of verb morphology acquisition). In the successive utterances, mother and child negotiate what they are buying. Since this is a pretend play situation, it would indeed be possible that they agree on buying alcohol (note that it is unclear to what extent the child can in fact be said to be engaged in symbolic play) but the mother insists that the toy shop items represent milk, coca cola and cacao (which is probably identifiable from the design of the toy items). The child finally gives in to the mother who labels each item on the counter, insisting the child adopts her point of view, and then uses wh-questions to test if the child has indeed acquired the labels for each toy item as she considers apt.

> (15) *CHI: A(l)kohol
>   'alcohol'
>   *MOT: Alkohol .
>   'alcohol'
>   *MOT: nein .
>   'no'
>   *MOT: das is(t) Milch, das is(t) Cola, un(d) das is(t) Kakao .
>   'that is milk, that is Coke, and that is cacao.'
>   *MOT: is(t) kein Alkohol .
>   'isn't alcohol'
>   *CHI: do(ch) .

'yes, it is'
*MOT: mm [: nein] .
        'mm' (disagreement)
*CHI: dalkohl@c [= Alkohol] .
        'alcohol'
*MOT: nein, das is(t) Cola .
        'no, that's Coke.'
*CHI: Cola .
        'coke'
*MOT: hm .
        'hm' (agreement)
*MOT: Cola .
…
*MOT: und wo is(t) der Kakao ?
        'and where is the cacao?'
*CHI: da .
        'there'
*MOT: da .
        'there'
*MOT: wo noch ?
        'where else?'
*CHI: da .
        'there'
*MOT: nein .
        'no'
*MOT: das is(t) Milch .
        'that's milk'
*MOT: das is(t) Kakao .
        'that is cacao.'
*MOT: was is(t) das ?
        'what is that?'
*CHI: &+bap .
        (phonological fragment)
*MOT: Kakao .
        'cacao'   [cel020504]

Although these play partners are co-constructing their play situation by negotiating the meaning of the toys they are playing with, the mother's utterances are short and, if longer, syntactically simple – the reason being that this negotiation is in fact carried out in terms of a labeling routine.

In the example selected from Rahel's transcript (Example (16)), Rahel and her mother are also playing with the toyshop. The child is selling goods to the mother, and they are negotiating what but mostly how much the mother is going to buy (bottles). The mother verbalizes her intentions within the play interaction, justifying why she wants to buy more bottles. In the process of transferring the requested items, the mother scaffolds the child counting and sorting the bottles.

(16) *CHI: kaut [= kauft] ?
         'buy?'
    *CHI: das .
         'that'
    *MOT: noch mehr soll ich kaufen ?
         'I am supposed to buy even more?'
    *MOT: da musst du mir aber schon (ei)n paar mehr Flaschen geben.
         'you must give me a few more bottles, then.'
    *MOT: eine, das reicht ja nich(t) für uns .
         'one, that is not enough for us'
…
    *MOT: &+mh guck mal, da passen nur die braun(e)n rein, un(d) da
         passen nur die weißen rein .
         ‚look here, the brown ones only fit there and the white ones
         only fit there.'
    *MOT: musst du mal alle weißen Flaschen da rein tun .
         ‚you must put all the white bottles in there' [rah020512]

By expressing intentions during pretense play, and by directing the child's attention to specific referents through adjectives instead of just pointing, utterances become longer and more grammatically complex.

Naturally, this analysis is only exemplary and should be interpreted as such – evidently, Celina's data from social play activities encompass a much wider range of different activities, including doing a puzzle and playing with vehicles which was not observed at data point 2 in Rahel's data. These differences in toys attended to must be considered when accounting for the differences observed; different toys and kinds of play are known to impact features of child-directed speech, including MLUw (e. g., O'Brien & Nagle, 1987). But while the present analysis cannot account for the observed differences in MLUw, the examples show that the construction of meaning in a toy play situation with the same toy results in very different communicative behaviors (focused on establishing the labels of the toys with versus focused on directing or justifying actions involving the toys).

