IMPLICIT THEORIES OF HEALTH:

INVESTIGATING THE INFLUENCE OF INCREMENTAL THEORIES OF HEALTH ON HEALTH-PROMOTING COGNITIONS AND BEHAVIORS

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Preface

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The first author developed the idea and wrote the manuscript. The third and fourth author were involved in collecting and analyzing the data. I gave valuable suggestions to each step and wrote parts of the manuscript.

Please note that some changes in headings, citation style, and formatting were undertaken to fit the layout of this dissertation. Supplemental materials were added to the text. No changes were made to the content of the articles and manuscripts.

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Originally, I wanted to thank several people at this point. As I can still thank these people personally, I would like to thank the person with whom this is no longer possible and to whom I dedicate this work:

Thank You, Mother!

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Abstract

Implicit theories of health refer to people's assumptions about the malleability of health, that is, whether health is perceived as changeable (incremental theory) or fixed (entity theory). The influence of implicit theories on health promotion is widely neglected in existing models of health behavior change (e.g., Health Action Process Approach, Social Cognitive Theory). Reviewing past research, I will show that findings so far suggest that a stronger incremental theory (i.e., assuming that a given characteristic is changeable) is positively related to numerous health-promoting outcomes. The main part of this work will present eight additional studies. These studies provide further correlational, experimental, and interventional support for the importance of incremental theories of health for health promotion. Based on the reviewed literature and the presented findings, I derive a conceptual model that describes the relationship between implicit theories and other cognitions that are relevant for health promotion (locus of control, outcome expectancy, and self-efficacy). This model can guide further research on implicit theories and explains how the included constructs interact to affect health promotion. Finally, limitations and implications to the presented research are discussed to improve future research on implicit theories. Accordingly, research on implicit theories should pay more attention to a precise distinction from related constructs (like locus of control). However, at the same time, it is relevant to examine the relationships between these constructs more closely to explain how implicit theories impact health promotion.

Deutsche Zusammenfassung

Implizite Gesundheitstheorien beziehen sich auf die Annahmen von Menschen über die Veränderbarkeit von Gesundheit; das heißt, ob Gesundheit als veränderbar (inkrementelle Theorie) oder stabil (Entitätstheorie) wahrgenommen wird. Der Einfluss impliziter Theorien auf Gesundheitsförderung wird in bestehenden Modellen zur Änderung des Gesundheitsverhaltens (z. B. Prozessmodell gesundheitlichen Handelns, Sozialkognitive Theorie) weitgehend vernachlässigt. Eine Zusammenfassung früherer Studien zeigt, dass bisherige Ergebnisse darauf hindeuten, dass eine stärkere inkrementelle Theorie (d. H. die Annahme, dass ein Merkmal veränderbar ist) positiv mit zahlreichen gesundheitsfördernden Ergebnissen zusammenhängt. Im Hauptteil dieser Arbeit werden acht zusätzliche Studien vorgestellt. Diese Studien liefern weitere korrelative, experimentelle und interventionelle Belege für die Relevanz inkrementeller Gesundheitstheorien zur Gesundheitsförderung. Basierend auf der beschriebenen Literatur und den präsentierten Ergebnissen leite ich ein konzeptionelles Modell ab, welches die Beziehung zwischen impliziten Theorien und anderen Konstrukten beschreibt, die für die Gesundheitsförderung relevant sind (Kontrollüberzeugung, Handlungs-Ergebniserwartung und Selbstwirksamkeit). Dieses Modell kann weitere Forschungen zu impliziten Theorien leiten und erklärt, wie die enthaltenen Konstrukte interagieren und so Gesundheitsförderung beeinflussen. Abschließend werden Einschränkungen und Implikationen der vorgestellten Forschung diskutiert, um zukünftige Forschung zu impliziten Theorien zu verbessern. Demnach sollte bei der Erforschung impliziter Theorien eine genaue Unterscheidung zwischen verwandten Konstrukten (wie Kontrollüberzeugung) stärker berücksichtigt werden. Gleichzeitig ist es jedoch wichtig, die Beziehungen zwischen diesen Konstrukten genauer zu untersuchen, um zu erklären, wie sich implizite Theorien auf die Gesundheitsförderung auswirken.

Chapter I

General Introduction

According to António Guterres (2020, March 19), Secretary-General of the United Nations, the 2019-20 coronavirus pandemic is considered as the world's greatest challenge of the 21st century as it poses a severe threat to societies, economies, and health care systems around the globe. As of July 14, 2020, the World Health Organization (2020, July 14) counts nearly 13 million reported cases and more than 550 thousand deaths attributed to the coronavirus SARS-CoV-2. The World Health Organization (2020, April 17) estimates that four out of five infected people show a mild course of the disease. People suffering from noncommunicable diseases (e.g., diabetes, heart disease, respiratory disease) are at higher risk of developing severe conditions or dying from COVID-19 (World Health Organization, 2020, March 11). The World Health Organization recommends engaging in health-promoting behaviors such as engaging in physical activity, keeping a balanced diet, and reducing stress to minimize the risk of developing a noncommunicable disease (World Health Organization, 2018). Furthermore, the World Health Organization and many federal bodies developed behavioral guidelines to counteract the spread of the coronavirus, which include preventive behaviors like washing hands regularly, social distancing, and following good respiratory hygiene (World Health Organization, 2020, April 29; see also Dohle et al., 2020).

Engaging in such *health-protective* or *health-promoting behaviors* is often challenging as it requires the development of new behavioral routines or changing one's habits (Orbell & Verplanken, 2010). Health behaviors often involve a conflict between long term goals (e.g., social distancing to avoid the spread of a virus) and short term goals (e.g., wanting to drink some beers with a couple of friends; Hofmann et al., 2008; Stroebe et al., 2013). To engage in health behaviors, it is often necessary to overwrite automatic behavioral response tendencies, and this requires the use of effective self-regulatory strategies (Hofmann et al., 2008; Orbell & Verplanken, 2010; Stroebe et al., 2013).

Multiple models exist to explain engagement in health promotion and prevention, like the Theory of Planned Behavior (Ajzen, 1991; Godin & Kok, 1996), the Social Cognitive

Theory (Bandura, 1989, 1998), or the Health Action Process Approach (Schwarzer, 2008). While these models primarily focus on the role of self-efficacy and outcome expectancy to predict health-promoting intentions and behaviors, a necessary prerequisite is often neglected in these models: *Implicit Theories of Health*, which refer to peoples' assumptions about the changeability versus stability of health (Bunda & Busseri, 2019; Thomas et al., 2019). Why would someone engage in any kind of health promotion or prevention if they do not believe that their health can be changed?

This dissertation discusses the influence of implicit theories of health on health-promoting cognitions and behaviors. It further provides a rationale for why implicit theories are a crucial prerequisite to consider when explaining health promotion. In the following section (section 1.1), I will provide a brief overview of research on implicit theories. Next, I will define what is meant by health promotion throughout this dissertation and provide an overview of social cognitive determinants of health promotion (section 1.2). I will conclude this chapter with a narrative review of research that examined the influence of implicit theories on health-promoting outcomes (section 1.3). Chapter II is based on an article that examines the influence of implicit theories on health-promoting attitudes and behaviors. Chapter III informs about the development of a tool to measure food choices, which served as the dependent variable in one of the experimental studies described in Chapter II and which has been used to study the relationship between implicit theories of health and food choices (Chapter III, Study 1). Chapter IV describes a randomized controlled trial that investigates the effectiveness of a smartphone-based intervention focusing on implicit theories to increase engagement in health-promoting behaviors. Chapter V consists of a manuscript to describe the influence of implicit theories of health on blame attributions and social support for people suffering from physical and mental illnesses. In the General Discussion (Chapter VI), I will summarize the introduced studies, derive a model that incorporates implicit theories to explain

health promotion, and reflect on limitations and further implications regarding implicit theories research in the health domain.

1.1 Implicit Theories: An Overview

Research on implicit theories originated from Carol Dweck's initial work on implicit theories of intelligence and personality (Dweck & Leggett, 1988). According to Dweck (1999, 2012), implicit theories refer to individuals' beliefs regarding the changeability versus stability of human traits or attributes. Dweck further differentiated that implicit theories exist in two forms: Holding an *entity theory* means that one thinks of an attribute as a stable quality that does not change. Concerning personality, endorsing an entity theory of personality goes along with the assumption that personality is stable over time and situations (Dweck, 1999, 2012). Holding an *incremental theory*, in contrast, means that the attribute is considered as a malleable and developable quality. Concerning personality, this view entails perceiving personality as changeable over time or in different contexts (Dweck, 1999, 2012). Entity versus incremental theories are widely understood as the endpoints of a continuum, and individuals differ in the extent of how strongly they endorse one of these theories (Burnette et al., 2013; Dweck & Leggett, 1988). While implicit theories are usually measured using explicit self-report scales (Dweck, 1999), they are considered to be *implicit* as individuals are usually unaware of the theories they hold but able to reflect on them when being asked (Bernecker & Job, 2019).

Implicit theories are an influential aspect of social cognition, as they affect individuals' behaviors, their inferencing processes, their goal setting, and the use of strategies to pursue these goals (Burnette et al., 2013; Dweck, 1999, 2012). Expanding from Dweck's work, the concept of implicit theories[1] has stimulated research in a wide array of domains (see also Dweck, 2012). A considerable body of research focuses on the influence of implicit theories

[1] In research, implicit theories are also referred to as mindsets or lay theories. Throughout this work, however, Dweck's original term implicit theories is used.

in achievement domains, like intelligence (Blackwell et al., 2007; Hong et al., 1995), intellectual abilities (K. D. Chen & Pajares, 2010; Good et al., 2012), or overcoming stereotype threat (Aronson et al., 2001; Good et al., 2003). Assumptions regarding the changeability of personal characteristics such as morality (Chiu, Dweck et al., 1997; Chiu, Hong, & Dweck, 1997), shyness (Beer, 2002; Zhang & Xu, 2019), and leadership ability (Burnette et al., 2010; Hoyt et al., 2012) are also heavily researched. In addition, implicit theories are researched in the context of interpersonal and intergroup relationships, including romantic relationships (Knee, 1998; Knee et al., 2003), peer relationships (Z. Chen et al., 2012; K. D. Rudolph, 2010), the perception of groups (Rydell et al., 2007), and the formation and persistence of stereotypes (Levy et al., 1998; Plaks et al., 2001).

The majority of studies focusing on implicit theories found that holding an incremental theory (i.e., belief in changeability) is associated with many positive outcomes (Burnette et al., 2013; Dweck, 2012). For example, Aronson and colleagues (2001) found that African American students who were encouraged to view intelligence as a malleable capacity were less likely to show the adverse effects of stereotype threat in academic performance. Individuals holding an incremental view of emotions (i.e., believing in the malleable nature of emotions) are better in regulating their emotions and negative affect (Kappes & Schikowski, 2013; Tamir et al., 2007). Viewing personality as changeable leads individuals to pay more attention to counter-stereotypic information (Plaks et al., 2001) and can decrease stereotyping (Levy et al., 1998). A meta-analysis by Burnette and colleagues (2013) concluded that holding an incremental theory is particularly helpful in behavioral domains that require self-regulation. The authors combined the results of 113 studies and concluded that an incremental theory is associated with more successful goal setting, goal operation, and goal monitoring. Incremental theorists (compared to entity theorists) are more likely to set learning goals (instead of performance goals), to use mastery-orientated strategies (instead of helpless-orientated strategies) for reaching their goals, and to focus more strongly on expectations

(instead of negative emotions) when monitoring goal progress (Burnette et al., 2013; see also Robins & Pals, 2002). Further, holding an incremental theory can serve as a protective buffer against the demotivating effects of failure feedback (Burnette et al., 2013) or when experiencing setbacks (Burnette & Finkel, 2012; Dweck et al., 1995; Dweck, 2012) by maintaining successful self-regulation in such situations (Burnette et al., 2013).

In the absence of external influences, implicit theories are relatively stable over time (Dweck et al., 1995; e.g., Robins & Pals, 2002). However, based on the positive outcomes that relate to holding an incremental theory in many domains, numerous experimental and interventional approaches have been developed to increase incremental theories. Experimental manipulations include simple statements or instructions that provide an incremental view (Kasimatis et al., 1996; Martocchio, 1994), confronting participants with (fictitious) articles, expert opinions (Chiu, Hong, & Dweck, 1997; Kray & Haselhuhn, 2007), or the use of biased questionnaires (Job et al., 2010). The resulting interventions combine different approaches to promote incremental theories and contain informative components, learning through examples, activities in which participants apply the learned information, and saying-is-believing exercises (e.g., Schleider & Weisz, 2018; Yeager et al., 2014). Especially in the context of intelligence and intellectual achievement, the effectiveness of these interventions has led to the development of large-scale programs to teach incremental views to students, like *Mindset Works* (https://www.mindsetworks.com/) or *Project for Education Research that Scales* (https://www.perts.net/; see Yeager et al., 2019 for an evaluation).

1.2 A Social Cognitive Perspective on Health Promotion

Before reviewing existing literature focusing on the relationship between implicit theories and health-promoting outcomes in section 1.3, I will first describe what is considered as health-promoting outcomes throughout this dissertation on a behavioral, motivational, and evaluative level. I will further introduce social cognitive determinants that impact these

outcomes. Research in social and health psychology has developed numerous models to explain health promotion (for an overview, see Conner & Norman, 1996; Prestwich & Kenworthy, 2018). Instead of providing a description and differentiation of these models, I will focus on variables that consistently reappear in these models.

1.2.1 Health-Promoting Outcomes

Based on the *Ottawa Charter for Health Promotion*, health promotion is defined as "the process of enabling people to increase control over, and to improve, their health" (World Health Organization, 1986, p. 1). Health psychological research has developed a variety of interventions to improve health promotion on different levels: On a behavioral level via increasing individuals' engagement in health behaviors; on a motivational level via boosting health behavior-intentions; and on an evaluative level via enhancing health-promoting attitudes.

Health Behavior

Health behavior can be defined as any activity undertaken by individuals to maintain or improve their health or prevent the emergence of diseases (Cockerham, 2014). Health behaviors can be subdivided in promoting behaviors to improve health (e.g., exercising, eating healthily), preventive behaviors to protect or maintain a given health status (e.g., vaccination, condom use), refraining from health-risk behaviors (e.g., substance abuse, careless driving), as well as checking-behaviors (e.g., attending health screenings), and sick role behaviors (e.g., taking medication, resting when being ill; see Faltermaier, 2017; Prestwich & Kenworthy, 2018). Since the different types of behaviors are subject to different underlying processes, various (health) psychological models have been developed, which are more or less suited to predict different types of behaviors. For example, the Protection Motivation Theory (Rogers, 1997) might be best to explain engagement in preventive or sick-role behaviors, while the Social Cognitive Theory (Bandura, 1977, 1986) might serve better to

explain engagement in health-promoting behaviors, like exercising. Although individual models emphasize the importance of different processes or variables, it should be emphasized that in most models, the behavior is preceded by a motivational component, which is health behavior-intentions.

Health Behavior-Intentions

A necessary prerequisite for initiating health behavior is the formation of a health behavior-intention (Allmer, 1997). Health behavior-intentions refer to the willingness to develop and maintain health-promoting behaviors or environments, as well as the willingness to reduce and avoid health-threatening behaviors or environments (Allmer, 1997). Intentions serve the purpose of achieving or restoring a desirable health status (compensatory intentions) or maintaining a desirable health status (preventive intentions; Allmer, 1997). In some models, the concept of intentions is also referred to as goals (Social Cognitive Theory, Bandura, 1989) or motives (Protection Motivation Theory; Rogers, 1997). However, for the context of health promotion, these terms are often used interchangeably as they focus on the willingness to engage in or refrain from behavior(s). A large number of interventions aim at stimulating the formation of health behavior-intentions. It is important to take into account that intentions are not automatically translated into behavior, as other factors influence this intention-behavior link (see section 1.2.2). The intention formation often depends on the evaluation of the behavior or its outcomes (Ajzen, 1991), which is conceptualized as health attitude.

Health Attitudes

A meta-analysis regarding the Theory of Planned Behavior concluded that attitudes were the strongest predictors for intentions (Armitage & Conner, 2001). According to Eagly and Chaiken (1993), attitudes refer to the tendency to evaluate a given entity with a certain amount of approval or rejection. Besides a simple positive-negative evaluation, attitudes can also relate to the evaluation of other characteristics. In the health domain, attitudes can be

formed regarding a particular health behavior (e.g., I like exercising), the evaluation of the outcome of this behavior (e.g., good physical appearance is desirable), or health in general (e.g., good health is important to me). The Reasoned Action Approach differentiates between affective and instrumental attitudes (Fishbein & Ajzen, 2010). Affective attitudes refer to the perceived or anticipated positive or negative experiences associated with the attitude object or behavior (e.g., exercising is fun). Instrumental attitudes refer to the perceived functionality of the attitude object or behavior (e.g., exercising is helpful to achieve good physical appearance; Fishbein & Ajzen, 2010). Especially early health psychological research has focused on the role of attitude change for health promotion (e.g., Bettinghaus, 1986; Petty et al., 2009; Rogers, 1975). The main goal of these approaches was changing attitudes to develop successful health and risk communication under the consideration of the Protection Motivation Theory (Rogers, 1975) or the Elaboration-Likelihood-Model (Petty et al., 2009).

While much research has been conducted on studying this simplified attitude-intention-behavior relation (especially concerning the Theory of Planned Behavior and the Theory of Reasoned Action), it has to be taken into account that attitudes and intentions do not automatically translate into behavior (Prestwich & Kenworthy, 2018; Sheeran & Webb, 2016). However, attitudes and intentions can be considered as proximal determinants of health behavior and were also studied as outcomes in implicit theories research in the health domain (see section 1.3; Chapter II). Next, I will introduce more distal determinants of health promotion that are relevant when studying attitude-intention-behavior relations.

1.2.2 Social Cognitive Determinants of Health Promotion

This section describes the relevance of locus of control, outcome expectancy, self-efficacy, and self-regulation for health promotion. I focus on these social cognitive determinants of health promotion as they consistently emerge as influencing variables in various psychological models of health. Furthermore, these constructs are also investigated in

research on implicit theories (see section 1.3.5), and their relevance is further discussed throughout this dissertation.

Locus of Control

One variable that is studied in relation to health promotion and behavior engagement is locus of control (Luszczynska & Schwarzer, 2005; Wallston et al., 1978). Locus of control stems from Rotter's (1954, 1990) social-learning theory and describes beliefs about the controllability of events and outcomes. An internal locus of control exists when an individual perceives a positive or negative event as a consequence of their behavior. In contrast, an external locus of control exists when this event is perceived as independent of their behavior, and beyond their control (Rotter, 1954, 1990). Regarding health, locus of control is often conceptualized as a three-dimensional construct (Wallston et al., 1978). An internal health locus of control refers to the assumption that individuals can control their health (Wallston et al., 1978). External locus of control is further divided into *powerful others locus of control* (i.e., assuming that health is mainly controlled by other people, like health professionals) and *chance locus of control* (i.e., assuming that health is mostly determined by luck or fate; Wallston et al., 1978). The constructs' three-dimensional structure has been criticized and appears to be sensitive to cultural differences and dependent on the medical condition investigated (Luszczynska & Schwarzer, 2005). Internal health locus of control often appears as the best predictor for health behaviors (especially in healthy populations; AbuSabha & Achterberg, 1997; Norman & Bennet, 1996). Control beliefs are incorporated into the Theory of Planned Behavior as a predictor of perceived behavioral control (Ajzen, 1991). A lack of control can also serve as a barrier to health behavior engagement in the Health Belief Model (e.g., Janz & Becker, 1984). Further, according to Allmer (1997), viewing health as controllable is a necessary precondition for the formation of health behavior-intentions.

Outcome Expectancy

Another heavily studied variable is outcome expectancy, which refers to assumptions whether a given behavior is perceived to lead to a particular outcome (Bandura, 1977). With regard to health, this refers to contingency expectations that a given health behavior (e.g., washing one's hand) leads to a particular result (e.g., decreasing the likelihood of getting infected with a virus). Stemming from Expectancy-Value Theory (Eccles et al., 1983), the construct of outcome expectancy is considered as a predictor of attitudes in the Theory of Planned Behavior (Ajzen, 1991). While outcome expectancy relates to whether one thinks that a given behavior can improve health, an instrumental attitude is the resulting evaluation that this behavior is perceived as useful or functional (see section 1.2.1). In the Health Action Process Approach (Schwarzer, 2008), as well as in the Social Cognitive Theory (Bandura, 1977), outcome expectancy is considered to have direct effects on intentions (and behavior). Further, outcome expectancy is similar to the construct response efficacy in the Protection Motivation Theory (Rogers, 1997), while the latter focuses on assumptions whether a given behavior is useful to protect against a perceived health threat (Rogers, 1997).

Self-Efficacy

In the Health Action Process Approach (Schwarzer, 2008) and the Social Cognitive Theory (Bandura, 1977), much attention is drawn towards the role of self-efficacy to predict health-promoting intentions and behaviors. Self-efficacy refers to an individual's assumption about being able to carry out a given behavior that leads to the desired outcome (Bandura, 1977). It has been found that self-efficacy is one of the strongest predictors of health behavior (AbuSabha & Achterberg, 1997; Sheeran et al., 2016). Self-efficacy is also included in the Protection Motivation Theory (Rogers, 1997) and can be considered as an equivalent to perceived behavioral control in the Theory of Planned Behavior and Theory of Reasoned Action (Fishbein & Cappella, 2006).