4.4.3 Qualitative analysis of solitary play activities

This section focuses on the noun-to-verb ratio observed during solitary play activities. Solitary play was defined as a play activity that was mainly not scaffolded by the parent, for example, when the child was exploring the toys in the room by herself. While at data point 1, speech directed to Rahel was characterized by a noun dominance (0.62), Celina's mother's speech showed the opposite: a clear verb dominance (0.35). A verb dominance is also observed for solitary play activities in Rahel's second session

(0.33). Thus, in this analysis, I examine Celina's solitary play activities at data point 1 in comparison with Rahel's solitary play at data point 1 and 2, aiming to gain insight into what aspects of the activities may be related to these outcomes.

During solitary play in Rahel's first session, the child often requested the mother to hand over objects in her proximity, as in (17). The child directs the mother's attention to the object of interest, and expresses her desire to be handed the object. In the example, the mother first does not respond to the action request but models a more appropriate request (i. e., adding *please*). After a series of further attempts of directing her mother's behavior, the mother finally responds. She ensures that she has identified the referent of the child's request by producing a single definite noun phrase, her intonation requiring the child to specify the referent of her request. These kinds of interactions occur more frequently when the mother is conversing with the investigator (in this example, GIS), and is thus not fully attentive to the child's vocalizations.

(17) *CHI: Kanne .
          'jug'
   *MOT: Kanne, bitte .
          ‚jug, please'
   *CHI: da .
          ‚there'
   *GIS: www
   *CHI: Mama da .
          'Mom, there'
   *CHI: Tanne [: Kanne] ham [: haben] .
          'jug have$_{INF}$'
   *MOT: ja .
          'yes'
   *CHI: da Mama .
          'there Mom'
   *CHI: ham [: haben] .
          'have$_{INF}$'
   *MOT: die Kanne ?
          'the jug?'   [rah020115]

The following example (18) is similar in that the child refers to an object in the playroom, directing the mother's attention to the toy in question. In this example, however, the mother corrects the child, providing the correct label using a copula construction (the copula does not contribute to the noun-verb-ratio).

(18) *CHI: Auto .
          'car'
   *CHI: Auto haben Mama, ja ?
          ‚car have$_{INF}$ mom, yes?'

*MOT: das is(t) doch der Einkaufswagen .
                    'but that is the shopping cart'   [rah020512]

In contrast, during the sessions in which verbs are dominant in child-directed speech during solitary play, interactions focus on actions instead of entities. For example, the child is riding the toy car, and asks the mother to join her, to which she briefly responds by asking the child where she is going (19).

    (19) *CHI: du auch mitdeh(e)n [: mitgeh(e)n] ?
                 'you too come with?
         *MOT: wo wills(t) du denn hingeh(e)n ?
                 'where do you want to go?'
         …
         *MOT: die dürfen nich(t) mitfahr(e)n ?
                 ‚they are not allowed to come with?'   [rah020512]

Verb dominance in speech directed to Celina during solitary play activities at session 1 results from the mother's deictic use of pronouns instead of full noun phrases in utterances that comment on or direct her child's behavior while she is exploring the room, see (20). These interactions serve to control, prohibit and direct the child's behavior in real time, and using deictic expressions instead of full noun phrases are very effective for achieving this goal. Since pronouns are not included in the noun counts, a verb dominance results.

    (20) *MOT: das lassen wir mal drin .
                 'that we are leaving in there'
         *MOT: das lassen wir da mal drinne [: drin], ja ?
                 'that we are leaving in there, alright?'
         *CHI: &+alne .
                 (phonological fragement)
         *MOT: ja, den kanns(t) du mitnehm(e)n wieder .
                 'yes, you can take it with you again'
         *MOT: un(d) das läss(t) du aber auch hier .
                 'and that you are leaving here as well'
         *MOT: ja ?
                 'yes?'
         *MOT: das tun wir da oben hin .
                 'that we are putting up there'   [cel020104]

To sum up, in solitary play activities, differences in how and with what intention the child recruits the mother's attention (focusing on entities or actions) result in noun versus verb bias in child-directed speech. Verb bias also results from the mother's use

of directives, where the goal is not to direct the child's attention to an entity but to prohibit the child from carrying out a specific action.