Self-Regulation

The constructs mentioned above are usually useful in predicting health behavior-intentions or attitudes. However, they are often less predictive of actual behaviors, which is considered as the intention-behavior gap (Prestwich & Kenworthy, 2018; Sheeran & Webb, 2016). Potential approaches to overcome the intention-behavior gap emphasize the importance of volitional processes that relate to the implementation of goals and intentions into actions and results (Prestwich & Kenworthy, 2018; Schwarzer, 2008). Therefore, more attention is drawn towards dual-process models to explain health behaviors as they account for the role of impulsive behavioral tendencies that can counteract the implementation of an intention into behavior (Hofmann et al., 2008; Strack & Deutsch, 2004).

A necessary volitional process that is heavily studied in the context of dual-process approaches is self-regulation (Hofmann et al., 2008). Self-regulation—or self-control—refers to the ability to suppress or control internal impulses in order to control one's behavior and to achieve desired goals or outcomes (Tangney et al., 2004; Vohs & Baumeister, 2004). Thus, self-regulation is different from self-efficacy. While self-efficacy refers to the initial evaluation of being able to perform a behavior successfully, self-regulation refers to the procedural ability to actually carry out the behavior and maintain the behavior in the context of conflicting goals or impulses (Hofmann et al., 2008; Stroebe et al., 2013). Similarly, Schwarzer (2008) included coping- and recovery-self-efficacy in the Health Action Process Approach, which can be considered as self-regulatory processes as they refer to maintaining health behavior even under challenging circumstances or when experiencing setbacks (Prestwich & Kenworthy, 2018; Schwarzer, 2008). As self-regulation helps to overcome impulses or competing goals, it serves as an important predictor of health behavior engagement (de Ridder & de Wit, 2006).

Given the fact that implicit theories predict successful self-regulation (Burnette et al., 2013), research about implicit theories has also been applied to health. In the next section, I

will review research focusing on the role of implicit theories for health promotion. Many of these studies also found that implicit theories influence the aforementioned social cognitive determinants of health promotion (see section 1.3.5).

1.3 Implicit Theories and Health Promotion

Given that implicit theories can predict successful self-regulation (Burnette et al., 2013) and that self-regulation is essential to overcome the intention-behavior gap (de Ridder & de Wit, 2006; Sheeran & Webb, 2016), it is not surprising that the relevance of implicit theories for health promotion is frequently studied. This section provides a narrative review focusing on research about implicit theories in the health domain. I differentiate four approaches on how implicit theories are studied in relation to health: (1.) cross-domain approaches in which the relationship between implicit theories of a non-health related-domain (e.g., personality) with health-related outcomes (e.g., mental illness) are studied; (2.) health domain-specific approaches in which implicit theories for specific health domains are studied (e.g., implicit theories of weight; implicit theories of smoking); (3.) generalized approaches, which focus on assumptions about the changeability of health in general; and (4.) research on the double-edged sword effect that focuses on potential adverse effects of holding an incremental theory. After describing these approaches, I will conclude this section with results regarding the relationship between implicit theories and the determinants of health promotion described in the previous section (section 1.2.2).

1.3.1 Cross-Domain Approaches

Implicit theories in a specific domain (e.g., intelligence) are considered as best predictors for outcomes in that particular domain (e.g., test scores; see Chiu, Dweck et al., 1997; Dweck, 2012). However, previous research has also investigated the influence of implicit theories in health-unrelated domains on health-related outcomes, with a strong emphasis on implications for stress and mental health (Burnette et al., 2020; Schleider et al.,

2015). For example, an incremental theory of emotion is related to fewer depressive symptoms (Tamir et al., 2007)**.** Correspondingly, Yaeger and colleagues (2014) found correlational and interventional evidence that an incremental theory of personality can buffer against stress and leads to better physical health in a set of longitudinal studies (with eight to nine months follow-ups). Extending this, Schleider and Weisz found that teaching an incremental theory of personality in a single-session intervention decreases risk factors (i.e., increased perceived control and fastened stress-recovery) for the development of mental illness (Schleider & Weisz, 2016b), as well as the number of symptoms of depression and anxiety (Schleider & Weisz, 2018). Stronger incremental theories of intelligence, emotion, and personality are also related to fewer reported symptoms in several screening instruments for different mental illnesses (e.g., anxiety, depression, alcohol abuse; Schroder et al., 2016). These relationships even persist when controlling for implicit theories regarding these mental illnesses (see also 1.3.2; Schroder et al., 2015, 2016). The relationship between implicit theories in health-unrelated domains with stress and the development of mental illness has been further corroborated by two meta-analyses (Burnette et al., 2020; Schleider et al., 2015).

1.3.2 Health Domain-Specific Approaches

Since the last decade, much research has focused on implicit theories in specific health domains. These approaches focus on assumptions about the changeability versus stability of single aspects of health, like body weight, physical activity, addiction and substance abuse, as well as mental health conditions.

Weight and Body Appearance

Implicit theories of weight refer to the assumption whether weight is perceived as changeable (incremental theory) or rather fixed around a given set-point (entity theory; Auster-Gussman & Rothman, 2018; Burnette, 2010; Burnette & Finkel, 2012). A stronger incremental theory of body weight predicts stronger intentions to continue dieting after being

confronted with a dieting set-back, a higher willingness to invest effort in achieving weight-related goals, stronger expectations regarding dieting success, and less weight gain in a longitudinal design (Burnette, 2010). Further, an intervention aimed at fostering an incremental theory of body weight leads to less weight gain, especially when being confronted with severe dieting setbacks (compared to a control group and a knowledge intervention group; Burnette & Finkel, 2012). A stronger shift towards an incremental theory for participants in the incremental intervention group also predicted weight loss (Burnette & Finkel, 2012). Correlational and experimental findings exist, showing that viewing health as changeable leads to lower calorie consumption in a bogus taste test (Ehrlinger et al., 2017). In a representative U.S. sample, Auster-Gussman and Rothman (2018) found that a stronger incremental theory is related to a lower BMI, perceiving weight as the result of behavior (compared to genetics) and more self-reported engagement in weight-managing behaviors (e.g., dieting behavior, exercising; Auster-Gussman & Rothman, 2018). Related research by Lyons and colleagues (2015) found that an incremental view of body appearance (i.e., assuming that body appearance can be changed) relates to more physical activity (Lyons et al., 2015).

Physical Activity and Exercising

A second area investigates implicit theories about physical activity and exercising (Kasimatis et al., 1996; Orvidas et al., 2018). An experimentally induced incremental theory of physical coordination (i.e., believing physical coordination can be learned) leads to more exercising motivation and less negative affect after performing an exhausting exercising routine (Kasimatis et al., 1996). For children, a stronger entity theory of athletic abilities relates to less motivation towards sports, while an incremental theory relates to more enjoyment of physical activity (Biddle et al., 2003). Orvidas and colleagues (2018) found that viewing one's fitness-level as changeable relates to stronger exercising-intentions and a higher

self-reported exercising frequency. A meta-analysis across 43 studies about implicit theories in the physical activity domain found that an incremental theory contributes to more beneficial motivation and goal-orientation (i.e., task orientation rather than performance orientation; Vella et al., 2016). However, the authors also reported a lack of experimental evidence and studies focusing on behavioral outcomes (Vella et al., 2016).

Substance Abuse and Addiction

A third area focuses on implicit theories in relation to substance abuse and addiction. In a representative U.S. sample, Thai and colleagues (2018) found that current smokers are more likely to endorse an entity theory of smoking (i.e., assuming that smoking behavior cannot be changed) compared to non-smokers and past-smokers. For current smokers, a stronger incremental theory is connected to lower expectations to become regular smokers (Fitz et al., 2015) and higher intentions to quit smoking in the near future (Thai et al., in press). Providing participants with information fostering an incremental view of smoking in a web-based intervention while using a smoking cessation app increases cessation rates compared to using the cessation app alone (Sridharan et al., 2019b). However, an incremental view of smoking does not only relate to positive outcomes. Fitz and colleagues (2015) found that non-smokers who held a stronger incremental theory of smoking reported higher expectations to try smoking in the future.

For alcohol abuse, a stronger incremental theory of drinking tendencies (i.e., viewing drinking behavior as changeable) is related to less self-reported alcohol abuse (Schroder et al., 2016). Further, it has been found that a stronger incremental theory of alcoholism is related to having a weaker explicit drinking identity, weaker habitual alcohol consumption, fewer alcohol-related problems, and a lower risk of developing alcohol-related disorders (Lindgren et al., 2020). Over time an incremental theory can attenuate the relationship between having a problematic drinking identity and alcohol consumption, that is, for participants with a stronger

explicit drinking identity, holding a stronger incremental theory of alcoholism resulted in a reduction in alcohol consumption over time (compared to participants with a stronger entity theory; Lindgren et al., 2020).

Extending the idea of implicit theories regarding different types of substance abuse, Sridharan and colleagues (2019a) developed an implicit theory measure regarding assumptions about the changeability of addiction in general. In contrast to findings on implicit theories of smoking, implicit addiction theories were not related to current smoking status or quitting intentions in the near future (Sridharan et al., 2019a). However, stronger incremental theories of addiction were related to a higher general motivation to quit smoking, a stronger commitment to quitting, perceiving fewer barriers for quitting, and attributing imagined failures of quitting to a lack of effort (instead of a lack of ability; Sridharan et al., 2019a). Drug users who were confronted with a message focusing on the changeability (versus stability) of addiction showed stronger intentions to pursue counseling and cognitive-behavioral treatment (Burnette et al., 2019). Furthermore, for drug offenders in a corrections-based intensive drug treatment program, a stronger incremental theory of addiction was related to a decreased likelihood of failing in a subsequent drug test (May & Pratt, in press).

Mental Health

As briefly stated in the last section (1.3.1), Schroder and colleagues (2015, 2016) not only investigated the relationship between implicit theories in other domains (intelligence, personality, emotion) on mental health symptoms but also developed implicit theory measures regarding various mental health conditions (depression, [social] anxiety, problematic drinking). Although they found that implicit theories regarding a specific mental condition were best to predict related symptoms, overlaps emerged. Furthermore, a generalized incremental theory—as a latent variable—predicted symptoms regarding all mental health domains (Schroder et al., 2016). A stronger incremental theory regarding anxiety (i.e.,

assuming anxiety is changeable) did not only relate to fewer symptoms but also to an increased willingness to seek individual therapy compared to medication (Schroder et al., 2015).

1.3.3 Implicit Theories of General Health

Good health is not just the result of following recommendations in a single health domain. Instead, good health is the result of health-conscious behaviors across several domains (Prochaska et al., 2008). For example, sticking to a healthy diet will not result in good health if the same person smokes a package of cigarettes every day and spends most of their time sitting on the couch. Therefore, many psychological interventions focus on health promotion across domains and target *multiple health behavior change* (Prochaska et al., 2008). This trend has influenced implicit theories research recently, as the impact of implicit theories of (general) health on multiple health domains is researched more often (Bunda & Busseri, 2019; Thomas et al., 2019; John-Henderson et al., in press). Such a generalized implicit theory of health refers to whether one's health is perceived as changeable (incremental theory) or fixed (entity theory; e.g., Bunda & Busseri, 2019).

Although Bunda and Busseri (2019) did not find an effect of their implicit theories manipulation on health behavior-intentions, stronger incremental theories were related to stronger health behavior-intentions when controlling for experimental condition and past, current, and anticipated future health status. The authors measured behavior-intentions across different health-domains (e.g., food consumption, physical activity, sleep), and incremental theories of general health were related to the overall mean across these domains (Bunda & Busseri, 2019). Thomas and colleagues (2019) examined the role of implicit theories of general health on healthy eating intentions. In two studies, they found correlational and experimental support for the relationship between incremental theories and stronger intentions to eat healthily. An incremental theory of general health also relates to higher levels of

physical activity measured over a one-week interval using accelerometers (John-Henderson et al., in press). Furthermore, stronger incremental theories were directly and indirectly—via increased physical activity—associated with lower BMI-scores (John-Henderson et al., in press).

This dissertation also focuses on implicit theories regarding assumptions about the changeability of health in general. The studies presented in the upcoming chapters will extend and replicate the results mentioned above, which mainly focused on the relationship between implicit theories and intentions. The presented studies will inform about the influence and relationship between implicit theories of general health with health-related attitudes (Chapter II, Study 2), health behavior engagement (Chapter II, Studies 1 and 4; Chapter IV), as well as food choices (Chapter II, Study 3; Chapter III, Study 1). Before presenting these studies, the next two sections relate to the adverse effects of holding an incremental theory (section 1.3.4) and the relationship between implicit theories and other determinants of health promotion (section 1.3.5) described earlier.

1.3.4 Double-Edged Sword Effect

The results presented above show that holding an incremental theory leads to a range of health-promoting outcomes. However, some research shows that an incremental theory can also have adverse effects, especially in the context of blame attributions and stigmatization. Across three studies, Hoyt and colleagues (2017) found that participants who read an article emphasizing the changeability of weight—compared to an article describing obesity as a disease—reported stronger anti-fat prejudices via an indirect effect of stronger blame attributions. Similarly, Burnette and colleagues (2017) showed that an incremental theory of weight increases body-shame via increased responsibility. While incremental theories increase anti-fat prejudices and body shame through increased blame and responsibility attributions, Hoyt and colleagues (Burnette et al., 2017; Hoyt et al., 2017) found a decrease in prejudices and shame through increased efficacy beliefs and decreased essentialist thinking.

As these opposing effects work in parallel, research in this domain is also called stigma-asymmetry model or double-edged sword effect (Hoyt et al., 2017; Hoyt et al., 2019). The negative effect of an incremental message via increased blame diminishes when the incremental message emphasizes that losing weight requires much effort and depends on the use of the right strategies (Hoyt et al., 2019). When using this compensatory incremental message, only the positive effects on weight-related outcomes appeared (mediated via increased efficacy beliefs and decreased essentialism; Hoyt et al., 2019).

Research on the double-edged sword effect is yet limited to the weight domain. In Chapter V, two studies are presented that investigate whether a similar model explains the influence of implicit theories of general health on blame and social support for people suffering from different mental and physical illnesses.

1.3.5 Implicit Theories and Determinants of Health Promotion

Models of health behavior strongly focus on the role of control beliefs, self-efficacy, and outcome expectancy to predict health behavior change (see section 1.2.2). The studies reviewed above show that implicit theories also serve a crucial role in health promotion. Implicit theories are not considered explicitly in models to predict health promotion, although these models include variables that inherently assume that health is changeable. For example, considering what causes health changes (locus of control), which behaviors lead to such changes (outcome expectancy), and whether one is capable of engaging successfully in this change process (self-efficacy) is inherently contingent on the belief that health is perceived as changeable. Therefore, I argue that implicit theories are a necessary precondition for the development of control beliefs, outcome expectancy, and self-efficacy in the health domain.

Previous research supports my claim that implicit theories play a crucial role in the set-up of other health-promoting cognitions. For example, incremental theories of weight relate to and influence higher internal and lower external health- and dieting-related locus of

control (Burnette, 2010). Similarly, Schleider and Weisz found that an intervention to boost incremental theories of personality also increases perceived control (Schleider & Weisz, 2016a, 2016b; Schleider & Weisz, 2018). Further, in line with my argument, Dweck assumed that implicit theories precede the set-up of control beliefs (Dweck, 2012; Dweck & Leggett, 1988). The influence of implicit theories on locus of control will be further demonstrated in Chapter II (Studies 1-3) and Chapter IV. The (causal) relationship between implicit theories and self-efficacy has been demonstrated several times: Incremental theories are connected to higher self-efficacy in dieting (Ehrlinger et al., 2017), physical activity (Kasimatis et al., 1996; Orvidas et al., 2018), smoking cessation (Burnette et al., 2019; Fitz et al., 2015; Sridharan et al., 2019a), and in many health-unrelated domains (e.g., Busseri & Samani, 2019; Tamir et al., 2007).

The influence of implicit theories on outcome expectancy is less clear. Incremental theories lead to stronger expectancy-value beliefs (Thomas et al., 2019) and offset efficacy (Burnette et al., 2017; Hoyt et al., 2019). The measures used to capture these constructs also include items that relate to outcome expectancy (e.g., "The more effort I put into managing my weight, the more successful I will be at it"; Burnette et al., 2017; "Making healthy food choices makes me feel good about myself"; Thomas et al., 2019). However, the relationship between implicit theories and these items is not reported. To investigate the relationship between implicit theories and outcome expectancy, the double-edged sword approach described in Chapter V explicitly addresses the role of outcome expectancy.

Chapter II

Is Your Health Malleable or Fixed? The Influence of Implicit Theories on Health-Related Attitudes and Behaviour

This chapter is based on the following publication:

Schreiber, M., Job, V., & Dohle, S. (in press). Is your health malleable or fixed? The influence of implicit theories on health-related attitudes and behaviour. *Psychology & Health*. https://doi.org/10.1080/08870446.2020.1761975 (Published online: 13 May 2020)

Please note that some changes in headings, citation style, and formatting were undertaken to fit the layout of this dissertation. Supplemental materials were added to the main text and the Appendix. No changes were made to the content of the article.

Abstract

Objective: Implicit theories of health describe the extent to which health is perceived as a fixed (entity theory) versus malleable (incremental theory) characteristic. In four studies, it was investigated how these theories correspond to health-related attitudes and behaviours.

Design: In Study 1 ($N = 130$), the relationship of implicit theories of health and health-related behaviours was assessed via self-reports. To investigate their causal influence on health-related attitudes (Study 2; $N = 357$) and hypothetical food choices (Study 3; $N = 351$), implicit theories of health were manipulated using fictitious newspaper articles. In Study 4 ($N = 235$), the relationship of implicit theories and health behaviours in daily life was investigated using experience sampling.

Results: Study 1 showed that a stronger incremental theory is positively associated with health behaviours like eating healthily or engaging in physical activity. Studies 2 and 3 revealed that a manipulation of implicit theories of health changes health-related attitudes and hypothetical food choices via an internal health locus of control. Study 4 showed that individuals with a stronger incremental theory reported more health-promoting behaviours in daily life.

Conclusion: These findings extend the knowledge about implicit theories as they show that they are highly relevant for health promotion.

Keywords: Implicit theories, health-related attitudes, health behaviour, locus of control

2.1 Introduction

Over the past decades, the frequency of chronic diseases, like cancer, diabetes, obesity, or heart diseases have increased globally (e.g., van Oostrom et al., 2016). Many researchers agree that this trend will continue over the next decades (e.g., Mathers & Loncar, 2006). Most chronic diseases could be prevented trough simple lifestyle changes like eating more healthily, maintaining sufficient physical activity or engaging in other preventive behaviours (e.g., Hill et al., 2003). Such lifestyle changes are influenced by numerous factors, including psychological, biological, social, or environmental factors (Dahlgren & Whitehead, 1991). In this article, we focus on psychological determinants of health behaviours and adopt a mindset perspective that focuses on peoples' beliefs about whether health is changeable at all, i.e., their *implicit theories of health*. At the core of this perspective is the assumption that people will not engage in preventive health behaviours if they do not believe that their health, in general, can change. In a series of four studies, we investigate how people's implicit theories of health influence health-related attitudes and behaviour in various domains.

2.1.1 Implicit Theories

Implicit theories (or *lay theories*) are basic beliefs that people use to organize their world and to guide their behaviour. People hold such lay theories with regard to various topics like whether the world is a just place (Hafer & Bègue, 2005; Lerner, 1980) or whether people have a free will (Aarts & van den Bos, 2011; Vohs & Schooler, 2008). They also hold theories about people's characteristics like intelligence or personality. One influential line of research investigated people's beliefs about the changeability of these characteristics (Dweck, 1999; Molden & Dweck, 2006). It has been shown that individuals differ in the extent to which they perceive that a given attribute or characteristic is stable versus malleable. Perceiving an attribute as a fixed entity that is static and not a subject of personal development is termed *entity theory*, whereas perceiving this attribute as a malleable and

changeable quality that can be developed is termed *incremental theory* (Dweck, 1999; Molden & Dweck, 2006). Entity versus incremental theories exist in many domains and they have been studied extensively throughout the last 30 years. Research began in the domain of intelligence (Blackwell et al., 2007; Hong et al., 1995) and achievement domains like athletic abilities (Kasimatis et al., 1996) or mathematical skills (Good et al., 2008). They have also been studied in domains like morality (Chiu, Dweck et al., 1997) or aging (Weiss et al., 2016).

Differences and changes of implicit theories are associated with a wide range of different outcomes. Especially holding an incremental theory has positive effects because it predicts successful self-regulation and more functional goal striving as compared to an entity theory. A recent meta-analysis revealed that holding an incremental theory improves goal setting, goal operating, and goal monitoring (Burnette et al., 2013). Reaching health-related goals or maintaining a good health often involves such self-regulation strategies (e.g., Hofmann et al., 2008). Therefore, it seems to be highly relevant and promising to investigate the effects of implicit theories for health.

2.1.2 Implicit Theories and Health

In the recent years, implicit theories have also been studied in various health domains. Burnette (2010) has examined the role of implicit theories in the context of weight management and showed that participants who adopted an incremental theory of body weight reported more persistence in dieting following dieting setbacks. Burnette and Finkel (2012) showed that developing an incremental view of body weight can buffer against setback-related weight gain. Incremental beliefs about body weight are also connected to less calorie consumption (Ehrlinger et al., 2017). Furthermore, incremental theories of fitness and body appearance are related to more self-reported physical activity, higher exercising frequency, and stronger exercising intentions (Lyons et al., 2015; Orvidas et al., 2018).

However, health-related research has also shown that incremental beliefs are not always beneficial. For example, it has been demonstrated that holding an incremental theory of smoking has different effects for non-smokers and smokers. Non-smokers who believed that smoking behaviour can be changed reported greater expectations to try smoking in the future. Smokers with an incremental theory about smoking reported lower expectations to become regular smokers (Fitz et al., 2015). These expectations might reflect unrealistic optimism (Fitz et al., 2015; Weinstein, 1980). Individuals who think that they could easily quit smoking in the future could be less likely to attempt quitting smoking now. Further, it has been shown that viewing body weight as changeable can increase stigmatization of oneself or others via attributions of overweight to personal blame or responsibility (Burnette et al., 2017; Hoyt et al., 2017).

Although implicit theories in specific health domains appear to be relevant to behaviours and assumptions in the given domain, this needs not necessarily be generalizable to perceptions and behaviour in other health domains or health in general (Bunda & Busseri, 2019; Burnette et al., 2013; Dweck, 1999; Job & Walton, 2017). This is particularly relevant because one's own health status is not just the result of specific behaviours in a single domain. Instead, it is determined by multiple behaviours across different domains (physical activity, maintaining a balanced diet, avoidance of alcohol and nicotine). Therefore, recent approaches to intervention research have emphasized the importance of developing interventions that target multiple health behaviours (James et al., 2016; Prochaska et al., 2008; Prochaska & Prochaska, 2011) or intensive lifestyle changes (e.g., Look AHEAD Research Group, 2014). In this paper, we thus investigate how general implicit theories about the changeability of health are connected to behaviours and attitudes in a wide range of different health domains. Such a perspective seems especially relevant for the development of interventions to improve people's lifestyle across different health domains. Interventions targeting a general implicit theory of health could be realized more cost-efficiently and would benefit health to a stronger

extent than interventions targeting implicit theories that are only relevant for a single health domain.

In a similar vein, Bunda and Busseri (2019) investigated the influence of implicit theories of health on health behaviour intentions. They demonstrated that general implicit theories of health exist and that people differ in how strongly they believe in the changeability of health in general. However, their experimental manipulation of implicit theories failed to show significant effects on health behaviour intentions. This may have occurred because their manipulation of implicit theories was too weak or because of the low internal consistency of their outcome measure. In addition, they only examined young adults, which limits the generalizability of their findings. Therefore, we wanted to extend these findings and investigate the role of implicit theories of health for attitude formation and health behaviour in daily life in more detail.

2.1.3 The Mediating Role of Locus of Control

Locus of control refers to the extent to which an individual thinks that the occurrence of an event is dependent on internal or external factors (Rotter, 1990). Locus of control has been widely applied in the health domain and it is usually conceptualized as a three dimensional construct (Wallston et al., 1978). The three dimensions differ in whether individuals think they can influence their own health by themselves (internal locus of control), whether they think that their health is controlled by powerful others, like health professionals (powerful others locus of control), or whether they think their health is determined by luck or fate (chance locus of control).

The construct of health locus of control differs from the implicit theory approach even though the two are strongly related. It is possible for a person who has a malleable theory of health to not have an internal locus of control if she does not perceive to have actual control over her behaviour or habits (e.g., because other people determine her diet). Having a malleable theory of health is a necessary (although not sufficient) precondition for people to

have an internal locus of control with regard to health. Accordingly, implicit theories have been proposed to precede and set-up control beliefs (Dweck, 2012; Dweck & Leggett, 1988). Thus, implicit theories begin earlier in a causal chain and produce or prevent perceptions of control. It is important that an individual first assumes that health is changeable. Only then does the question arise whether oneself or other factors control and cause the changes.

2.1.4 Current Research

In this research, the role of implicit theories of health for a wide range of health behaviours was investigated. A first aim was to examine if and how interindividual differences in the perception of the changeability of health are connected to self-reported health behaviours and perceptions (Study 1). We assumed that an incremental theory of health would be related to various health-promoting behaviours, such as healthy eating or physical activity, but negatively related to health-damaging behaviours, such as smoking or alcohol consumption. In a second step, implicit theories of health were manipulated to investigate whether they influence health-related attitudes (Study 2) and hypothetical food choices (Study 3). Moreover, Study 2 and 3 tested if health locus of control mediates this effect. Third, the influence of implicit theories of health on the execution of health-promoting and health-damaging behaviours in daily life was examined using an experience sampling approach (Study 4). All studies received ethical approval by the German Association of Psychology (DGPs). In all studies, informed consent was obtained from all participants prior to participation.

2.2 Study 1

In Study 1, we examined the relationship between implicit theories of health, self-reported health variables (e.g. healthy eating, physical activity), and the three dimensions of health locus of control (internal, powerful others, and chance).

2.2.1 Method

Participants

One-hundred-thirty participants (115 women, M_{age} = 27.96, SD_{age} = 10.60) from a participant pool of a large German university took part in this online study in exchange for course credit or voluntarily without receiving compensation.

Measures

To measure the extent to which participants perceive health as malleable versus stable, six items were adapted from validated and reliable measures traditionally used to assess implicit theories (see Dweck, 1999). Participants indicated how much they agreed with each item (e.g., "You can substantially change your own health.") using a 7-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*). Three items represented an incremental theory of health, and three items represented an entity theory of health (see Table 2.1). For further analyses, the mean of all six items was computed after recoding the three reverse-coded items to represent an Implicit Theories of Health Scale (ITHS). Higher values on this scale imply that an individual holds an incremental theory of health, whereas lower values imply that an individual holds an entity theory of health. The internal consistency of the scale was high (α = .89).

Table 2.1

Means and Standard Deviations of the Implicit Theories of Health Scale Items (Study 1)

Items	*M*	*SD*
You have a certain health status, and you cannot really do much to change it. (r)	5.72	1.18
Your health is something about you that you cannot change very much. (r)	5.81	1.14
No matter who you are, you can significantly change your own health.	5.29	1.33
To be honest, you cannot really change how healthy you are. (r)	5.88	1.19
You can always substantially change how healthy you are.	5.27	1.42
You can change your own health status considerably.	5.41	1.31

Note. (r) = reverse coded items.

To measure health-related variables, several items from the German Health Interview and Examination Survey for Adults (DEGS; Gößwald et al., 2012) were included. The DEGS is a validated questionnaire that is widely used to examine health-related variables in the German population. We included items to measure participants' general health status ("How is your health status in general"; 1 = *very bad* to 5 = *very good*), how often they engage in physical activity ("On how many days of a week are you physically active enough to make you sweat or out of breath?"; number of days), how often they exercise ("How often do you exercise?"; 1 = *no exercising* to 5 = *regularly, more than 4 hours a week*) and, how much attention they pay to maintain a sufficient amount of physical activity ("Overall, how much attention do you pay to sufficient physical activity?"; 1 = *not at all* to 5 = *very much*). To measure health-damaging behaviours, we included the DEGS-items to measure alcohol consumption ("How often do you drink an alcoholic beverage, like a glass of wine, beer, mixed drinks or liquor?"; 1 = *never* to 5 = *4 times a week or more*) and smoking status ("Do you smoke currently - if only occasionally?"; dummy coded: 0 = *no, not anymore/have never smoked*, 1 = *yes, daily/yes, occasionally*). Participants were also asked to indicate how often

they eat healthily ("If you think about the past month, how often have you been able to eat a healthy diet?"; 1 = *never* to 5 = *always*).

To measure health locus of control, the Health- and Illness- Related Locus of Control Questionnaire (KKG; Lohaus & Schmitt, 1989) was used. The KKG consists of 21 items all answered on 6-point Likert scales (1 = *strongly disagree* to 6 = *strongly agree*). Similar to its English equivalent (Wallston et al., 1978), the KKG consists of three subscales (with seven items each) to measure internal (e.g. "If I do not feel well physically, I have to blame myself."; $\alpha = .75$), powerful others (e.g. "If I feel well physically, then I owe it mainly to the advice and help of others."; $\alpha = .68$), and chance health locus of control (e.g. "Whether my symptoms last longer depends mainly on chance."; $\alpha = .85$).

2.2.2 Results

The mean of the ITHS was relatively high ($M = 5.56$, $SD = 1.02$). The distribution of participants' means was highly skewed (skewedness = −0.80, $SE = 0.21$) indicating that participants were more likely to perceive health as malleable rather than fixed. To test if implicit theories of health are connected to self-reported health variables, Spearman correlations between the mean of the ITHS and the other health-related measures were calculated. As depicted in Table 2.2, the ITHS was positively correlated with participants' general health status, frequency of physical activity, participants' attention towards maintaining sufficient physical activity and the frequency of healthy eating (all $p < .05$). However, implicit theories were not related to exercising frequency, alcohol consumption or smoking status. Additionally, a positive correlation with internal health locus of control and a negative correlation with chance health locus of control ($p < .05$) were found, whereas no relationship was found between implicit theories and powerful others health locus of control.

Table 2.2

Means, Standard Deviations and Correlation Coefficients between Self-Reported Health Behaviors and Perceptions, Health Locus of Control, and Implicit Theories of Health (Study 1)

Variable	*M*	*SD*	Spearman's ρ
Implicit theories of health (ITH)	5.56	1.02	--
General health status	3.98	0.73	.33**
Physical activity (frequency)	2.55	1.88	.19*
Physical activity (attention)	3.09	1.09	.26**
Exercising (frequency)	3.42	1.16	.01
Healthy eating (frequency)	2.58	0.76	.22*
Alcohol consumption (frequency)	2.85	1.04	.10
Smoking status (0 = nonsmoker, 1 = smoker)	0.28	0.45	-.02
Health locus of control (internal)	3.86	0.69	.27**
Health locus of control (powerful others)	2.84	0.67	.08
Health locus of control (chance)	2.33	0.80	-.53**

* $p < .05$. ** $p < .01$.

2.2.3 Discussion

Study 1 demonstrated that implicit theories of health are connected to people's self-reported health. Participants holding a stronger incremental theory of health (i.e., believe that health is malleable and can be changed) reported a better health status, engaged in more physical activity, paid more attention to maintain sufficient physical activity and reported to eat healthily more often. Contrary to our expectations, there was no relationship between implicit theories of health and exercising and health-damaging behaviours like smoking and alcohol consumption. The high mean on the ITHS suggest that the assumption of health as a malleable construct is widespread in the population. Still, although most participants reported

a strong incremental theory, there was variation in the extent of how strongly they perceived health as changeable. These differences in the strength of incremental theory endorsement were related to different health-outcomes.

Further, Study 1 revealed that a stronger incremental theory of health is connected to the perception that individuals themselves can control their health and that it is not controlled by factors like luck or fate. This supports the idea that health locus of control might be a mediator between implicit theories and their influence on health-related outcomes. This assumption was tested in Study 2 and 3.

2.3 Study 2

In the second study, the influence of a manipulation of implicit theories on health-related attitudes was investigated to test the causal effect of implicit theories. Based on the assumption that implicit theories of health precede attributions of control (Dweck, 2012; Dweck & Leggett, 1988), it was also investigated if health locus of control mediates the effect of this manipulation of implicit theories of health on health-related attitudes. The study was preregistered on Open Science Framework (https://osf.io/75h8y/).

2.3.1 Method

Participants

In this study, 358 US participants were recruited via Amazon Mechanical Turk. All participants received financial compensation for their participation ($0.80). One participant had to be excluded because she did not pass the attention check (see below). The remaining sample consisted of 357 participants (174 women, M_{age} = 37.38, SD_{age} = 12.35). Sample size was determined prior to data collection using G*Power 3 (Faul et al., 2007) based on Study 1

and an expected effect size of $d = 0.3$ (with $\alpha = .05$; $1\text{-}\beta = .80$). This resulted in a required total sample size of $N = 352$ participants.

Procedure

To examine whether implicit theories of health have an impact on the perceived importance of health-related attitudes, participants were randomly assigned to one of two experimental conditions. To prevent potential demand characteristics, a cover story was used to convey participants that the study consisted of two independent surveys. The first part of the study was described as a reading comprehension task while the second part was described as an unrelated survey to measure health-related variables. Participants then read a fictitious newspaper article in which health was described as a malleable quality that can be changed through behaviour (malleable condition) or as a fixed trait that is mostly controlled by genes (fixed condition). This manipulation was similar to other implicit theory manipulations (e.g. Chiu, Dweck et al., 1997; Kasimatis et al., 1996). After reading the article, participants answered three short questions about the article's content as attention check. In the second part of the study, participants responded to the dependent measures and were presented with an on-screen debriefing after providing demographic data.

Measures

To test if the manipulation was successful, participants' implicit theories of health were measured using the ITHS (see Study 1). Again, the reliability of the ITHS was high ($\alpha = .93$). To measure health-related attitudes, participants saw 22 health-related activities (e.g. "to brush your teeth after every meal") and were asked how important they perceived each activity on 7-point Likert scales (1 = *not at all important* to 7 = *extremely important*; Burgmer & Forstmann, 2018). The mean rating of all 22 items was computed to calculate an overall health-attitude score ($\alpha = .90$). Health locus of control, including the three subscales internal, powerful others, and chance health locus of control, was assessed using the 18-item

Multidimensional Health Locus of Control Scale (Form A; Wallston et al., 1978). Participants provided answers on 6-point Likert scales (1 = *strongly disagree* to 6 = *strongly agree*). Reliability of the three subscales was good (internal: α = .87; powerful others: α = .79; chance: α = .80).

2.3.2 Results

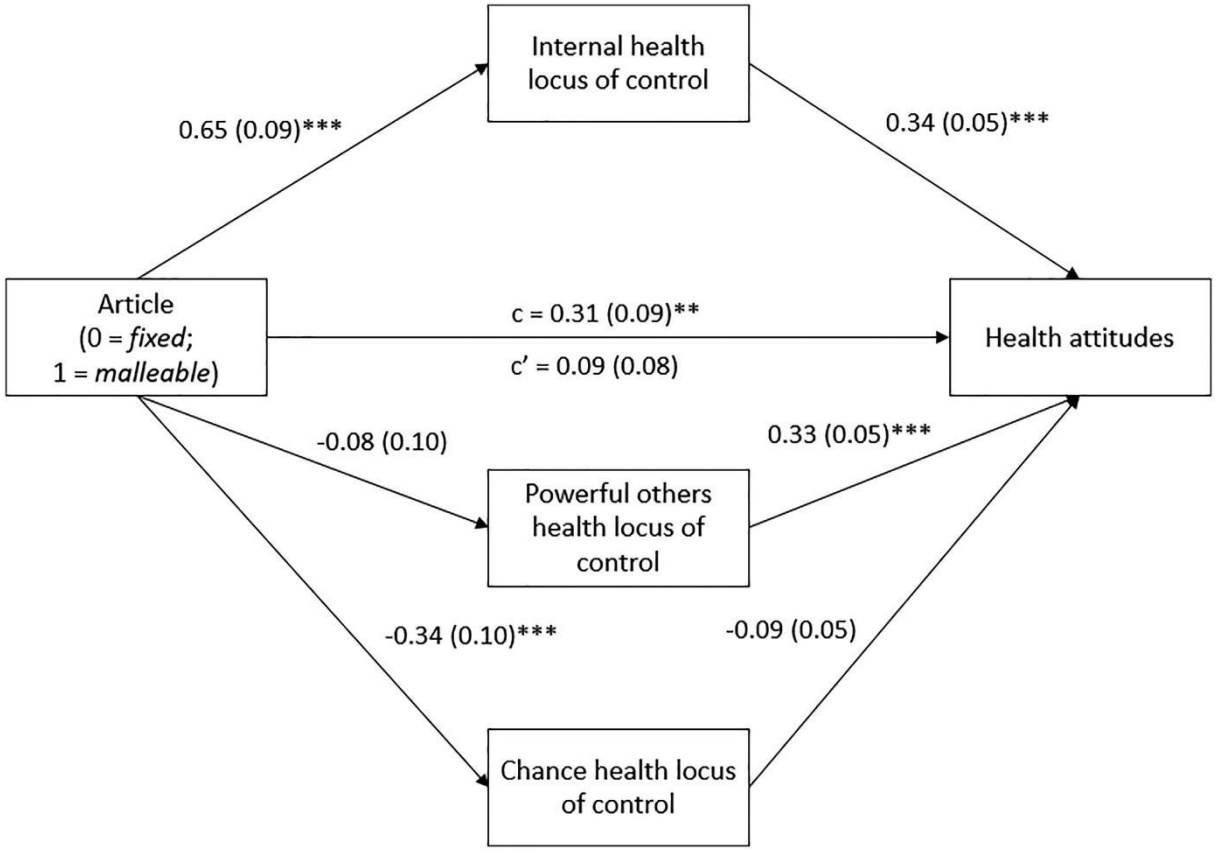
On average, participants spent 120.18 seconds reading the article (*SD* = 147.83), and answered 2.42 (*SD* = 0.69) of the three attention-check questions correctly. A t-test revealed that our manipulation had an effect on participants implicit health theories: Participants in the fixed condition were less likely to view health as changeable (*M* = 4.78, *SD* = 1.45) relative to participants in the malleable condition (*M* = 5.74, *SD* = 1.04; *t*(321.92) = 7.18, *p* < .001, 95% CI = [0.70, 1.22], *d* = 0.76). Next, a t-test tested whether the manipulation had an effect on health-related attitudes. Participants in the fixed condition rated health-related behaviours as less important (*M* = 4.85, *SD* = 0.83) compared to participants in the malleable condition (*M* = 5.16, *SD* = 0.87; *t*(355) = 3.45, *p* = .001, 95% CI = [0.13, 0.49], *d* = 0.37).

To test if health locus of control mediates the effect of the manipulation on the health attitudes ratings Hayes' (2013) PROCESS macro was used (model 4; 5,000 bootstraps). Condition was dummy coded (0 = *fixed*, 1 = *malleable*) and internal, powerful others, and chance health locus of control were added as parallel mediators to the model. Figure 2.1 illustrates the regression coefficients and standard errors of the model. This analysis revealed a significant indirect effect of the manipulation on health attitudes via internal health locus of control (*b* = 0.22, *SE* = 0.04, 95% CI = [0.14, 0.31]) whereas the indirect effects via powerful others (*b* = −0.03, *SE* = 0.03, 95% CI = [-0.10, 0.04]) and chance health locus of control (*b* = 0.03, *SE* = 0.02, 95% CI = [-0.003, 0.08]) were not significant. The direct effect of the manipulation (*b* = 0.31, *SE* = 0.09, *t*(355) = 3.45, *p* = .001, 95% CI = [0.13, 0.49]) did

not remain significant after entering the mediators to the model ($b = 0.09$, $SE = 0.08$, $t(352) = 1.08$, $p = .280$, 95% CI = [-0.07, 0.24]).

Figure 2.1

Parallel Mediation Model Including the Three Dimensions of Health Locus of Control as Mediators of the Influence of an Implicit Theories of Health Manipulation on Health-Related Attitudes



Note. Regression coefficients are indicated and standard errors are depicted in brackets.
** $p < .01$. *** $p < .001$.

2.3.3 Discussion

Study 2 revealed that implicit theories of health can be altered by providing participants with information emphasizing the changeability vs stability of health. This manipulation had an influence on health-related attitudes. Participants who adopted a weaker incremental theory rated different health behaviours as less important. This effect was

mediated via an internal locus of control. A weaker incremental theory of health decreased the perception that one is in control of one's own health, which in turn was related to health-related attitudes.

2.4 Study 3

Because in Study 1 participants with a stronger incremental theory reported to eat healthier, we decided to test whether a manipulation of implicit theories of health also has an influence on hypothetical food choices. It was expected that participants who read an article emphasizing the malleability of health choose healthier food items compared to participants who read an article emphasizing the stability of health. We assumed that this effect would again be mediated via internal health locus of control. We also tested for a mediation via powerful others and chance-related health locus of control in case that these variables appear to be more relevant for food choices as for the dependent variable measured in Study 1. The study was preregistered (http://aspredicted.org/blind.php?x=5g8dv6).

2.4.1 Method

Participants

Based on the same sample size calculation as in Study 2, 352 participants were recruited via Amazon Mechanical Turk. All participants received financial compensation for their participation ($1.00). One participant did not pass the attention check and was excluded from further analyses. The remaining sample consisted of 351 participants (162 women; M_{age} = 35.31, SD_{age} = 10.42).

Measures and Procedure

Participants' implicit theories of health were manipulated by the same procedure as in Study 2. Participants also answered the same three attention check items and the ITHS as manipulation check (α = .90). As cover story participants were again told that they take part in

two unrelated surveys (reading comprehension task vs. dietary intentions). To measure hypothetical food choices, participants responded to the 18 trials of the Multiple Food Test (MFT; Schreiber et al., 2020). In each trial, participants saw a set of four food items and were asked to indicate which of the depicted foods they would prefer to choose and eat now. Based on the Nutrient Profiling Model by the UK Food Standards Agency (Rayner et al., 2005) all food items are divided into four health-categories (1 = *unhealthy*, 2 = *less healthy*, 3 = *healthy,* and 4 = *very healthy*). In each trial, one food item out of each of the four health categories was presented. Across all 18 trials, a mean was calculated that ranges between 1 (reflecting an unhealthy choice tendency) and 4 (indicating a very healthy choice tendency). Reliability of the MFT was good (α = .78), To asses health locus of control, participants responded to the Multidimensional Health Locus of Control Scale (Form A; Wallston et al., 1978). Reliability of the three subscales was high (internal: α = .88; powerful others: α = .86; chance: α = .84).