5 Discussion

The study presented in this thesis investigated to what extent the characteristics of speech three mothers direct at their two-year old children varies as a function of activity. Two sessions were analyzed for each participant (n=3), enabling an analysis of inter- and intra-individual variation. Three activities were included in the analysis: book sharing, social play, and solitary play, as observed in two-hour sessions, recorded in a standardized but naturalistic setting when children were aged 2;1 and 2;5, respectively. This chapter first offers a summary and contextualization of the primary findings (Chapter 5.1) before addressing the limitations of the present study (Chapter 5.2). A sketch of implications for future studies concludes the thesis (Chapter 5.3).

5.1 Summary and contextualization of findings

The research questions the present study sought to address were: (1) Do characteristics of speech addressed to German-learning two-year old children vary as a function of activity in unstructured designs? (2) What is the extent and nature of within-activity variation, both inter- and intra-individually?

The study indicates, descriptively, that differences in characteristics of German-child directed speech arise when comparing book sharing, social play and solitary play activities but interactions within and across participants are complex because of inter- and intra-individual variation.

With respect to lexical diversity, results must be interpreted with caution because of the small language samples entered into calculation, which distorts results even when using the D measure. The finding that emerges from the analysis is that social play was highest in lexical diversity, and for solitary play and book sharing, results were more variable across participants.

For MLUw, a developmental trend was observed, and individual differences were stable across sessions. Differences between participants in the book sharing context

were less pronounced compared with the two other contexts. Participants showed stable yet reverse patterns for MLU across the three contexts, indicating that the way activities impacted utterance length differed between participants. However, standard deviations were very high in all data.

The noun-verb ratio showed a general trend for noun dominance in the book sharing context, which is a well-attested finding cross-linguistically (Altınkamış et al., 2014; Choi, 2000; Rosemberg et al., 2020; Stoll et al., 2012). In addition, a tendency for verb preference is observed at data point 2, although sample size is very limited. However, results mirror Kauschke and Klann-Delius (2007) who show that verbs are more frequent in German child-directed input. Further, Doering et al's study results (2020), i.e. the tendency of noun dominance over verb dominance in book sharing was replicated.

The findings for wh-questions showed that inter-individual variation was stable across sessions, but no clear trend between activity and frequency of wh-questions was observed.

The finding that MLUw is higher in book sharing compared to play (e.g. Poulain & Brauer, 2018) was not replicated in this study but this may be an artefact of the small sample sizes available here. On that note, an interesting finding is that patterns of influence of activities on measures were most stable across sessions for the child for which most data were aavailable (Emely). This suggests that sample size may be an influential factor which challenges the validity of the results of the present investigation.

Evidence from research designs that manipulates activity context suggests that the characteristics of parental verbal behavior in play and book sharing activities are associated with the presence or absence and types of toys and books. For example, dolls, vehicle toys and building toys elicit different amounts of language and result in variations of verbal behavior (O'Brien & Nagle, 1987). Different types of toys tend to elicit of specific forms of play: representational toys such as toy phones tend to elicit symbolic play, while functional toys such as puzzles and drawing boards elicit functional (goal-directed) play. Type of play in turn is associated with differences in communicative behaviors in child-caregiver interactions (Creaghe et al., 2021). These fine-grained differences were not accounted for in the current coding scheme and so within-activity variability of social play may at least be partially a consequence of methodology.