2.4.2 Results

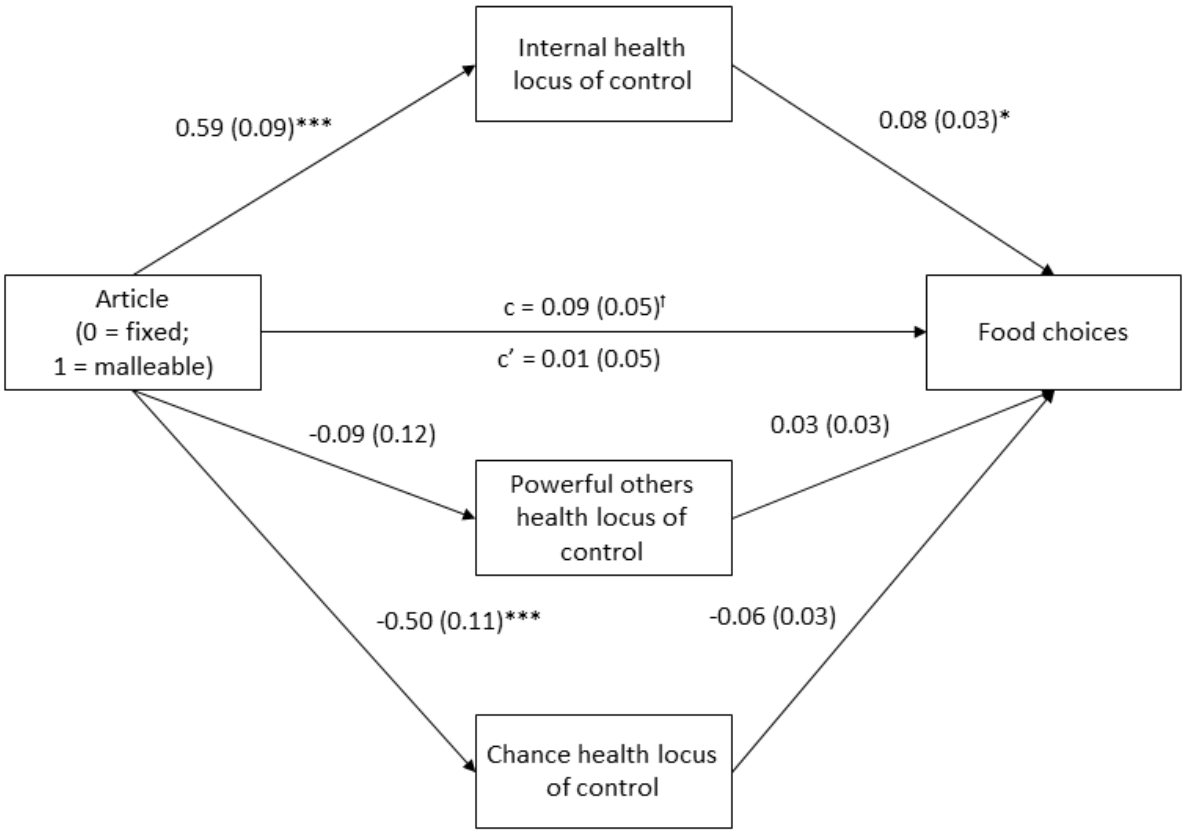
On average, participants spent 192.42 seconds reading the article (*SD* = 147.88), and answered 2.48 (*SD* = 0.67) of the three attention-check questions correctly. A t-test revealed that the manipulation was successful. Participants in the fixed condition showed a weaker incremental theory of health (*M* = 4.76, *SD* = 1.41), whereas participants in the malleable condition were more likely to perceive health as changeable (*M* = 5.74, *SD* = 1.00; *t*(313.81) = 7.49, *p* < .001, 95% CI = [0.72, 1.24], *d* = 0.80). Next, it was tested whether the manipulation also had an influence on hypothetical food choices using an independent t-test. The effect of the manipulation just missed statistical significance (*t*(349) = 1.75, *p* = .082 (two-tailed), 95% CI = [-0.01, 0.19], *d* = 0.19). As a tendency, participants in the fixed condition made less

healthy food choices in the MFT ($M = 2.52$, $SD = 0.48$) compared to participants in the malleable condition ($M = 2.60$, $SD = 0.47$).

Although there was no total effect of the manipulation on hypothetical food choices, a mediation analysis (Hayes, 2013; model 4; 5,000 bootstraps) revealed a significant indirect effect via internal locus of control ($b = 0.05$, $SE = 0.02$, 95% CI = [0.01, 0.09]). The indirect effects via powerful others ($b = -0.003$, $SE = 0.01$, 95% CI = [-0.02, 0.01]) and chance health locus of control ($b = 0.03$, $SE = 0.02$, 95% CI = [-0.001, 0.07]) were not significant. The direct effect of the manipulation was not significant after entering the mediators to the model ($b = 0.01$, $SE = 0.05$, $t(346) = 0.28$, $p = .779$, 95% CI = [-0.09, 0.12]). Figure 2.2 illustrates the regression coefficients and standard errors of the model.

Figure 2.2

Parallel Mediation Model Including the Three Dimensions of Health Locus of Control as Mediators of the Influence of an Implicit Theories of Health Manipulation on Food Choices



Note. Regression coefficients are indictaed and standard erros are depicted in brackets.
† $p < .10$. * $p < .05$. *** $p < .001$.

2.4.3 Discussion

Similar to Study 2, this study revealed that implicit theories of health can be influenced by providing information regarding the changeability of health. Although no significant effect of our manipulation on hypothetical food choices was revealed, we found that our manipulation had an influence on internal health locus of control. A higher internal locus of control was, in turn, related to healthier food choices, and the indirect effect of implicit theories of health on healthy food choices via internal locus of control was significant. A limitation of Study 3 is that the MFT only measures hypothetical food choices,

although recent research documented that the MFT is strongly related to real food choice behaviour (Schreiber et al., 2020).

The aim of the final study was to test whether implicit theories of health are connected to a broad set of health behaviours that people typically show in their daily lives.

2.5 Study 4

An experience sampling study was conducted to examine naturally occurring real life behaviours. Based on Study 1, it was expected that implicit theories of health might be more relevant to predict health-promoting behaviours and less relevant for predicting health-damaging behaviours.

2.5.1 Method

Participants

For this experience sampling study, 235 participants (128 women, M_{age} = 23.21, SD_{age} = 4.25) were recruited via various forms of adverting (mailing lists, social media advertisements, ads). Participants received course credit or were reimbursed with €10 for participating in the study. As additional incentive participants received €20 if they responded to more than 80% of the surveys sent during the mobile phase of the study.

Procedure

Participants were recruited to participate in a study on "everyday life", which consisted of two parts. The first part was a screening survey in which participants provided demographic data and health information. Additionally, they registered their mobile phone for the mobile phase via SurveySignal (Hofmann & Patel, 2015). The mobile phase started on the following day. During this phase, participants received five signals per day on their smartphones between 9 am and 9 pm for seven consecutive days. The signals were sent at random points in time and each signal contained a link to an online mobile survey that was valid for one hour. In these surveys, participants provided information about their current

situation, how they felt at the moment, and were asked if they performed healthy and/or unhealthy behaviours. Further information about the study's setup and other measured variables are described elsewhere (Dohle & Hofmann, 2019).

Measures

To measure implicit theories of health, participants responded to the ITHS during the screening survey ($\alpha = .90$). Participants were also asked about their general health status (1 = *very bad* to 5 = *very good*). During the mobile phase, participants were asked in each survey (1) if they did something healthy and also (2) if they did something unhealthy within the past hour (with a random sequence of the two questions). If they clicked *yes*, they were asked to describe the healthy (unhealthy) behaviour briefly and were asked how beneficial (harmful) they judged their behaviour on 5-point Likert scales (0 = *not at all* to 4 = *very much*).

2.5.2 Results

In total, 6973 mobile surveys were completed, and in 37.11% of these responses ($n = 2588$) healthy and/or unhealthy behaviours were reported. Healthy behaviours were reported more often ($n = 1516$) than unhealthy behaviours ($n = 1072$). As in Study 1, participants were more likely to view their health as malleable ($M = 5.46$, $SD = 1.01$). In addition, participants holding a stronger incremental theory of health reported a better health status (Spearman's $\rho = .14$, $p = .028$). To test whether implicit theories of health predicted the frequency of healthy and unhealthy behaviours, the percentage of healthy ($M = 21.67\%$, $SD = 14.32$) and unhealthy behaviours ($M = 16.00\%$, $SD = 14.57$) in relation to the total number of given responses was calculated for each participant[2]. A regression analysis on the percentage of healthy behaviours revealed that implicit theories predicted the frequency of

[2] Raw frequencies of behaviours cannot be used because most participants did not answer all signals (e.g. because they were busy or missed the signal).

reported healthy behaviours in daily life ($b = 2.39$, $SE = 0.91$, $t(233) = 2.62$, $p = .009$, 95% CI = [0.59; 4.18], $r^2 = .03$). The positive regression coefficient indicates that a stronger incremental theory was related to more frequent reporting of healthy behaviours in daily life. Implicit theories of health did not predict the frequency of unhealthy behaviours ($b = 0.32$, $SE = 0.94$, $t(233) = 0.34$, $p = .732$, 95% CI = [-1.53; 2.18], $r^2 = .001$). In addition, it was investigated if implicit theories of health are connected to participants' perceptions about how beneficial (harmful) they rated their healthy (unhealthy) behaviours. To test this, multilevel analyses were performed treating behaviour ratings as Level 1 unit and participants as Level 2 unit. These analyses revealed that holding a stronger incremental theory of health was connected to perceiving ones' healthy behaviours as more beneficial (b = 0.10, SE = 0.03, $t(208.88) = 2.89$, $p = .004$, 95% CI = [0.03; 0.17]). For the unhealthy behaviours, no relationship between implicit theories of health and the harmfulness ratings was found ($b = 0.02$, $SE = 0.06$, $t(198.92) = 0.40$, $p = .693$, 95% CI = [-0.09; 0.14]).

2.5.3 Discussion

Study 4 revealed that implicit theories of health predict the frequency of reporting healthy behaviours in daily life. Moreover, participants with a stronger incremental theory of health perceived their healthy behaviours to be more beneficial. In line with the results of Study 1, there was no relationship between implicit theories and the frequency of reporting unhealthy behaviours. One reason for this pattern of results could be the framing of the implicit theories of health measure, which is focused on positive change in health by healthy behaviours and less on the damaging effect on health by unhealthy behaviours.

2.6 General Discussion

The purpose of the present research was to examine the role of implicit theories for health-related attitudes and behaviours. The results of this research advance the understanding about implicit theories and its application to health in several ways. First, this research shows

that implicit theories of health are connected to attitudes and behaviour in different health domains. Second, we demonstrated that implicit theories of health can be manipulated experimentally, and that they causally influence health-related attitudes. Third, we found support for the assumption that implicit theories of health are an important prerequisite for control beliefs. Fourth, we were able to show that implicit theories are not only related to retrospectively assessed health behaviours, but also predict behaviours using an experience sampling procedure. Finally, the results revealed an asymmetric relationship of implicit theories of health with health-promoting versus health-damaging factors: Holding a stronger incremental theory of health was connected to more health-promoting behaviours, but there was no relationship between implicit theories of health and health-damaging behaviours.

2.6.1 Theoretical and Practical Implications

This research suggests that people's implicit theories of health are highly relevant for the adoption of health-promoting behaviours and could be taken into account in interventions that focus on health promotion and multiple health behaviour change (e.g., James et al., 2016; Prochaska et al., 2008). Importantly, our studies provide evidence that implicit theories of health can be altered via providing participants with information about the malleability versus stability of health.

Our research also shows, however, that most people already endorse an incremental view of health, which might be due to various factors. Throughout one's life, most individuals are confronted with situations in which they experience that their health does change, for example, when recovering from a cold. Additionally, public health campaigns, media, and marketing campaigns often convey the image that health can be changed or improved. Although most people view health as changeable, our results suggest that people differ in the extremity of holding an incremental theory and that incremental views can be weakened experimentally. Because stronger incremental views are related to health-related outcomes, it

is of prime importance to identify population groups that do not view health as changeable and to examine the determinants of such views. Recent research has shown that holding a stronger entity theory of body weight is related to higher age, less educational attainment, lower income, and being part of an ethnic minority (Auster-Gussman & Rothman, 2018). These variables could also be potential determinants for holding an entity theory of health in general. Other aspects like medical history or being confronted with or suffering from a chronic or longer lasting disease might also lead to adopting an entity view of health. A better understanding on how health-related implicit theories evolve and develop seems crucial to identify groups that hold a stronger entity theory and who could benefit from interventions that target the adoption of a stronger incremental view of health.

In Study 2 and 3, it was demonstrated that the influence of an implicit theories manipulation on health-related outcomes was mediated via internal locus of control. This fits to the assumption that implicit theories precede attributions of control (Dweck, 2012; Dweck & Leggett, 1988). It also extends Schleider and Weisz' (2016a; 2018) findings that an incremental theory intervention increases perceived emotional and behavioural control in the context of mental illness. In both studies, however, no mediation via chance and powerful others health locus of control was found. As Study 1 suggests implicit theories were not related to powerful others health locus of control which can explain why no mediation via this subscale was found. Although the mediation analysis revealed that our manipulation also influenced chance-related control beliefs, chance locus of control was not related to the outcomes measured in Study 2 and 3. This fits to reviews that conclude that internal health locus of control is often a better predictor for health behaviours compared to the two other subscales and that the predictive validity of the subscales of the Multidimensional Health Locus of Control Scale differs across different health behaviour domains (AbuSabha & Achterberg, 1997; Wallston, 2005).

Study 1 and 4 revealed a positive relationship between holding a stronger incremental theory of health and health-promoting behaviours. Furthermore, Study 4 demonstrated that participants holding a stronger incremental theory of health rated their healthy behaviours as more beneficial for their own health. This connection between holding a stronger incremental theory of health and perceptions about the beneficial potential of healthy behaviours suggests that these participants often execute behaviours that are more effective for their long-term health. This finding, however, could also be explained through increased outcome-expectancy (Bandura, 1986; Williams et al., 2005). Outcome-expectancy refers to expectations about the contingency that a given behaviour leads to a particular outcome and could therefore influence attitudes and behaviour (Bandura, 1986). Holding a stronger incremental theory of health may cause individuals to show these behaviours more often because they are more likely to expect positive effects on their health.

Implicit theories of health might also be connected to health-related self-efficacy (Bandura, 1977; Strecher et al., 1986). Self-efficacy refers to expectations of a person to be able to successfully carry out desired actions on the basis of their own competence (Bandura, 1977). While our research supports the assumption that implicit theories are relevant for the setup of control beliefs, research in the domain of physical activity and smoking suggests that implicit theories are also a precondition for self-efficacy beliefs (Fitz et al., 2015; Orvidas et al., 2018). On a theoretical level, it seems reasonable to assume that implicit theories about health are a necessary (but insufficient) precondition for the setup of both health-related control beliefs and self-efficacy.

Surprisingly, no relationship between implicit theories of health and health-damaging behaviours like smoking or alcohol consumption has been observed. One explanation might be that for health-damaging behaviours (e.g. social drinking, cigarette craving), contextual or impulsive factors are often more relevant, whereas health-promoting behaviours are more often the result of reasoned attitudes and goal directed behaviour (Hofmann et al., 2008).

Therefore, implicit theories of health seem to be more relevant for health-promoting and thus goal-directed behaviours. Furthermore, it might be that individuals with a stronger incremental theory do not see the need to reduce health-damaging behaviours because they think they could easily stop engaging in these behaviours in the future. This reasoning would be in line with Fitz et al. (2015)finding that non-smokers who hold an incremental theory of smoking have greater expectations of trying smoking in the future. Taken together, our and the results of Fitz et al. (2015) could be interpreted as a form of unrealistic optimism (Weinstein, 1980) that might arise when health is perceived as changeable. Interpreted in this way, an incremental theory could lead participants to overestimate how easily they can adjust health-damaging behaviours, which overshadows the negative consequences of these behaviours on one's own health. At the same time, our research shows that an incremental theory of health does not lead to more health-damaging behaviours, as we found no indication for a positive association between these constructs. Therefore, we would assume that developing a stronger incremental view of health in an intervention would lead, in general, to important positive lifestyle changes. We also believe, however, that a promising direction for future research would be to study and address conditions under which an incremental theory of health could have negative effects on health behaviour. It is possible, for example, that unrealistic optimism is relatively domain-specific. For example, people who never smoked and who have no experience with smoking may overestimate how easily people can quit. For other unhealthy behaviours, such as unhealthy snacking, people may have more realistic ideas how hard it can be to stop unhealthy snacking habits.

2.6.2 Limitations

It is important to note that Study 1 and 4 were correlational. Therefore, it cannot be determined if holding a stronger incremental theory of health increases health behaviours or vice versa. It should be noted, however, that in Study 4, implicit theories were measured

before health behaviours were assessed, which suggests that implicit theories can be conceptualized as a cause rather than an effect. In addition, a causal relationship between implicit theories of health and health-related outcomes was demonstrated in Study 2 and 3.

As we did not include a neutral control group in Study 2 and 3, it is not clear whether our effects were driven by the positive influence of our malleable message or the negative influence of our fixed message. However, a pooled analysis revealed that across studies, the mean of the ITHS in both experimental groups (Study 2 and 3) was significantly different from the mean of the ITHS measured in Study 1 and 4 in which no manipulation was included (see Appendix A). The effect was stronger, however, for the entity manipulation. The smaller effect size for the incremental manipulation might be due to the fact that the majority in our samples already perceived health as changeable.

For the experimental studies, it could be argued that our results may be caused by demand characteristics of the study design. Although we used a cover story to prevent such demand effects, we cannot fully rule out that some participants could have guessed the true purpose of the study and the experimental manipulation. Further studies should ask whether participants were aware of the true purpose of the study to exclude these participants from further analyses.

Furthermore, some of our effects and correlations were rather small, which might be the result of a sample bias. Most of our participants were young and rather well educated and therefore more likely to view health as malleable. This may have reduced the variance in the implicit theories of health measure, and it is possible that effects are larger for more heterogeneous samples. It is also important to acknowledge that most of the dependent variables in our studies were measured via self-reports. In future studies, more objective

measures for health-promoting and -damaging behaviours should be used (e.g. pedometers to assess physical activity, carbon monoxide breath measure to asses smoking).

2.6.3 Conclusion

Implicit theories of health refer to the extent to which someone assumes that health is changeable (incremental theory) or stable (entity theory). In this paper, it has been demonstrated that these beliefs can affect a large range of health-relevant attitudes and behaviours. Therefore, addressing implicit theories in interventions could be a fruitful and important component of public health interventions. A change in one's mindset could be the first step to motivate individuals to adopt a healthier lifestyle and thereby prevent or postpone the development of lifestyle rooted chronic diseases.

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Appendix: Pooled Analysis to Compare Implicit Theories across Studies

To test whether the means of the Implicit Theories of Health Scale in the experimental groups differed compared to a neutral group without manipulation, a pooled analysis was performed for which we combined the data of all four studies into one new data set. We added

a condition variable that distinguished participants without any manipulation ("neutral group"; Studies 1 and 4), participants who received the "health is malleable" manipulation, and participants who received the "health is fixed" manipulation (Studies 3 and 4). We conducted an ANOVA with condition as independent variable (0 = *malleable*; 1 = *no manipulation*; 2 = *fixed*) and the mean of the ITHS as dependent variable. The ANOVA revealed that the groups differed in regard to the mean value of the ITHS (F[2, 1070] = 65.73, $p < .001$). Contrast analyses revealed that participants in the malleable condition had higher values on the ITHS (M = 5.74; SE = .05) compared to participants in the neutral group (M = 5.50; SE = .05; t[717.19] = 3.25; SE = .08; p = .001, d = 0.24). In contrast, the mean of participants in the fixed condition was lower (M = 4.77; SE = .08) compared to this neutral group (t[634.32]= - 7.79; SE = .09; $p < .001$; d = -0.59).

Chapter III

The Multiple Food Test: Development and Validation of a New Tool to Measure Food Choice and Applied Nutrition Knowledge

This chapter is based on the following publication:

Schreiber, M., Bucher, T., Collins, C. E., & Dohle, S. (2020). The Multiple Food Test: Development and validation of a new tool to measure food choice and applied nutrition knowledge. *Appetite, 150*, Article 104647. https://doi.org/10.1016/j.appet.2020.104647

Please note that some changes in headings, citation style, and formatting were undertaken to fit the layout of this dissertation. No changes were made to the content of the article.

Abstract

Assessing individual food choices within health and nutrition related research is challenging and there is a strong need for valid and reliable instruments. In this paper, we introduce the Multiple Food Test as a new tool for measuring food choices and applied nutrition knowledge. The Multiple Food Test has the format of an image selection task. Part one of the Multiple Food Test consists of 18 trials in which participants are presented with sets of four food items and asked to choose one item they would prefer to consume (choice scale). In part two, participants saw the same 18 trials and were asked to indicate which of the items presented they perceived as being the healthiest (applied knowledge scale). Results across three studies (total $N = 666$) indicate that both subscales of the Multiple Food Test have good psychometric properties. Healthier choices were significantly associated with implicit theories of health, healthy eating frequency and importance (Study 1), a stronger health versus taste motive (Study 1 and 2), self-control, and habitual fruit and vegetable intake (Study 2). In Study 3, choices in the Multiple Food Test positively predicted actual food choices. The applied knowledge scale showed agreement with an existing nutrition knowledge scale, and higher scores were associated with higher levels of self-control (Study 2). The Multiple Food Test presents new opportunities to evaluate underlying variables and interventions that influence food choice or eating behavior.