In general, interpretation of results with respect to previous studies is difficult because of the high within-activity variability in the present study, which is known to be a result of unstructured and comparatively long observations (Tamis-LeMonda et al., 2017). This variation is not found in studies that limit observations to dyads interacting for short periods (e. g. four minutes per activity in Doering et al., 2020; ten minutes per activity in Poulain & Brauer, 2018). Importantly, the lack of task has as a consequence that dyads do not engage in the same activity for the same amount of time. In contrast with studies set in the home environment that allow free roaming, mothers and children in the data analyzed were constrained to the playroom and the objects that were present. But within that environment, they could act freely and structure their time themselves (what I dubbed 'standardized but naturalistic setting'). An interesting observation is that within the "free play" recording, regardless of the amount of speech transcribed, there was relative stability with respect to the number of activities coded, as well as the proportion of speech that occurred in each play-oriented activity. This suggests that despite extraneous variables impacting behaviors, the standardized setting did have some controlling effect on participants' behavior.

Qualitative analyses were presented as an attempted to shed some light on the inter- and intraindividual variation observed and how different organization of activities may impact results. The findings point to the fact that activities are socially constructed, and future research should consider that when studying how activities impact characteristics of child-directed speech.

Finally, General conclusions should not be drawn from the present study, which, considering the small, self-selected sample, is of descriptive and exploratory nature. Limitations are discussed in the following section.

5.2 Limitations

Beyond limitations in terms of generalizability that arise from the nature of the sample (self-selected, small sample), the study suffers from the lack of control mechanisms that ensure accuracy of annotation. For example, the German MOR grammar applied has some serious (albeit as of now not quantified) limitations which pose a problem to the reliability of annotations. For manual annotations (activity coding), interrater reliability was not checked which also adds sources of error to the data submitted to

analysis. There are some limitations that are inherent in the characteristics of the dataset used. First, due to presence of observers and use of more or less intrusive video taping, observer bias reduces the ecological validity of the data obtained.

It is also worth pointing out that observer presence and behavior was highly variable, and it was not taken into account in the analysis here. This is a problem because the observer's presence, as has been pointed out, has substantial influence on participants' dyadic interactions which were the focus of analyses here.

Further, the dataset analyzed is not time locked, and so true differences in amount of speech, rate of speech, and duration of activities could not be analyzed. Also, the lack of video data renders it impossible to take into account gestures, e. g. in referential communication. Using only audio data also adds a certain degree of uncertainty in figuring out what is happening in the data when coding activities; and a major limitation is that activities were only coded when speech was produced. The true range and distribution of activities in sessions cannot be captured in an analysis as presented here, where video data is not available and transcripts are not time locked.

On another note, the present study reported outcomes of measures that are often reported in studies of child-directed speech. These measures operationalize quantitative and qualitative characteristics of a variety of constructs that are thought to be relevant in the linguistic environment, such as complexity and lexical diversity, noun and verb use and frequencies of questions, transforming these features into numeric data that can be analyzed and facilitate comparability across studies. However, this sets aside (or at least backgrounds) groundedness of language in interaction, since the communicative context is not quantified and thus lost in analysis. The qualitative analysis has been an attempt shed some light on how outcomes of quantitative measures interact with communicative goals and organization of activities, but these analyses have remained exemplary.

Another limitation is that within the scope of this thesis, the use of repetition was not investigated. However, repetition is an important characteristic of child-directed speech, and not taking it into account in analyses despite its relevance in caregiver-child interaction is a limitation of this study. The use of repetition, in the sense of exact or partial self-repetitions or expansions to the child's vocalizations, has been studied extensively: Variation sets (Küntay & Slobin, 2002) have been shown to be characteristic of speech directed to children in a range of languages. Variation sets are defined as a "sequence of utterances with a constant intention but varying form", including lexical substitution and rephrasing, addition and deletion of specific

referential items, reordering of constituents. While the impact of socio-economic status on communicative functions of variation sets in child-directed speech has been subject of analyses (e.g., Tal & Arnon, 2018), the study of how the type of activity affects the use of variation sets in child-directed speech is an under-studied topic that has been given attention only recently (Alam et al., 2021). This is also because studying variation sets in a corpus requires extensive manual annotation and/or use of algorithms, as Alam et al. (2021) did in their study based on naturalistic data.