Keywords: Food choice, Eating behavior, Diet quality, Nutrition knowledge, Health perception

3.1 Introduction

An unhealthy diet is characterized by insufficient intake of fruits, vegetables, legumes, nuts, and grains and excessive intakes of (saturated) fats, sugars and salt (World Health Organization, 2020) and is an important predictor for the development of various chronic diseases (World Health Organization, 2003). Therefore, health and nutrition researchers often develop interventions or study factors that may help individuals to make healthier food choices. To evaluate the success of these interventions or to study the impact of influencing factors, it is crucial to measure food choices in a reliable and valid way. Some tools that are used to measure food choices are compensation choices (e.g., Keller et al., 2015), the Fake Food Buffet (e.g., Bucher et al., 2012), the Web Buffet (Bucher & Keller, 2015), or the Food Choice Task (Foerde et al., 2018). However, their applicability in research has limitations due to a small number of foods from which individuals can choose, which may make these tools unsuitable for assessing a variety seeking goal that is also relevant when making food choices (Haws & Liu, 2016; Liu et al., 2015). In addition, most tools are restricted to use within laboratory environments. By comparison, the internet is currently integrated into individual's everyday life. For example, food choices are increasingly being made online (e.g. via online grocery shopping) or through smartphone applications (e.g. meal delivery services such as Uber Eats). Furthermore, because online research offers new ways to study large, and more diverse samples while decreasing research-related costs, research is increasingly being conducted online (e.g., Gosling & Mason, 2015). As a result, there is a strong need to develop and validate food choice tasks that can be used in online settings.

Food choice is complex and influenced by various factors, each on different levels (Stok et al., 2017). Two factors that influence choice at an individual level are food preference and nutrition knowledge. Nutrition knowledge can be defined as knowledge about different aspects of nutrition (e.g. nutrients, dietary guidelines) and their relationship to health (Miller & Cassady, 2015). Although associations between nutrition knowledge and choice are

generally small, knowledge is a modifiable factor, with a certain level of knowledge as a prerequisite to make healthy choices. The literature distinguishes between factual (or declarative) nutrition knowledge, e.g., knowing that a given food is high in a specific nutrient, and applied (or procedural) nutrition knowledge, e.g., knowing how to assemble a healthy meal (Mötteli et al., 2016). Applied knowledge, which can be defined as an individual's understanding of the overall healthiness of foods or meals, is more strongly associated with healthier choices compared to factual knowledge (Mötteli et al., 2016; Worsley, 2002).

The aim of this research was to develop a psychometrically sound tool to measure people's food choices and applied nutrition knowledge. We aimed to design a tool that could be easily added to various research designs, that offers a variety of foods to choose from, and is not restricted to laboratory research settings. We refer to this tool as the *Multiple Food Test*. In the current paper, we will briefly review existing tools to measure food choice in both online and laboratory settings. We then describe the development of the Multiple Food Test and present results from three studies in which we investigate its psychometric properties.

3.1.1 Evaluation of Existing Tools to Measure Food Choices

Currently, several tools exist that can measure food choices. However, they vary in applicability within different research contexts. In this section, four tools will be described and compared, based on different aspects that impact their use. The four tools were chosen because they include a behavioral approach to measuring food choice, which incorporates choices between differing products, in contrast to self-reported questionnaires, which only assess preferences or consumption frequency of various foods or food groups. Approaches such as the Restaurant of the Future at the Wageningen University (Hinton et al., 2013) and the FoodScapes Lab at the Aalborg University (Nørnberg et al., 2014) were not included in the current overview, as they are stationary facilities that cannot be used elsewhere without considerable effort.

Compensation Choices

A convenient way to measure food choice is to offer participants a selection of different food items, after their participation in a study, and to then measure which items they choose as compensation (e.g., Friese et al., 2008; Keller et al., 2015; van Dillen et al., 2013). In this paradigm, participants are often presented with healthy and unhealthy alternatives (e.g. chocolate bars versus fruits), without the participants being aware that these choices serve as the measure of primary interest. Although such a measure includes real choice behavior and is easy to implement, it has some limitations. One problem is that only a small variety of foods is offered, which questions the validity of the paradigm and also undermines a variety seeking goal (Haws & Liu, 2016; Liu et al., 2015). This reduced variety makes the measure prone to the influence of different taste preferences, food allergies, or eating styles (veganism, special diets). It remains questionable why a participant chooses the specific items (for themselves or for someone else) and whether the participant actually consumes the chosen item. Another disadvantage is that this approach to measuring food choice can only be implemented in laboratory studies. Although compensation choice studies can be conducted online via offering vouchers for healthy or unhealthy products, this increases the time between food selection and actual consumption, which can distort measurements even more.

Fake Food Buffet

Another method that can be used to assess food choices within a close to natural environment is the Fake Food Buffet (Benson et al., 2018; Bucher et al., 2012; Sproesser et al., 2015). In this paradigm, participants are presented with a buffet that includes a variety of realistic food replicas. Participants are asked to select a plate of food items they would like to eat from this buffet. This method has been validated in comparison to food choices made using real foods, and includes a variety of different food items (Bucher et al., 2012). Another benefit of this paradigm is that it offers the opportunity to calculate the amount of various

foods and nutrients (e.g. kilojoules or fiber of the selected items) or the contribution to total energy from each of these different food groups (e.g. percent energy from grains). The major constraints are that the initial set up of such a buffet is expensive and running a fake food study is time consuming compared to tools that can be applied online. Using the Fake Food Buffet requires weighing all of the food items chosen after each laboratory session and the use of algorithms to compute the nutrient profiles of these. Furthermore, the Fake Food Buffet use is restricted to laboratory based research.

Web Buffet

Because of its restriction to a laboratory environment a web version of the Fake Food Buffet was developed (Bucher & Keller, 2015). In this image-based online task, participants are first asked to choose between different food components (i.e. meat, vegetables, starchy side dish). In the second part, they can select the proportion of the chosen vegetables and side dishes. As with the Fake Food Buffet, the Web Buffet offers the opportunity to measure different nutrients and portion sizes. Setting up such a study can be a major effort because algorithms for programming the online study must be computed and nutrient profiles need to be calculated for the meals chosen. Furthermore, images of every possible food component combination, each with differing portion sizes (e.g. the current Web Buffet includes 216 different combinations) must be taken in advance. Another downside is that the current version of the Web Buffet only includes eight different food components, which may not align with participants' usual food choices.

Food Choice Task

Another measure that can be used to assess food choices in an online setting is the Food Choice Task (Foerde et al., 2018; Steinglass et al., 2015). In the first part of this task, participants see 43 images of food items and are asked to rate the perceived healthfulness and tastiness of these food items. Based on these ratings, one food item (that has been rated as

neutral on the health-scale and taste-scale) is chosen as reference item for the second part. In the second part, participants are asked to choose between the reference item and every other item. Then, a preference score for foods high and low in fat is computed (see Steinglass et al., 2015 for a detailed description). The advantage of this task is that it includes a high variety of food items and that it can be used in online research. However, the categorization of the food items is based only on their fat content, while other nutrients that contribute to a healthy diet are ignored. Furthermore, the choice measure only assesses preferences in relation to the individual reference item for each participant. This results in an additional source of variance that needs to be controlled for statistically and taken into account when interpreting the results.

Table 3.1 summarizes the description of tools to measure food choices mentioned in the previous paragraphs and compares these tools with the Multiple Food Test introduced in the current paper.

Table 3.1

Comparison between Existing Tools to Measure Food Choices and the Multiple Food Test

	Compensation choices	Fake Food Buffet	Web Buffet	Food Choice Task	Multiple Food Test
Ease of use	High	Low	Medium	Medium	High
Ease of interpretation	Medium	Medium	Medium	Medium	High
Measurement of healthy food choices	Questionable	Yes	Yes	Questionable	Yes
Use in online studies	No	No	Yes	Yes	Yes
Variety of foods	Low	High	Low	High	High

Note. The criterion to determine "ease of use" is based on costs that arise when using the different tools or the amount of time that is necessary to run and/or program these studies (i.e. financial costs for fake food items; time to program the online tools or the algorithms behind them). The evaluation of the other criteria is based on the description of the tools in the text. For example "measurement of healthy choice" was rated as "questionable" when healthiness ratings are mostly based on single nutrients (such as fat content for the Food Choice Task).

3.1.2 Nutrition Knowledge and Food Choices

An important prerequisite for making healthy food choices is nutrition knowledge (Stok et al., 2017). Numerous measures have been developed, each with a focus on different aspects of this construct (e.g., Dickson-Spillmann et al., 2011; Mötteli et al., 2016; Parmenter & Wardle, 1999). However, the relationship between nutrition knowledge and dietary behavior is often small, or fails to reach significance (Shepherd & Stockley, 1987; Wardle et al., 2000; Worsley, 2002). One reason might be that scales to measure nutrition knowledge are often conceptualized as skill tests and a knowledge score is built after summation of correct responses to a number of multiple-choice questions (Worsley, 2002). This all-or-nothing-format sometimes results in low internal consistency of the measures and/or their subscales (e.g., Spendlove et al., 2012; Turconi et al., 2003). This format is less adequate for

detecting different levels of nutrition knowledge because it does not account for the fact that some of the wrong answers are closer to the correct answers than others. For example, when participants have to choose the healthiest food option, those questionnaires typically do not differentiate between choosing the second healthiest option or the least healthy option (which would indicate a lower level of nutrition knowledge). In addition, nutrition knowledge measures are based on national dietary guidelines that vary between countries, which restricts their use and/or comparison in cross-cultural studies. The questions are often very complex and rely on other skills (e.g. numeracy skills), making them difficult to answer. Another key limitation of existing nutrition knowledge scales is that these measures often focus more strongly on declarative rather than applied or procedural nutrition knowledge (Mötteli et al., 2016). For example, knowing that given foods are high in specific nutrients (declarative/ factual knowledge) might not be relevant for the decision about which pizza would be the healthiest choice on a restaurant menu (procedural/applied knowledge). It might be more important to know how healthy compared to unhealthy a given food item is than knowing that this food item contains a low or high amount of some nutrient (e.g., Mötteli et al., 2016). Therefore, the Multiple Food Test was designed to measure *applied nutrition knowledge* via measuring health perceptions of different food items that vary in their overall healthiness.

3.1.3 Current Research

The Multiple Food Test was developed to overcome the aforementioned shortcomings of existing food choice and nutrition knowledge measures. It is an image-based multiple choice test and consists of two parts in order to measure both food choices and applied nutrition knowledge. Each part contains 18 sets of four images of food items that vary in their healthiness. In each set, participants are asked to indicate which of the depicted food items they would choose to eat (choice scale) and which they believe to be the healthiest item (knowledge scale).

In a set of three studies, the internal consistency and validity of the Multiple Food Test was evaluated. In the initial phase of tool development (Study 1), internal consistency and convergent validity was evaluated by examining relationships with health- and eating-related constructs. In Study 2, the convergent validity of the Multiple Food Test was tested in more detail by assessing its relationship with measures of practical nutrition knowledge (Mötteli et al., 2016), self-control (Tangney et al., 2004), and general diet quality (O'Reilly & McCann, 2012). To test concurrent validity, it was evaluated whether choices in the Multiple Food Test could predict real food choices in Study 3.

Inclusion criteria for all three studies were: (1) no food intolerances or allergies and (2) not following a diet that prevents consumption of specific foods or food groups (e.g., vegan diet). Informed consent was obtained from all participants prior to participation in all studies. All participants were informed about the study's aim subsequent to study completion. All studies were conducted in accordance with the ethical guidelines by the German Association of Psychology (DGP) and the American Psychological Association (APA).

3.2 Study 1

The goal of this online study was to develop the Multiple Food Test and to evaluate internal consistency of the choice and knowledge scales. Because food choices are influenced by a wide variety of factors (Stok et al., 2017), we have investigated relationships with health- and eating-related variables to evaluate its convergent validity. Prior research has shown that health-related choices and behaviors are commonly influenced by individual's beliefs about the changeability of health (i.e. implicit theories of health; Schreiber et al., in press). Therefore, we expected that viewing health as a changeable construct would be related to healthier choices in the Multiple Food Test. Based on research on the unhealthy = tasty intuition, the tendency to perceive healthy foods as less tasty (Haws & Liu, 2016; Liu et al., 2015; Raghunathan et al., 2006), we assumed that participants who considered a health

motive as more important than a taste motive would make healthier choices in the Multiple Food Test. Furthermore, the relationship between the Multiple Food Test and the frequency of healthy eating and the subjective importance of a healthy diet was investigated. Whether answers in the Multiple Food Test were related to dieting concerns, hunger, time since last meal, and self-reported anthropometric variables was also investigated.

3.2.1 Method

Participants

For the online-study, 546 German participants were recruited online via Facebook-postings in university and public groups. Responses of 121 participants were incomplete and therefore excluded (22.16%). The remaining sample consisted of 425 participants (M_{age} = 28.35, SD_{age} = 8.08; 84.71% female). As compensation, participants had the chance to win one of five 10€-Amazon gift vouchers.

Test Development

The Multiple Food Test contains 24 different food items, categorized into four health categories, ranging from 1 = *unhealthy* to 4 = *healthy*. This categorization is based on the Nutrient Profiling Model by the UK Food Standards Agency (Arambepola et al., 2008; Rayner et al., 2005). The nutrient profiling score incorporates positive points for energy (kilojoule), saturated fat, total sugar, and sodium and negative points for protein, fruit/vegetable/nut content[3], and fiber content. The score has a range between −15 (indicating healthy foods) and +30 (indicating unhealthy foods). Content validity of the nutrient profiling score was confirmed using a nutrition expert panel (Arambepola et al., 2008; Rayner et al., 2005) and corresponds with lay persons' perceptions of healthiness (Bucher et al., 2015). Furthermore, the Nutrient Profiling Model has been used to inform the scoring system for

[3] Please note that potatoes are classified differently in various countries. While they are classified as carbohydrate foods in Germany or the UK, they are classified as vegetables in the US or Australia. In the current study, points for vegetable content were allocated to foods made from potatoes.

Australia's and New Zealand's Health Star Rating program, a front-of-pack food label to assist consumers to make healthier food choices (Australian Department of Health, 2014; Buckett et al., 2019). For the current study, we defined four health categories with a gap of at least three points between categories, based on the Nutrient Profiling Model (see supplementary materials for a nutrient profile calculator), and ensured that food items from each major food group were included (fruits, vegetables, foods rich in carbohydrates, foods rich in protein, dairy products, and sweet and salty snacks). Table 3.2 gives an overview of food items included in the two versions of the Multiple Food Test.

Table 3.2

Categories and Items Used in the Multiple Food Test First Version (Study 1) and Second Version (Studies 2 and 3)

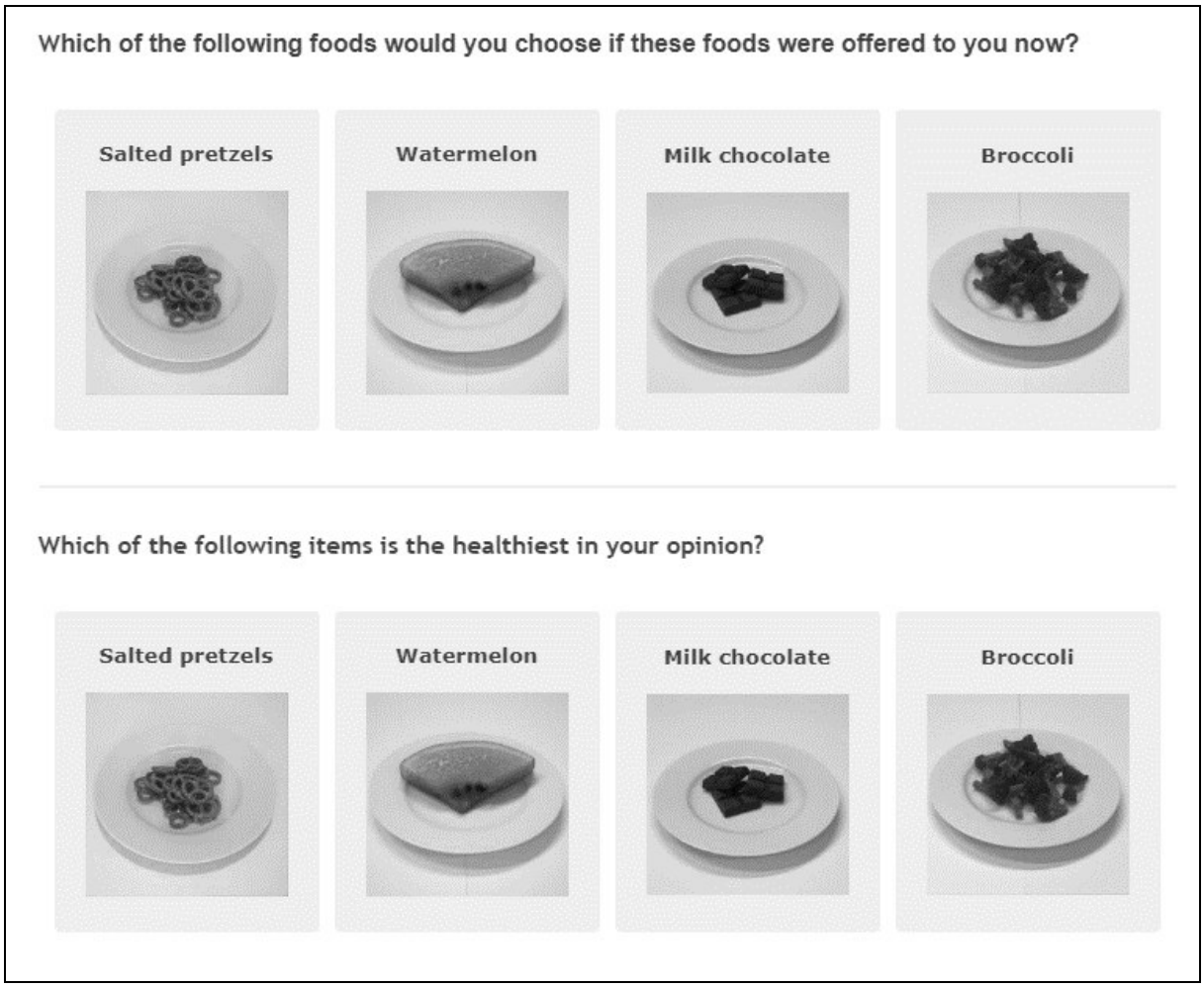
Categories	Items (first version)	Items (second version)
1 = *unhealthy* (NPS between 17 and 25)	pork sausage (17), cheese slices (19), *chocolate donut* (22), feta cheese (23), salami slices (25), milk chocolate (25)	pork sausage (17), *butter croissant* (17), cheese slices (19), feta cheese (23), salami slices (25), milk chocolate (25)
2 (NPS between 5 and 14)	*baguette slices* (5), rice (5), potato chips (5), salted pretzels (12), *smoked salmon* (13), gummi bears (14)	rice (5), potato chips (5), *ham slices* (11), *ice cream* (11), salted pretzels (12), gummi bears (14)
3 (NPS between -4 and 0)	grapes (-4), watermelon (-4), banana (-3), multi-grain-toast (-3), chicken slices (0), pasta (0)	grapes (-4), watermelon (-4), banana (-3), multi-grain-toast (-3), chicken slices (0), pasta (0)
4 = *very healthy* (NPS between -10 and -7)	broccoli (-10), green peas (-9), cauliflower (-9), potatoes (-8), carrots (-8), strawberries (-7)	broccoli (-10), green peas (-9), cauliflower (-9), potatoes (-8), carrots (-8), strawberries (-7)

Note. NPS = nutrient profile score. Nutrient profile scores for each item are depicted in brackets. Items that were revised between the first and second version of the Multiple Food Test are depicted in italics.

The Multiple Food Test consists of two parts with 18 trials each to measure food choices and applied nutrition knowledge. In every trial within the choice part, participants view a set of four food images and are asked to indicate which of these items they would choose, if these items were offered to them (see Figure 3.1 and supplementary materials for a Qualtrics preview and template). Every image set contains one item out of each healthiness category. The occurrence of food items between the different food sets are randomized and counterbalanced for the number of presentations, with every item appearing four times across the 18 trials. After completing the choice scale, participants respond to the knowledge scale. In this part, participants see the same 18 trials as before, but are asked to decide within each set which item they believe is the healthiest (see Figure 3.1). For both subscales of the Multiple Food Test, the mean is computed across all 18 trials. Scores can range between 1 (*unhealthy choices/little knowledge)* and 4 (*healthy choices/high knowledge).*

Figure 3.1

Screenshot of an Exemplary Trial to Measure Choice (Upper Part) and Knowledge (Lower Part) in the Multiple Food Test



Measures

Implicit Theories of Health. Participants answered the Implicit Theories of Health Scale (Schreiber et al., in press) to measure the extent to which they perceive health as being a malleable construct versus a fixed property. The scale consists of six items (e.g. "You can change your own health status considerably."), all measured on 7-point Likert-scales (1 = *strongly disagree* to 7 = *strongly agree*). The internal consistency of this scale was good (Cronbach's $\alpha = 0.88$).

Frequency and Importance of Healthy Eating. Participants answered two items to indicate how often they eat healthily ("When you think about the last month, how often did you manage to eat healthy?"; 1 = *never* to 5 = *always*) and how important a healthy diet is for them ("How important is maintaining a healthy diet for you?"; 1 = *not at all important* to 5 = *very important*).

Health over Taste Motive. To measure the extent to which participants have a stronger health versus taste motive when making food choices, participants were presented with five statements ("Food should be … healthy; easy to prepare; cheap; tasty; fast to prepare"). They were asked to arrange these statements according to how important these are to them. A health versus taste score was calculated by subtracting the position of the health motive from the position of the taste motive, with higher values indicating that participants had a stronger health versus taste motive. The statements were selected based on the Food Choice Questionnaire (Steptoe et al., 1995).

Concern for Dieting. Participants answered the Concern for Dieting subscale of the Restrained Eating Scale (Herman & Polivy, 1980). Internal consistency of these six items (e.g. "Do you have feelings of guilt after overeating?"; 0 = *never* to 3 = *always*) was acceptable (Cronbach's $\alpha = 0.71$).

Control and Demographic Variables. Before answering the Multiple Food Test, participants indicated how hungry they felt at that moment (1 = *not hungry at all* to 5 = *very hungry*) and how much time had passed since they consumed their last meal (1 = *less than 1 h* to 13 = *more than 12 h*). In the last part of the study, participants indicated their gender, age, weight and height, with BMI (kg/m^2) calculated.

3.2.2 Results and Discussion

To assess internal consistency of the Multiple Food Test, Cronbach's α was computed. The internal consistency of the choice scale was acceptable (Cronbach's α = 0.74) whereas the internal consistency of the knowledge scale (Cronbach's α = 0.61) was lower than the recommended level of 0.70 (DeVellis, 2012; Kline, 2000).

To analyze how the choice and knowledge scales of the Multiple Food Test are related to other constructs, correlations were computed (see Table 3.3). The choice scale of the Multiple Food Test was positively associated (ρ = 0.10, p = .032) with implicit theories of health (i.e., participants who view health as malleable made healthier choices). Healthier choices were related to eating healthily more frequently (ρ = 0.17, p = .001) and viewing a healthy diet as important (ρ = 0.16, p = .001). Having a higher health versus taste motive was related to healthier choices in the Multiple Food Test (ρ = 0.22, p < .001). No relationship was identified between concern for dieting and choices in the Multiple Food Test (ρ = .06, p = .196), which is line with studies demonstrating that in many situations, restrained eating does not lead to healthier eating (Herman & Mack, 1975; Klesges et al., 1992). However, a positive relationship was found between concern for dieting and the knowledge scale of the Multiple Food Test (ρ = .13, p = .007), indicating that higher nutrition knowledge was related to stronger dieting concerns. Hunger (ρ = −0.06, p = .224) and time since last meal (ρ = 0.06, p = .232) were not related to choices in the Multiple Food Test. Surprisingly, a negative correlation between hunger and the knowledge scale was found (ρ = −0.12, p = .018), meaning that participants who reported being more hungry had lower values on the knowledge scale. In addition, gender was related to both parts of the Multiple Food Test, indicating that female participants made healthier choices (r_{pb} = .14, p = .003) and had a higher knowledge (r_{pb} = .15, p = .002). Such gender differences have also been found in other studies in the nutrition knowledge literature (e.g., Wardle et al., 2000).

Table 3.3

Means, Standard Deviations, and Spearman Correlations between the Multiple Food Test Choice Scale and Knowledge Scale with Other Measures (Study 1)

Measure	*M*	*SD*	MFT-C		MFT-K	
			ρ	*p (2-tailed)*	ρ	*p (2-tailed)*
Multiple Food Test (Choice)	2.63	0.43	–	–		
Multiple Food Test (Knowledge)	3.66	0.19	0.01	.869	–	–
Implicit theories of health	5.81	1.01	0.10	.032	0.00	.999
Healthy eating (Frequency)	3.36	0.72	0.17	.001	-0.01	.775
Healthy eating (Importance)	3.64	0.85	0.16	.001	0.05	.317
Health over taste motive	-0.76	1.56	0.22	<.001	-0.07	.146
Concern for Dieting	6.72	3.35	0.06	.196	0.13	.007
Hunger	2.00	1.05	-0.06	.244	-0.12	.018
Time since last meal (in hours)	3.84	3.33	0.06	.232	.002	.687
Gender (0 = *male*, 1 = *female*)	–	–	0.14_a	.003	0.15_a	.002
Age	28.35	8.08	0.01	.815	0.03	.577
BMI	24.20	4.78	-0.03	.540	-0.03	.596

Note. MFT-C = Multiple Food Test (Choice); MFT-K = Multiple Food Test (Knowledge).
[a] Point-biseral correlation is depicted because gender was measured dichotomously.

3.3 Study 2

The main aim of Study 2 was to test the validity of the Multiple Food Test. To assess the convergent validity of the knowledge scale of the Multiple Food Test, the Practical Knowledge About Balanced Meals Scale (PKB-7; Mötteli et al., 2016) was used. We chose the PKB-7 because it measures applied nutrition knowledge (knowledge about the composation of balanced meals) which might be closely connected to the type of nutrition knowledge that is measured by the Multiple Food Test. To test the convergent validity of the

choice scale of the Multiple Food Test, we expected a positive correlation with the Brief Self-Control Scale (Tangney et al., 2004). A measure of diet quality (O'Reilly & McCann, 2012) was included to investigate whether general nutrition behavior was related to responses in the Multiple Food Test. We changed the format for assessing the eating motives from Study 1 to investigate the absolute relationship between the Multiple Food Test and these motives.

3.3.1 Method

Participants

An a-priori sample size calculation using G*Power (Faul et al., 2007) resulted in an optimal sample size of $N = 150$ assuming low to medium correlations between measures ($\rho = 0.2$; $\alpha = 0.05$, $1\text{-}\beta = 0.8$) with a recruitment of a sample size target of $N = 200$ to allow for incomplete data and drop-outs. In the current study, 201 US participants were recruited via Amazon Mechanical Turk ($M_{age} = 36.71$, $SD_{age} = 11.71$; 42.79% female). All participants received financial compensation for participation ($ 2.30).

Measures

Multiple Food Test. Version 2 of the Multiple Food Test was used in this study. To increase internal consistency of the knowledge scale, three food items were exchanged (ham slices, ice cream, and croissant instead of baguette slices, smoked salmon, and chocolate donut) in this version (see Table 3.2). These changes resulted in good internal consistency (Cronbach's $\alpha = 0.88$) of the knowledge scale compared to Study 1, while internal consistency for the choice scale was again on an acceptable level (Cronbach's $\alpha = 0.73$).

Practical Nutrition Knowledge. An additional measure of nutrition knowledge was included. Participants answered the Practical Knowledge About Balanced Meals Scale (PKB-7; Mötteli et al., 2016). The PKB-7 consists of seven questions examining practical nutrition knowledge about healthy and balanced meals. For every question, there are three to four answer options. Every correct response is scored as one whereas incorrect or *don't know*

responses are scored as zero. The number of correct answers is calculated per participant. The internal consistency of this scale was poor (Kuder-Richardson 20 = 0.20).

Self-Control. To assess participants' self-control, the Brief Self Control Questionnaire (Tangney et al., 2004) was used. The questionnaire consists of 13 items (e.g. "I am good at resisting temptation.") all measured on 5-point Likert-scales (1 = *not at all* to 5 = *very much*). The internal consistency of this scale was good (Cronbach's $\alpha = 0.89$).

Diet Quality. To assess participants' diet quality, participants responded to a short diet quality questionnaire (O'Reilly & McCann, 2012). The questionnaire contains 13 items measuring how often relevant food groups (vegetables, fruits, meat, milk, salt, convenience food, sweets, salty snacks, etc.) are consumed. Each item is scored from 0 to 10. Higher scores indicate that participants reported to eat accordingly to nutrition guidelines (e.g. for fruits: eating more than 5 servings scored 10 while eating no fruits scored 0). A total diet quality score is calculated with a range between 0 and 130 points (indicating high diet quality). The internal consistency of these items was poor (Cronbach's $\alpha = 0.43$).

Eating Motives. To measure health motives participants answered five single items ("It is important for me that the food I consume is … healthy; tasty; cheap; easy to prepare; fast to prepare") measured on 5-point Likert-scales (1 = *not at all* to 5 = *very much*).

Other Variables. As in Study 1, Concern for Dieting (Cronbach's $\alpha = 0.77$) was assessed using items from the Restrained Eating Scale (Herman & Polivy, 1980). Additionally, hunger, time since the previous meal, and the same anthropometrics as in Study 1 were measured (self-reported gender, age, weight, and height).

3.3.2 Results and Discussion

Correlation coefficients between both subscales of the Multiple Food Test and all other measures are summarized in Table 3.4. As expected, there was a positive relationship between the knowledge scale of the Multiple Food Test and the PKB-7. However, the correlation was weak ($\rho = 0.27$, $p < .001$), which might be due to the fact that the internal

consistency of the PKB-7 was low. Furthermore, the size of the correlation suggests that the measures capture different aspects of nutrition knowledge, which were not as closely connected as initially thought: While the Multiple Food Test measures knowledge about single food items, the PKB-7 focuses on the composition of nutritionally balanced meals. Higher self-control was related to healthier choices ($\rho = 0.14$, $p = .048$) and higher knowledge ($\rho = 0.15$, $p = .030$) in the Multiple Food Test. We did not find a significant correlation between overall diet quality and both subscales of the Multiple Food Test (both p's > .05), which suggests that general eating patterns are not mirrored in single food choices. Given that fruit and vegetable intakes are strongly related to risk of chronic disease and all-cause mortality (van Duyn & Pivonka, 2000; Wang et al., 2014) and to lay perceptions of a healthy diet (Paquette, 2005), these items were examined more closely. Fruit ($\rho = 0.26$, $p < .001$) and vegetable intakes ($\rho = 0.19$, $p = .007$) were positively correlated with healthier choices in the Multiple Food Test. Similar as in Study 1, a high health motive was related to healthier choices ($\rho = 0.22$, $p = .002$) while a higher taste motive was not related ($\rho = -0.09$, $p = .223$) to choices in the Multiple Food Test. While the choice scale of the Multiple Food Test was again not related to concern for dieting ($\rho = 0.01$, $p = .897$), the negative correlation between the knowledge scale and concern for dieting ($\rho = -0.20$, $p = .003$) indicates that higher concern for dieting was related to lower values on the knowledge scale. This stands in contrast to findings of Study 1 and is discussed in more detail in the general discussion. Hunger ($\rho = 0.00$, $p = .957$) and time since last meal ($\rho = -0.07$, $p = 347$) were not related to choices in the Multiple Food Test. As in Study 1, higher self-reported hunger was associated with lower values on the knowledge scale of the Multiple Food Test ($\rho = -0.16$, $p = .026$). Again, the Multiple Food Test was not related to BMI or age, and in contrast to Study 1, no gender difference was found (all p's > .05).

Table 3.4

Means, Standard Deviations, and Spearman Correlations between the Multiple Food Test Choice Scale and Knowledge Scale with Other Measures (Study 2)

Variable	*M*	*SD*	MFT-C		MFT-K	
			ρ	*p (2-tailed)*	ρ	*p (2-tailed)*
Multiple Food Test (Choice)	2.51	0.44	–	–		
Multiple Food Test (Knowledge)	3.58	0.38	-0.02	.748	–	–
PKB-7	3.60	1.34	0.07	.303	0.27	<.001
Self-Control	3.43	0.77	0.14	.048	0.15	.030
Diet Quality Index	66.04	17.28	0.11[a]	.115	0.03	.681
Vegetable Consumption	4.64	2.33	0.19	.007	-0.03	.640
Fruit Consumption	7.64	2.55	0.26	<.001	-0.02	.826
Health Motive	3.57	0.98	0.22	.002	0.06	.434
Taste Motive	4.22	0.85	-0.09	.223	0.08	.293
Cheap Motive	3.37	1.10	-0.09	.207	-0.02	.818
Easy Motive	3.47	1.06	-0.07	.330	-0.02	.731
Fast Motive	3.29	1.11	-0.18	.012	-0.09	.201
Concern for Dieting	5.87	3.49	0.01	.897	-0.20	.003
Hunger	2.00	1.46	0.00	.957	-0.16	.026
Time since Last Meal (in hours)	4.74	3.52	-0.07	.347	-0.03	.655
Gender (0 = *male*; 1 = *female*)	–	–	0.10[b]	.149	-0.08[b]	.282
Age	36.71	11.71	-0.08	.256	0.12	.102
BMI	29.81	7.67	-0.09	.201	-0.01	.922

Note. MFT-C = Multiple Food Test (Choice); MFT-K = Multiple Food Test (Knowledge); PKB-7 = Practical Knowledge about Balanced Meals Scale.
[a] Pearson correlation is depicted because both measures were normally distributed.
[b] Point-biseral correlation is depicted because gender was measured dichotomously.

3.4 Study 3

The main aim of Study 3 was to test the concurrent validity of the Multiple Food Test. Hence, it was evaluated whether healthier choices in the Multiple Food Test can predict choices made in a compensation choice paradigm.

3.4.1 Method

Participants

Sample size was determined before data collection using G*Power (Faul et al., 2007) assuming a medium to high correlation ($\rho = 0.4$; $\alpha = 0.05$, $1-\beta = 0.8$) and resulted in an optimal sample size of $N = 34$. To be on the safe side, 40 participants were recruited for this laboratory study ($M_{age} = 25.73$, $SD_{age} = 7.15$; 60% female). All participants were recruited from the campus of a large German university and received 1.00 € and a snack as compensation.

Procedure

In the beginning of the study, participants responded to the choice scale of the Multiple Food Test (version 2; see Table 3.2). Internal consistency was good (Cronbach's $\alpha = 0.81$). After answering the Multiple Food Test, real food choices were measured using a compensation choice paradigm. Participants were asked to indicate which of four food items they would like to choose as compensation for participating in this study. Participants were able to choose between baby carrots, a banana, potato chips and a croissant. These four items were the same items that were depicted in the tenth trial of the Multiple Food Test. This target trial was inserted in the middle of the Multiple Food Test to prevent potential memory- or consistency-effects when making the real food compensation choice. After the compensation choice, participants responded to the knowledge scale of the Multiple Food Test (Cronbach's $\alpha = 0.61$) and to demographic questions.

3.4.2 Results and Discussion

In total 28 participants (70%) chose the same food item as compensation, as in the target trial of the Multiple Food Test. Intra-class correlation (two-way random model) between the target trial in the Multiple Food Test and the compensation choice was high (*ICC* = 0.73). An OLS regression revealed that the healthiness of the chosen item in the target trial positively predicted healthiness of the item that was chosen as compensation (β = 0.57, $t[38] = 4.27$, $p < .001$; 95% CI [0.32; 0.88], $R^2 = 0.32$). A second OLS regression revealed that the mean of the choice scale of the Multiple Food Test significantly predicted healthiness of the item that was chosen as compensation (β = 0.55, $t[38] = 4.08$, $p < .001$; 95% CI [0.64; 1.90], $R^2 = 0.31$). Overall, these results indicate that choices in the Multiple Food Test are predictive of real food choices.

3.5 General Discussion

In the current paper, the Multiple Food test was introduced as a measure that combines the assessment of food choices and applied nutrition knowledge. In a set of three studies, the psychometric properties of both subscales of the Multiple Food Test were investigated. Across all studies, internal consistency of the choice scale of the Multiple Food Test was acceptable. Internal consistency of the second version of the knowledge scale was good in Study 2, but the internal consistency of the knowledge scale was lower in Study 3, which could be due to the fact that the knowledge part was asked after participants had chosen a compensation item, which may have biased the results. Study 1 identified that healthier choices in the Multiple Food Test were related to a view of health as a malleable characteristic, the tendency to eat healthily more often and considering a healthy diet as more important. The choice scale was related to a stronger health versus taste motive, while it was not related to dieting concerns, hunger, or the time since eating a previous meal. Study 2 replicated the latter results and identified that healthier choices were related to higher self-

control and higher fruit and vegetable intake. Furthermore, choices in the Multiple Food Test predicted real food choices (Study 3). The correlation between the knowledge scale of the Multiple Food Test and the PKB-7 was lower than expected which is not surprising given the low internal consistency of the PKB-7. The knowledge scale of the Multiple Food Test was also related to self-control (Study 2).

While most of the results provide good evidence to support validity of the Multiple Food Test, some results need further examination. In Studies 1 and 2, a negative relationship between hunger and knowledge was observed. A possible explanation is that foods which are high in energy or fat may be perceived as *healthier* by participants who are hungry due to greater potential to reduce hunger. This is consistent with findings that unhealthy foods are perceived as more filling (Suher et al., 2016). Research also suggests that hunger increases attractiveness of unhealthy foods (Lozano et al., 1999; Siep et al., 2009). This increased attractiveness could have led to a bias to rate these foods as healthier as a mean of cognitive dissonance reduction (Festinger, 1957; Ong et al., 2017). Furthermore, it has been shown that hunger can bias attitude formation and leads to more positive evaluations of foods (Crites & Aikman, 2005; Lozano et al., 1999). This positivity bias might have led to more misjudgments of the foods' healthiness.

The inconsistent findings for the relationship between restrained eating and the knowledge scale could have occurred due to cultural differences between the samples used in Study 1 (Germany) and 2 (USA). While a positive relationship between nutrition knowledge and restrained eating is supported by the literature (Bond et al., 2001), the explanation for the negative relationship obtained in Study 2 remains speculative. Higher concern for dieting or engaging in dieting more frequently could have resulted in the formulation of lay theories about what constitutes healthy foods, which could have biased the healthiness judgments.

3.5.1 Advantages of the Multiple Food Test

The Multiple Food Test combines the measurement of food choices and applied nutrition knowledge. In research that directly focuses on the influence or the moderating role of nutrition knowledge on food choices, the Multiple Food Test may be a useful tool because both constructs are measured on comparable scales. The Multiple Food Test was designed to overcome disadvantages of existing tools when measuring food choice. It includes a large variety of food items and trials, which increases its utility and accounts for a variety seeking goal. It produces two scores which are easy to compute and to interpret. These scores are informed by a validated and objective nutrient profiling model and can be analyzed like rating scales. Answering the Multiple Food Test only takes five to seven minutes, while it can also be added quickly to laboratory and online studies (see supplementary materials for a Qualtrics template). The Multiple Food Test is almost language free and easy to understand, which enables its use for research involving children or internationally. Furthermore, the outcome of the Multiple Food Test (choice and applied knowledge) could be used within experimental study designs to test the effectiveness of interventions to increase healthy choice and consumption.

The Multiple Food Test complements the battery of existing tools that can be used to measure food choices and applied nutrition knowledge. Particularly for online research, the Multiple Food Test can be easily added into studies. In laboratory settings, the Multiple Food Test can be a time- and cost-efficient alternative to existing measures. Another domain in which the Multiple Food Test can be used is ecological momentary assessment or experience sampling. For example, it would be possible to examine naturally occurring daily life events and how these factors impact preferences for healthier versus less healthy foods. It should be noted that both subscales of the Multiple Food Test can be used individually, or together, depending on the research question that is being evaluated. It may also be possible to adjust and adapt the test to cultural differences in eating patterns or the representativeness of foods

by exchanging some food items with other foods that have a similar nutrient profile score. However, it would then be advisable to re-examine the validity and reliability of the adapted test in the population in which its use is intended.

3.5.2 Limitations and Outlook

Limitations need to be acknowledged. Firstly, most of the reported correlations were relatively small, though statistically significant. However, small correlations or effect sizes are common when investigating eating behavior or food choice (e.g., O'Connor et al., 2008; Wardle et al., 2000) and food choice is influenced by differing motives, attitudes, habits, personality traits, or situational variables (Furst et al., 1996; Michela & Contento, 1986; Stok et al., 2017). In addition, the sample populations were relatively homogeneous, which may have reduced variance in the measured variables. Current results cannot be applied to the whole population due to exclusion of individuals with food intolerances or allergies, and those who avoid specific foods or food groups. Further studies should include these groups of individuals. Such differences in eating styles (e.g. veganism, vegetarianism) could serve as a variable of future interest in terms of responses to the Multiple Food Test.

The choice scale of the Multiple Food Test only captures hypothetical choices, although this is also true for other tools that examine food choice (Web Buffet, Fake Food Buffet, and Food Choice Task). However, as shown in Study 3, choices made within the Multiple Food Test have been shown to relate strongly to real food choices. It is important to keep in mind that the Multiple Food Test and other tools described are measures of current dietary intentions or preferences within the context of defined experiments, which differs from habitual or usual food choices. The Multiple Food Test does not reflect usual diet variety that is measured when evaluating the healthfulness of an individual's overall diet. To measure usual intake, food frequency questionnaires or diet quality indexes are recommended. Another limitation is that the current version of the Multiple Food Test mainly included food items that

are typical from a Western diet. Future studies should include typical food items from other cuisines (e.g., Asian or Latin American) to increase the generalizability of the test.

3.5.3 Conclusion

The Multiple Food Test is a valid and reliable measure for food choice and applied nutrition knowledge. It extends the current repertoire of tools available to measure these constructs, especially in online settings. It is based on the established nutrient profiling model for assessing nutritional quality of selected foods. The Multiple Food Test includes a high variety of foods, increasing its utility across various research designs and population groups within research on eating behaviors and food choice.

Declaration of Competing Interest

The authors declare no conflict of interest.

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Supplementary Materials

The current version of the Multiple Food Test, as used in Studies 2 and 3, can be found in the articles' supplementary materials (https://www.sciencedirect.com/science/article/abs/pii/S0195666319308347). Furthermore, an OSF-repository (https://osf.io/uefyx/) was created in which food images, a nutrient-profile calculator, and a Qualtrics template for the Multiple Food Test can be found.