Variation and repetition also links to the study of metadiscursive versus conversational reactions (Kilani-Schoch et al., 2009) an issue which was briefly noted with reference to an example in the qualitative analysis. In future studies it would be interesting to analyze possible variation of frequency and types of metadiscursive reactions/negative evidence by activity.

Further implications and future directions are sketched in the following section, which concludes this thesis.

5.3 Implications and future directions

Bearing in mind the limitations of the present study, some important implications emerge which are worth pointing out for future research.

In line with previous research (Glas et al., 2018), it was shown that activity context is a relevant variable to take into account, in particular when analyzing characteristics of the language environment across different populations and samples (this is also particularly relevant in studies that compare data from different populations within and across cultures, as for instance noted in a study on communicative intentions Vogt et al., 2015). Especially in cross-cultural research, it must be taken into account that "the types of activities and the specific practices that comprise them are culturally rooted" (Rowe & Weisleder, 2020, p. 209). Thus, future research into the intricate interplay between characteristics of speech and situational context should consider how activities may be operationalized such that comparability across datasets is maintained while accounting for the fact that activities are socially constructed.

I hope to have demonstrated that in addition to studies that collect data in manipulated activity contexts, and studies that set out to record activities in the home, it is fruitful to study the association between activities and characteristics of child-

directed speech using existing data. While technologies have made collection and transcription of large speech samples more cost-efficient, data collection and transcription are still associated with high costs, such that exploiting existing data for new purposes remains an important pillar of research on child language development. In this study, I showed that even corpora which did not by design intend to document different or particular activity contexts are potentially fruitful resources for studies of child-directed speech across different activities. This is because lengthy, unstructured recordings of 'free play' involving a range of toys and books subsume a range of different activities that can be made available for analysis using inductive coding procedures.

While it was demonstrated that the current TalkBank and CHILDES infrastructure provides resources for annotating activities in such datasets (namely, gem headers), and subsequently analyzing speech as a function of coded activities, the work presented here has also revealed the challenges and limitations of the system currently in place (most importantly, lack of time locking in older datasets, optionality and lack of standardization of representation of activity contexts in transcripts). A large and growing body of research demonstrates that activities shape speech directed to children in complex ways, which has methodological implications for studies on the description of the linguistic learning environments:

> Researchers should be cautious in assuming that a language or gesture sample from a single type of activity (e.g., 'free play' in the sense of joint manual action) accurately portrays one's communication. They should also be cautious when combining data from multiple settings. Results show that the type of shared activity and caregivers' accompanying gestures play an integral role in shaping caregiver-infant interactions. Researchers studying infants' natural language development should therefore strive for a comprehensive portrayal of infants' language input by including factors other than the linguistic content itself. " (Puccini et al., 2010, pp. 293–294)

Thus, it seems to be of interest for the research community to discuss which measures may be appropriate to improve options of representation of activity contexts within CHILDES.

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Appendix

For transparency and reproducibility, data and analysis materials are included in the electronic supplement. It is organized as follows:

- Resources
    - CHILDES exports, including the Szagun corpus, media files, and the version of the German MOR grammar that was used for this work
    - the files provided by Gisela Szagun, sociodemographic metadata table provided by Gisela Szagun
- Project
    - CLAN-work
        - data
            - transcripts in three coding passes
            - the analytical sample subjected to analyses, including derived files
        - commands: documentation of CLAN programs used to annotate, preprocess, and analyze data
        - outputs: CLAN outputs (tables, CLAN output files)
        - the MOR grammar including the updated lexicon file
    - r_project
        - data, scripts, and output produced using the software, including dataset and figures

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