Chapter IV

An Implicit Theories Intervention for Health Behavior Change: A Randomized Controlled Trial

This chapter is based on the following manuscript that was submitted to *Social Science & Medicine* on July 20, 2020:

Schreiber, M. & Dohle, S. (2020). *An implicit theories intervention for health behavior change: A randomized controlled trial*. Manuscript submitted for publication.

Please note that some changes in headings, citation style, and formatting were undertaken to fit the layout of this dissertation. Supplementary tables were added to the main text. No changes were made to the content of the manuscript.

Abstract

Objective: Implicit theories of health are beliefs about whether health is malleable (incremental theory) or fixed (entity theory). This randomized controlled trial (RCT) investigates whether a smartphone-based ecological momentary intervention designed to promote an incremental theory of health increases the frequency of performing health-promoting behaviors in daily life.

Method: In this two-arm, single-blind, delayed intervention, 149 German participants (M_{age} = 30.58, SD_{age} = 9.71; 79 female) were asked daily over a period of three weeks to indicate whether they had performed ten health-promoting behaviors throughout the day. Either after one week (early intervention; n = 72) or two weeks (delayed intervention; n = 77) of baseline behavior measurement, participants were presented with intervention materials designed to strengthen an incremental theory of health. Data collection for this study ran between September and October, 2019.

Results: Multilevel analyses revealed that across conditions, participants reported to engage in health-promoting behaviors more often after being confronted to the intervention materials compared to baseline (b = 0.14, t[146.65] = 2.06, SE = 0.07, p = .042, 95% CI [0.01, 0.28]). When analyzed separately, this intervention effect was only present for the delayed intervention group (b = 0.27, t[1492.37] = 3.50, SE = 0.08, p < .001, 95% CI [0.12, 0.42]).

Conclusion: This RCT shows that a smartphone-based intervention promoting an incremental theory of health serves as time- and cost-efficient approach to increase the frequency of performing health-promoting behaviors. Explanations are provided as to why the effectiveness of the intervention differs between intervention groups. In addition, implications are derived that may guide the development of future interventions focusing on implicit theories to achieve health behavior change.

Keywords: Implicit theories, Mindsets, Multiple health behavior change, Randomized controlled trial, Ecological momentary intervention, Germany

4.1 Introduction

According to the World Health Organization (2018), 71% of all worldwide deaths are attributed to noncommunicable diseases like cardiovascular diseases, cancer, respiratory diseases, or diabetes. The risk of suffering from such a disease can decrease due to adopting a healthier lifestyle that includes sufficient physical activity, a healthy diet, and the avoidance of harmful substances like tobacco or alcohol (van Dam et al., 2008; World Health Organization, 2018). Engagement in such health-promoting behaviors often involves a high level of self-regulatory strategies (Cameron & Leventhal, 2008; Hofmann et al., 2008). An essential prerequisite for successful self-regulatory processes are *implicit theories* (Burnette et al., 2013). Implicit theories refer to people's beliefs about the changeability of human attributes and characteristics (Burnette et al., 2013; Dweck, 1999). According to Dweck's (1999) framework, people differ in the extent to which they hold an *incremental theory*, i.e., assuming that a given attribute is developable and malleable, versus an *entity theory*, i.e., assuming that an attribute is fixed and stable. Recent research shows that a stronger incremental theory of health has a positive influence on maintaining a healthy lifestyle across multiple health behavior domains (Bunda & Busseri, 2019; Thomas et al., 2019; Schreiber et al., in press). Extending these findings, the main aim of this randomized controlled trial was to investigate whether promoting an incremental theory of health increases the frequency of performing health-promoting behaviors in daily life.

4.1.1 Implicit Theories

Early research about implicit theories mainly focused on assumptions about the changeability of intelligence (Blackwell et al., 2007; Hong et al., 1995) or personality (Dweck & Leggett, 1988). Since this first research, implicit theories have been studied across a wide array of domains like willpower (Job et al., 2010; Job et al., 2015), morality (Chiu, Dweck et al., 1997), stereotypes (Levy et al., 1998), or interpersonal relationships (Knee, 1998). The

majority of studies found that holding a stronger incremental theory in one domain (i.e., assuming that the given characteristic is malleable) leads to positive outcomes (Burnette et al., 2013; Dweck, 2012). For example, in a meta-analysis across 113 studies, holding an incremental theory was found to predict successful goal setting, goal monitoring, and goal operating, and, in turn, better self-regulation (Burnette et al., 2013). Therefore, many interventions have been developed to foster an incremental theory in order to create positive changes for individuals. The modes of delivering such interventions range from single-session approaches (Schleider & Weisz, 2016b; Schleider & Weisz, 2018), multi-session approaches (Blackwell et al., 2007; Burnette & Finkel, 2012), to large-scale educational programs (e.g., Project for Educational Research That Scales [PERTS]; see Yeager et al., 2019).

Since the past decade, research about implicit theories has also become popular in different health domains, like weight management (Auster-Gussman & Rothman, 2018; Burnette, 2010; Burnette & Finkel, 2012), physical activity (Lyons et al., 2015; Orvidas et al., 2018), smoking (Fitz et al., 2015; Thai et al., 2018), addiction (Burnette et al., 2019; Sridharan et al., 2019a), and mental health (Schleider & Weisz, 2016a; Schleider & Weisz, 2018). For example, it has been shown that an incremental theory can protect against setback related weight gain (Burnette & Finkel, 2012), is related to higher motivation and intention to achieve a healthy weight (Taber et al., 2017), leads to greater motivation to quit smoking (Sridharan et al., 2019a), and decreases anxiety and depressive symptoms (Schleider & Weisz, 2018).

Implicit theories in different domains are not necessarily interconnected (Dweck, 1999; Plaks et al., 2009). For example, one might believe that one's body weight is rather fixed around a given set-point, while at the same time thinking that smoking behavior can be changed easily. Therefore, implicit theories have not only been studied in single health domains but also for health in general. Such generalized implicit theories have been examined concerning their impact on multiple health behavior domains (Bunda & Busseri, 2019;

Thomas et al., 2019; Schreiber et al., in press). In that sense, an incremental theory of (general) health regards the assumption that health is malleable and changeable, while an entity theory of health implies that health is perceived as fixed and stable (Bunda & Busseri, 2019; Thomas et al., 2019; Schreiber et al., in press). Correlational research has shown that holding an incremental theory of health is related to stronger intentions to engage in different health-promoting behaviors (Bunda & Busseri, 2019) and to the frequency of performing health-promoting behaviors (Schreiber et al., in press). In addition, experimental findings suggest that a strengthened incremental theory of health leads to more positive attitudes towards different health-promoting behaviors (Schreiber et al., in press) healthier dieting intentions (Thomas et al., 2019), and healthier food choices (Schreiber et al., in press). Extending this correlative and experimental evidence, the current research seeks to examine the efficacy of an intervention program designed to promote an incremental theory of health. Using a smartphone-based ecological momentary intervention (see Heron & Smyth, 2010), it is further tested whether the promotion of incremental theories of health has a direct impact on one's health behavior engagement in everyday life. Compared to an intervention that focuses only on implicit theories in a single health domain, this approach may serve as an efficient strategy to encourage multiple health behavior change.

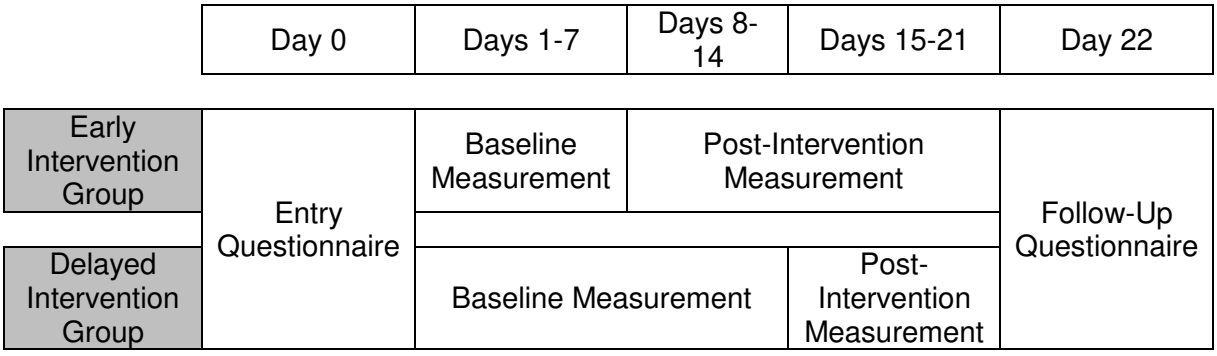
4.2 Method

To investigate whether fostering an incremental theory of health increases the frequency of performing health-promoting behaviors in daily life, a two-arm, delayed intervention-design was realized as randomized controlled trial. The intervention was delivered online using Qualtrics and included that participants kept a daily diary over the course of three weeks. Participants were randomly assigned (single-blind) to an early or delayed intervention group using Qualtrics randomizer while maintaining an evenly distributed number of participants in each group (1:1 block randomization).

In the beginning of the study (day 0), all participants responded to an entry questionnaire to measure implicit theories of health, health locus of control, health-related self-efficacy, health-related outcome expectancy, health status, health value, health-change motivation, anthropometric (height, weight), and demographic variables (age, gender, education, occupation). One day after responding to the entry questionnaire the daily diary phase started. Over the course of three weeks (21 days) participants received daily invitations to complete a short questionnaire via text messages distributed via SurveySignal (Hofmann & Patel, 2015). The invitations were sent daily at 8 pm and participants were asked to respond within four hours. In these daily questionnaires, participants were asked to indicate whether they performed ten different health-promoting behaviors throughout the respective day. The number of daily performed health-promoting behaviors served as primary outcome measure. Depending on the assigned condition, participants received intervention materials to foster an incremental theory either after seven (early intervention group) or 14 days (delayed intervention group) of baseline behavior measurement. After 21 days, participants were invited to participate in a follow-up questionnaire measuring the same constructs—except anthropometric and demographic items—as in the entry questionnaire. Figure 4.1 provides an overview of the study's design.

Figure 4.1

Overview of the Intervention-Flow for the Early and Delayed Intervention Group



Data collection for this study ran between September 13, 2019 and October 10, 2019. The study was approved by the faculty's ethic commission. It was registered as randomized controlled trial in the German Clinical Trials Register (trial number: DRKS00017379) and was preregistered in OSF (https://osf.io/y7un5/).

4.2.1 Sample Size Calculation

Sample size was determined prior to data collection using G*Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007) based on an expected effect size of $f = 0.15$ (with $\alpha = .05$; $1\text{-}\beta = .90$). This resulted in a required total sample size of $N = 96$ participants. Because it was also planned to run multilevel models, a total sample size of $N = 120$ was targeted to increase the probability of achieving model convergence. As described further in the results section, main analyses were performed using data from $N = 149$ participants.

4.2.2 Recruitment, Eligibility Criteria, and Compensation

Participants were recruited via the institutes' participant pool and via social media postings. Eligibility criteria were a minimum age of 18 years, owning a smartphone with touch display and mobile internet access, and being able to answer daily questionnaires over the period of 21 days. All participants received financial compensation for their participation: 3€ each for completing the entry and follow-up questionnaire, 4€ for responding to the intervention materials, 0.25€ for each completed daily questionnaire, and a bonus of 10€ for responding to more than 17 (80%) of the daily questionnaires (in total: up to 25.25€).

4.2.3 Measures

Table 4.1 provides an overview about the measures which were included in the different questionnaires of the intervention and informs about the internal consistency of the included scales in the follow-up.

Table 4.1

Overview of Variables and Internal Consistencies of the Scales Measured in Different Parts of the Intervention

Measure	Entry	Intervention	Follow-Up
Implicit Theories of Health Scale	I (α = .88)	I (α = .85)	I (α = .87)
Internal Health Locus of Control	I (α = .76)		I (α = .83)
Chance Health Locus of Control	I (α = .82)		I (α = .88)
Powerful Others Locus of Control	I (α = .74)		I (α = .80)
Health-Related Self-Efficacy	I (α = .85)		I (α = .83)
Health-Related Outcome-Expectancy	I (α = .77)		I (α = .79)
Health Status	I		I
Health Value	I		I
Change Motivation (self)	I		I
Change Motivation (others)	I		I
Age	I		
Gender	I		
Height	I		
Weight	I		
Education	I		
Occupation	I		

Note. The letter I indicates that the measure was included in the given part of the study.

Implicit Theories

To measure implicit theories of health, the Implicit Theories of Health Scale (ITHS; Schreiber et al., in press) was used. The scale consists of six items (e.g., "You can substantially change your own health."). Three items represent an incremental theory of health and three items represent an entity theory of health (which were recoded). Answers were given on 7-point Likert scales (1 = *strongly disagree* to 7 = *strongly agree*). A mean across all

items was computed with higher values indicating a stronger incremental theory. Internal consistency was good (α_{entry} = .88).

Health Locus of Control

The Health- and Illness- Related Locus of Control Questionnaire (KKG; Lohaus & Schmitt, 1989) was used to measure health locus of control. The KKG consists of 21 items all answered on 6-point Likert scales (1 = *strongly disagree* to 6 = *strongly agree*). Similar to its English equivalent (Wallston et al., 1978), the KKG consists of three subscales (with seven items each) to measure internal (e.g., "If I do not feel well physically, I have to blame myself."), powerful others (e.g., "If I feel well physically, then I owe it mainly to the advice and help of others."), and chance health locus of control (e.g., "Whether my symptoms last longer depends mainly on chance."). Internal consistency of all subscales was good (internal: α_{entry} = .76; chance: α_{entry} = .82; powerful others: α_{entry} = .74).

Health-Related Self-Efficacy

To measure health-related self-efficacy, the Perceived Health Competence Scale (PHCS, Smith et al., 1995) was used. The scale consists of eight items (e.g., "I'm generally able to accomplish my goals with respect to my health.") measured on 5-point Likert-scales (1 = *strongly disagree* to 5 = *strongly agree*). Internal consistency of the PHCS was good (α_{entry} = .85).

Health-Related Outcome Expectancy

Health-related outcome expectancy was measured using six statements to assess how much participants agree that specific health behaviors can influence one's own health ("Your health is strongly influenced by … eating behavior, … physical activity and exercising, … consumption of harmful substances, … enough sleep and relaxation, … personal and dental hygiene, … regular doctor visits and checkups."). Participants' agreement was assessed via 7-

point Likert-scales (1 = *strongly disagree* to 7 = *strongly agree).* Internal consistency of this scale was good (α_{entry} = .77).

Further Health-Related Variables

Single items were used to measure current subjective health-status ("How would you describe your health status in general?"; 1 = *bad* to 7 = *excellent*), health value ("How important is your health to you?"; 1 = *not at all important* to 7 = *very important*), and to measure the extent to which participants think that they should change their health from their point of view ("It is important to me to change something about my health."; 1 = *strongly disagree* to 7 = *strongly agree*) and from the perspective of others ("From the perspective of others, I should change something about my health."; 1 = *strongly disagree* to 7 = *strongly agree*).

Health-Promoting Behaviors

In the daily diaries, participants were asked daily whether they performed ten health-promoting behaviors throughout the respective day (see Table 4.2; 0 = *no*, 1 = *yes*). We only measured behaviors (a) that could be performed during a regular day, (b) that were based on national recommendations from public health authorities (e.g., Federal Centre for Health Education), and (c) that showed no ceiling- or floor-effect regarding the frequency of performing these behaviors, which was determined in a pretest (N = 325). Concerning the latter, we did not include behaviors such as brushing one's teeth or washing one's hands because the pretest showed that almost all participants conducted these behaviors on a daily basis. The sum of performed health-promoting behaviors served as the primary outcome measure.

Table 4.2

Items to Measure the Frequency of Performing Health-Promoting Behaviors

Health-promoting behavior	Category
I ate at least two servings of fruit.	Nutrition
I ate at least three servings of vegetables.	Nutrition
I did not eat sweets.	Nutrition
I drank at least two liters of water.	Nutrition
I have been physically active for at least 30 minutes so that I started to sweat and/or was slightly out of breath.	Physical Activity
I walked or cycled at least 6.5 kilometers.	Physical Activity
I exercised.	Physical Activity
I took some time to relax.	Relaxation
I slept for at least 7 hours.	Relaxation
I used dental floss.	Hygiene

4.2.4 Intervention Materials

Participants received a link to the intervention materials either after seven (early intervention group) or 14 days (delayed intervention group) of baseline measurement. Similar to other interventions to promote incremental theories (e.g., Blackwell et al., 2007; Burnette & Finkel, 2012; Schleider & Weisz, 2016b), the intervention materials consisted of informative, exemplary, and reflective components. More precisely, the intervention materials included (1) a (fictitious) newspaper article that described health as mainly influenced by lifestyle and engagement in health-promoting behavior (see also Schreiber et al., in press), (2) three fictitious blog posts in which individuals reported positive health changes, (3) an essay priming in which participants were asked to describe health changes in their lives, and (4) an article that focused on the benefits of beliefs in changeability in other domains. The materials are available in the OSF-repository (https://osf.io/y7un5/). After reading the articles and the three blog posts, participants answered one question regarding the content of the materials as

attention check. In addition, an independent rater checked the content of the essays to determine whether the participants followed the task description. Based on this, an attention check score was calculated, ranging from one to four, with four points indicating that all content questions were answered correctly and that the essay fitted the instruction.

4.3 Results

4.3.1 Participants

Initially, 393 participants were screened regarding eligibility criteria (see CONSORT flow diagram in Figure 4.2). Two hundred fifty-four participants were randomly assigned to one of the two intervention arms (early versus delayed intervention). As some participants discontinued their participation or did not respond to the intervention materials, a total of 161 participants received the allocated intervention. Participants were excluded from data analysis when they did not complete the entry questionnaire or did not respond to the daily diaries during the first week. No participants were excluded based on their attention check scores, as all remaining participants scored two points or higher. Consequently, main analyses were performed with 149 participants. The mean age for the analyzed sample was 30.58 (*SD* = 9.71), with 79 (53%) female and 70 (47%) male participants. Further demographic characteristics can be found in Table 4.3, and the CONSORT flow diagram (Figure 4.2) provides an overview of participant flow and informs about dropout-reasons in each intervention group. For additional follow-up analyses, data of *N* = 138 was available.

Figure 4.2

CONSORT Flow Diagram

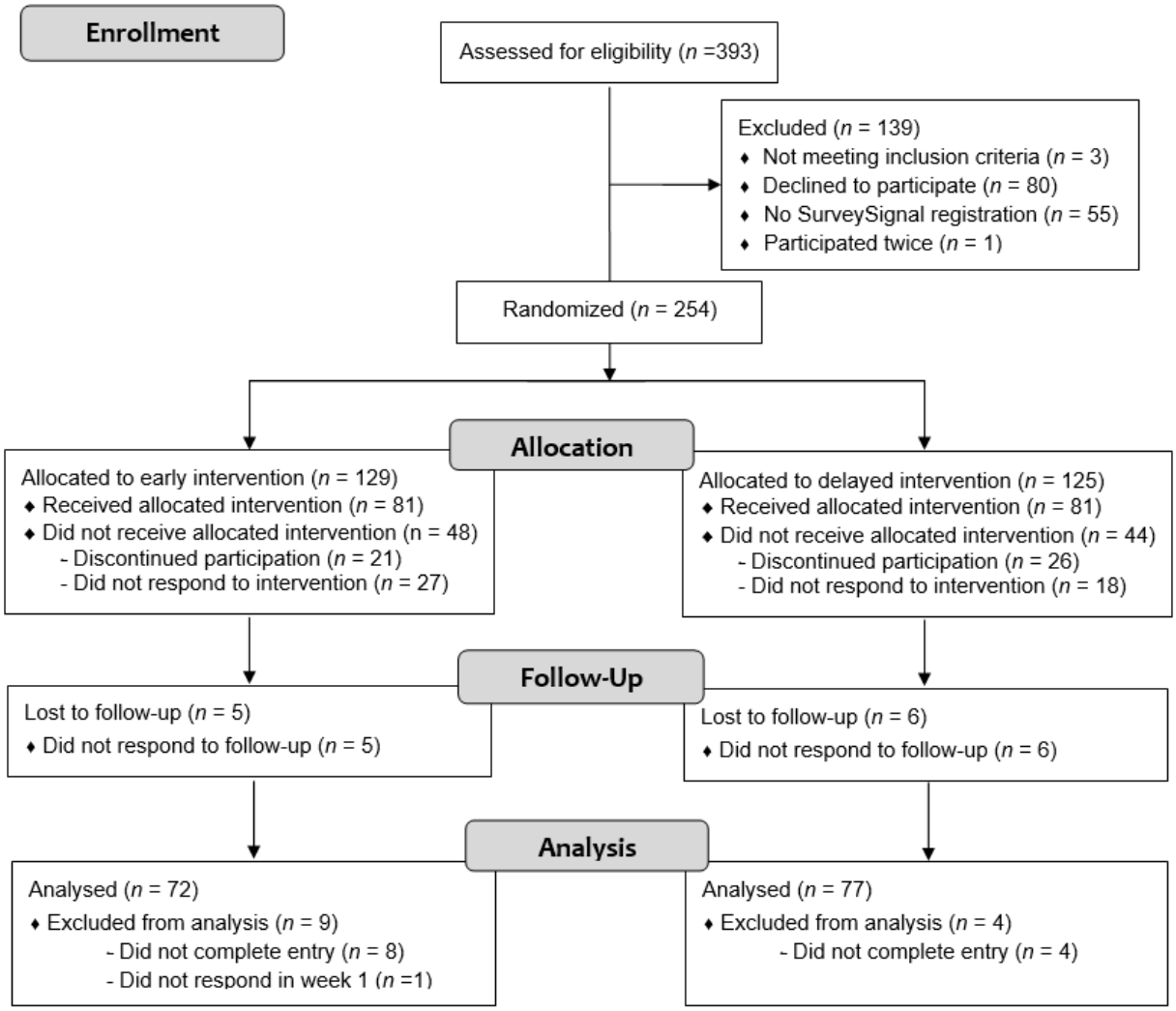


Table 4.3

Baseline Characteristics of Participants in Total and by Intervention Group

	Total (N = 149)		Early (n = 72)		Delayed (n = 77)		Condition Difference
	M	*SD*	*M*	*SD*	*M*	*SD*	
Age	30.58	9.71	31.31	10.44	29.91	8.98	$t(147) = 0.88$
Implicit Theories	5.29	0.99	5.36	1.06	5.22	0.92	$t(147) = 0.86$
Internal Locus	3.78	0.70	3.87	0.72	3.69	0.67	$t(147) = 1.61$
Powerful Others Locus	2.90	0.73	2.92	0.73	2.88	0.73	$t(147) = 0.34$
Chance Locus	2.35	0.74	2.39	0.79	2.32	0.70	$t(147) = 0.60$
Self-Efficacy	3.52	0.68	3.54	0.71	3.51	0.64	$t(147) = 0.26$
Outcome-Expectancy	5.56	0.83	5.63	0.81	5.49	0.84	$t(147) = 1.02$
Height (in meters)	174.60	9.63	175.21	9.38	174.04	9.89	$t(147) = 0.74$
Weight (in kilogram)	77.82	18.88	78.18	21.26	77.49	16.51	$t(146) = 0.22$
BMI	25.37	5.17	25.22	5.43	25.52	4.95	$t(146) = 0.35$
Health Status	4.99	1.15	4.97	1.13	5.00	1.18	$t(147) = 0.15$
Health Value	6.11	0.98	5.97	1.07	6.23	0.87	$t(147) = 1.64$
Change Motivation (self)	5.50	1.22	5.43	1.27	5.56	1.18	$t(147) = 0.64$
Change Motivation (others)	3.37	1.77	3.44	1.68	3.30	1.86	$t(147) = 0.50$
	n	%	*n*	%	*n*	%	
Gender							
Male	70	47.0	29	40.3	41	53.2	$\chi^2(1) = 2.51$
Female	79	53.0	43	59.7	36	46.8	
Education							
Lower secondary school	4	2.7	2	2.8	2	2.6	
Secondary school	10	6.7	4	5.6	6	7.8	
Entitlement to study at a university of applied sciences	3	2.0	3	4.2	0	0.0	$\chi^2(4) = 3.66$
higher education entrance qualification (Abitur)	61	40.9	28	38.9	33	42.9	
University degree	71	47.7	35	48.6	36	46.8	
Occupation							
Full-time employed	40	26.8	24	33.3	16	20.8	
Part-time employed	13	8.7	4	5.6	9	11.7	
Studying	81	54.4	36	50.0	45	58.4	
Housewife/Househusband	3	2.0	0	0.0	3	3.9	$\chi^2(6) = 8.90$
Retired	5	3.4	3	4.2	2	2.6	
Occupational disability	3	2.0	2	2.8	1	1.3	
Other	4	2.7	3	4.2	1	1.3	

4.3.2 Preliminary Analyses

As depicted in Table 4.3, there were no significant differences between the two intervention groups regarding demographics or other measures included in the entry questionnaire, suggesting that the randomization was successful. In total, participants answered 3015 daily questionnaires; on average, each participant answered 20.23 questionnaires (*SD* = 1.42, range: 12 to 21).

To test whether the intervention led participants to adopt a stronger incremental theory, a paired-samples *t*-test with ITHS scores measured in the entry questionnaire and ITHS scores after responding to the intervention materials was performed. This *t*-test revealed that participants reported a stronger incremental theory after responding to intervention materials ($M = 5.58$, $SE = 0.07$), compared to the entry questionnaire ($M = 5.29$, $SE = 0.08$; $t[148] = 4.07$, $SE = .07$, $p < .001$, 95% CI [0.15, 0.43], $d = 0.32$). A 2 (intervention group: early vs. delayed) x 2 (time of assessment: entry questionnaire vs. directly after seeing the intervention materials) mixed ANOVA revealed that the intervention lead to an increase in incremental theories in both groups indicated by a significant main effect of time of ITHS assessment ($F[1, 147] = 16.42$, $p < .001$, $\eta_p^2 = .10$), a non- significant main effect of intervention group ($F[1, 147] = 1.19$, $p = .278$, $\eta_p^2 = .01$), and a non-significant interaction ($F[1, 147] = 0.02$, $p = .887$, $\eta_p^2 = .00$).

4.3.3 Frequency of Performing Health-Promoting Behaviors

A mixed ANOVA was conducted to test whether the intervention increased the frequency of performing health-promoting behaviors in daily life. As within-subject factor, the mean number of health-promoting behaviors per day was aggregated for every week, and intervention group (early versus delayed) was entered as between-subject factor. The results of the mixed ANOVA showed no significant main effect of intervention group ($F[1, 147] = 0.92$, $p = .340$, $\eta_p^2 = .01$). There was also no significant difference between mean daily

performed behaviors per week (F[2, 294] = 1.46, p = .233, η_p^2 = .01). However, a significant interaction between intervention group and week was found (F[2, 294] = 3.06, p = .048, η_p^2 = .02). Table 4.4 shows marginal means, standard errors, and confidence intervals for daily performed behaviors per week for both intervention groups.

Table 4.4

Marginal Means, Standard Errors, and 95% Confidence Intervals for Mean Performed Health Behaviors per Day as Result of the Condition X Time Mixed ANOVA

Condition	Week	*M*	*SE*	95%-Confidence Interval	
				Lower level	Upper level
Early intervention	1	4.60	0.17	4.27	4.92
	2	4.64	0.18	4.29	4.99
	3	4.56	0.18	4.21	4.91
Delayed intervention	1	4.70	0.16	4.38	5.01
	2	4.75	0.17	4.42	5.09
	3	4.99	0.17	4.65	5.33

To test whether the intervention increased the frequency of performing health-promoting behaviors on a daily level, multilevel models were performed. Day was treated as level 1 unit and participant as level 2 unit. Intervention status (0 = *pre-intervention*, 1 = *post-intervention*) served as level 1 predictor while the number of performed health-promoting behaviors served as level 1 dependent variable. For each analysis, a deviance test was conducted whether a random-slope or a random-intercept model results in a better model fit. Across both intervention groups, the (better fitting) random-slope model showed an increase in the number of performed health-promoting behaviors after responding to the intervention materials (b = 0.14, t[146.65] = 2.06, SE = 0.07, p =.042, 95% CI [0.01, 0.28]). Further multilevel-models revealed that the effect of the intervention only appeared for the delayed

intervention group (random-intercept, $b = 0.27$, $t[1492.37] = 3.50$, $SE = 0.08$, $p < .001$, 95% CI [0.12, 0.42]), while no difference before and after the intervention was detected for the early intervention group (random-slope, $b = 0.02$, $t[69.23] = 0.14$, $SE = 0.11$, $p = .889$, 95% CI [-0.2, 0.23]).

4.3.4 Additional Analyses

Additional analyses revealed that participants did also report a stronger incremental theory in the follow-up questionnaire ($M = 5.42$, $SE = 0.08$) compared to the entry questionnaire ($M = 5.24$, $SE = 0.08$; $t[137] = 2.42$, $SE = 0.07$, $p = .017$, 95% CI [0.03, 0.32], $d = 0.20$). Furthermore, participants reported a stronger internal health locus of control in the follow-up questionnaire ($M = 3.92$, $SE = 0.06$) compared to the entry questionnaire ($M = 3.78$, $SE = 0.06$; $t[137] = 3.17$, $SE = 0.04$, $p = .002$, 95% CI [0.05, 0.23], $d = 0.28$). For the other health-related variables, no significant difference between the entry and follow-up questionnaire emerged.

4.4 Discussion

The purpose of the present research was to examine whether an incremental theory of health can be promoted in a smartphone-based ecological momentary intervention and, in turn, increases the frequency of performing health-promoting behaviors in daily life. In line with our predictions, we found that the RCT led to stronger incremental theories of health. Furthermore, across conditions, participants showed a significant increase in the frequency of performing health-promoting behaviors after being confronted with the intervention materials. However, this effect was only driven by the delayed intervention group, whereas no increase in health-promoting behaviors occurred for the early intervention group.

One possible explanation for why the effectiveness of the interventions differed between intervention groups relies on the involvement of daily diary assessments. Keeping track of one's daily health behaviors represents a form of self-monitoring, a behavior change

technique that can have an intervention effect itself (Michie et al., 2013). The slight increase in health-promoting behaviors between the first and second week for both groups (see Table 4.4) suggests that an effect of self-monitoring appeared in the present study. However, increased awareness of one's behavior evoked by self-monitoring can result in measurement reactivity (Barta et al., 2014). The daily diaries might have led to differing conclusions regarding the sufficiency of participants' health behavior engagement between the two intervention groups, which had an impact on the effectiveness of the incremental theories intervention. Having engaged in self-monitoring for seven days, participants in the early intervention group might have concluded that they already show a sufficient amount of health behaviors and that there is no need for further improvement (*signaling sufficiency*). For participants in the delayed intervention group, on the other hand, self-monitoring over two weeks could have increased the attention towards not showing substantial improvements in health behaviors (*signaling deficiency*). In this case, being confronted with materials supporting the changeability of health afterwards seems to have increased the motivation to act accordingly. Without receiving further supportive information, participants in the early intervention group, in contrast, show a decrease in performing health-promoting behaviors. Further research is needed to investigate whether the observed time-dependent effectiveness of the intervention replicates consistently or has resulted by chance.

Although no intervention effect emerged for the early intervention group, the introduced intervention led to changes in health behavior for the delayed intervention group. Thus, this study is the first to show that implicit theories of health can be influenced through an intervention delivered in people's daily lives, and it provides further evidence of the relevance of these theories for health behavior change across multiple health domains. The results show that even a one-shot implicit theory intervention via online-materials can increase engagement in health-promoting behaviors. Hence, this approach represents a time-, effort-, and cost-efficient way for health promotion.

Additional analyses revealed that the intervention-based increase in incremental theories of health is not just short-termed, as participants also reported stronger incremental theories in the follow-up questionnaire (compared to the entry questionnaire). In addition, the present intervention led to a stronger internal health locus of control. This is consistent with previous findings showing that a stronger internal health locus of control mediates the effect of an implicit theories of health manipulation on health-promoting outcomes (Schreiber et al., in press). It also fits findings that an incremental theory of personality intervention increases primary control in the context of mental illness (Schleider & Weisz, 2016b; Schleider & Weisz, 2018). It remains to be tested whether the change in internal health locus of control stems from the intervention materials, the daily diary assessment, or the combination of both.

4.4.1 Limitations and Generalizability

Recently, the relevance of implicit theories interventions has been seriously tackled in two meta-analyses concluding that they only produce weak effects in educational settings (Sisk et al., 2018). According to classic convictions (Cohen, 1988), the reported effect sizes or regression coefficients in the present research also fall in this category. However, it has been argued that these convictions should be used with caution, and effect sizes should be evaluated in consideration of the area or context investigated (Cohen, 1988; Funder & Ozer, 2019). Especially in health or educational research, even small effects can have far-reaching consequences when evaluated in a broader context (Funder & Ozer, 2019; Yeager et al., 2019).

Regarding the generalizability of findings, it is essential to note that the surveyed sample differs from the general population, especially regarding age, educational level, and student proportion. Participation in the study required owning a smartphone with internet access, and recruitment was realized via social media and mailing-lists. This has limited the studies' accessibility for individuals of older age. Moreover, participants reported high values

on other health-relevant measures at baseline (e.g., health-status, health change motivation, self-efficacy; see Table 4.3). For individuals holding such characteristics, it could have been easier to engage in health-promoting behaviors or to adopt new behavioral routines. On the other hand, the present intervention even leads to positive changes in health-promoting behaviors for individuals already starting with such advantageous conditions. Thus, individuals lacking these attributes might benefit even more from the intervention introduced.

The present study is in line with the majority of research showing that a stronger incremental theory leads to beneficial outcomes (Burnette et al., 2013). However, holding an entity theory can be instrumental under specific circumstances. A stronger incremental theory of health not only implies that one's health can improve but also means that one's health might worsen. For this reason, an incremental theory would be less adaptive when a prevention focus is present (Sevincer et al., 2014; Sue-Chan et al., 2012), that is, when one is trying to conserve a given health status. For individuals being confronted with the process of aging or suffering from long-lasting diseases, it may be more self-serving to believe in the stability of health.

4.4.2 Theoretical and Practical Implications

As introduced in the present research, addressing implicit theories of health serves as a new approach for achieving positive health behavior change. The expanding research of implicit theories in the health domain (Bunda & Busseri, 2019; Thomas et al., 2019; Schreiber et al., in press) may guide the development of health interventions or could be integrated into health education. Nevertheless, further steps are needed to test whether the present findings replicate and can be generalized. First, direct replications could test whether the effectiveness of an incremental theories intervention is indeed time-sensitive, as demonstrated in the present study. Next, conceptual replications could investigate what modes of delivering an implicit theories intervention are most effective and for whom. For example, the effectiveness might

be higher when delivered in person in form of courses or presentations or in multi-session approaches, in which the changeability of health is emphasized several times over an extended course of time. Studies with increased follow-up periods should test the longevity of an increase in incremental theories and the respective impact on health behaviors. Finally, the generalizability to different populations and different measures of health behavior needs to be ensured.

Research on implicit theories of health would also benefit greatly from examining the antecedents and determinants that lead to the adoption of an incremental versus entity theory (see Schreiber et al., in press). Auster-Gussman and Rothman (2018) found that incremental theories of body weight are more common when being white, of a young age, and when having a higher level of income and education. These variables, as well as one's own medical history or that of close others, should also play a significant role in the formation of implicit theories (see Schreiber et al., in press). The present study shows that even a rather young and educated sample with high self-reported health and high incremental theories at baseline benefits from an incremental theories intervention. It is possible that effects would be much more pronounced when studying population groups with stronger entity theories of health.

4.4.3 Conclusion

This study is the first RCT demonstrating that incremental theories of health can be increased in a single-session smartphone-based intervention. Contrary to our assumptions, the intervention only led to an increase in performing health-promoting behaviors when delivered at a later point in time. Further studies are crucial to assure whether the observed time-dependent variation in effectiveness replicates. Incremental theories interventions are expected to be most effective for individuals holding a stronger entity theory of health. Factors that favor the development of an entity theory of health should be investigated to

identify population groups that would benefit most from the interventional approach introduced in this paper.

Chapter V

Blaming Others for Their Illness: The Influence of Health-Related Implicit Theories on Blame and Social Support

This chapter is based on the following manuscript that was submitted to *Psychology & Health* on July 20, 2020:

Dohle, S., Schreiber, M., Wingen, T., & Baumann, M. (2020). *Blaming others for their illness: The influence of health-related implicit theories on blame and social support*. Manuscript submitted for publication.

Please note that some changes in headings, citation style, and formatting were undertaken to fit the layout of this dissertation. No changes were made to the content of the manuscript.

Abstract

Objective: Implicit theories of health, also referred to as mindsets of health, are people's beliefs about the malleability of health. Past research suggests that an incremental theory of health (believing that health can change) is an important prerequisite for preventive health behaviors. Besides these intrapersonal benefits, less is known about the interpersonal effects of implicit theories of health. An incremental theory of health may lead to increased blame and decreased social support towards people who are ill.

Design: Both studies (Study 1: $N = 433$, Study 2: $N = 397$) experimentally manipulated implicit theories of health (incremental vs. entity) and presented participants vignettes that described individuals suffering from different illnesses.

Main Outcome Measures: Blame, sympathy, outcome expectancy, and social support.

Results: Study 1 demonstrates that an incremental theory of health increases blame towards people suffering from an illness, regardless of whether it is a physical or mental illness, and blame indirectly attenuates social support. Study 2 shows that an incremental theory increases outcome expectancy, which indirectly amplifies social support.

Conclusion: This research suggests that an incremental theory of health may decrease social support via blame, but increases in outcome expectancy may counteract this effect.

Keywords: Implicit theories, Multiple health behavior change, Blame, Social support

5.1 Introduction

Some years ago, Stroebe (2011) suggested that there may be unpleasant side-effects to health education and prevention "which psychologists have been slow to recognize" (p. 309). By encouraging people's perception that health is under personal control, "health education not only increases the motivation of people to improve their own behavior, but may also motivate them to blame others who fail to live up to these new standards" (Stroebe, 2011, p. 310). Although attribution theory has long recognized that control beliefs can affect blaming of ill persons (e.g., Weiner et al., 1988), an important determinant of control beliefs has been largely overlooked: people's implicit theories, that is, the extent that people believe that certain human attributes, such as health, are malleable (Dweck, 1999, 2012, 2017). Beliefs about malleability of health are an essential precondition for the pursuit of preventive health behaviors (e.g., Schreiber et al., in press); in addition, they are often—directly or indirectly—addressed in many public health campaigns which usually stress that health is malleable and that people's own behaviors are key in order to remain healthy. Although such educational messages likely encourage people to adopt a healthier lifestyle, possible negative interpersonal effects, such as increases in blaming others for their own illness, are often neglected. In this research, we examine whether implicit theories of health influence blame and social support towards others who suffer from an illness.

5.1.1 Implicit Theories

Implicit theories are basic beliefs that people use to organize their world and to guide their behavior (Dweck, 2012). According to Dweck (Dweck, 1999, 2012, 2017), people differ in the extent of how strongly they endorse an incremental or an entity theory. An incremental theory, also known as a growth mindset, denotes the belief that a given attribute is malleable and can be changed. An entity theory, also known as a fixed mindset, is characterized by the belief that a given attribute cannot be changed despite efforts for change. Individuals with

stronger incremental theories are more likely to think that they have greater control over personal outcomes; as a result, they are often more persistent because they believe that they can change attributes through practice and learning (Dweck, 2012). Individuals with stronger entity theories, in contrast, often focus on proving that they possess certain abilities, believe that they have to be flawless, and often worry about failure (Dweck et al., 1995; Dweck, 2012).

Implicit theories have been studied extensively in the field of intelligence, and it has been demonstrated that an individual's beliefs about the malleability of intelligence can have significant effects on academic and emotional outcomes (for an overview, see Costa & Faria, 2018). Moreover, research on implicit theories has captured the interest of researchers in several other domains such as personality (Erdley & Dweck, 1993), emotion (Tamir et al., 2007), or morality (Chiu et al., 1997). Across these domains, research has consistently demonstrated that an incremental theory has a positive impact on achievement, adjustment, and well-being (Dweck, 1999, 2017; Yeager et al., 2014). Moreover, a meta-analysis revealed that holding an incremental theory improves goal setting, goal operating, and goal monitoring, which are crucial processes for effective self-regulation (Burnette et al., 2013).

In recent years, implicit theories research has also been applied in health-related contexts. In the domain of smoking, research has shown that incremental beliefs of smoking—believing that smoking behavior is changeable—is associated with lower expectations of becoming a regular smoker and increased intentions to quit (Fitz et al., 2015; Thai et al., in press). Lyons and colleagues (2015) found that young women who believed that that general body appearance is changeable reported higher levels of physical activity than those who thought that body appearance is stable and fixed. In addition, implicit theories about fitness have been demonstrated to predict self-efficacy, self-value, and exercise frequency (Orvidas et al., 2018). In the area of weight and weight control, Burnette (2010) and Burnette and Finkel (2012) found that individuals who believed that body weight is

malleable had more optimistic expectations about their weight loss, showed greater persistence, and gained less weight after dietary setbacks than people with an entity theory of body weight. However, it has also been noted that although a strong endorsement of the belief that weight is malleable increases offset efficacy—the belief that effortful actions have the potential to alleviate certain conditions—it also predicts self-stigma via an increase in self-blame (Burnette et al., 2017).

More recently, researchers have extended this research and addressed implicit theories about health in general (Bunda & Busseri, 2019; John-Henderson et al., in press; Schreiber et al., in press; Thomas et al., 2019). This research found that an incremental theory of health is related to stronger intentions to engage in health-promoting behaviors (Bunda & Busseri, 2019; Thomas et al., 2019), to the frequency of performing health-promoting behaviors (Schreiber et al., in press), and to higher levels of physical activity and a lower body mass index (John-Henderson et al., in press). These results are promising, as they imply that interventions aiming at changing people's general implicit theories of health (compared to health-specific implicit theories) may serve as an important leverage point for multiple health behavior change.

5.1.2 Implicit Theories, Attributions, and Reactions towards Others

Dweck's work on implicit theories has strong roots in attribution theory (Heider, 1958; Weiner, 1974, 1985, 2000). Attribution theory postulates that individuals' causal attributions for events determine their reactions to those events and their expectations about future events (Dweck & Leggett, 1988; Weiner, 1985). Similar to the implicit theory approach, attribution theory is both an intrapersonal and interpersonal theory because it incorporates not only self-directed but also other-directed cognitions, emotions, and behaviors (U. Rudolph et al., 2004; Weiner, 2000). However, an important distinction between the two approaches is that attribution theory tends to depict particular factors as inherently controllable or uncontrollable (Dweck & Leggett, 1988; Hong et al., 1999). For example, abilities are considered

uncontrollable and genetically coded, while effort is generally considered controllable (Weiner et al., 1988). Dweck and Leggett (1988), in contrast, assume that every quality can be understood as controllable or uncontrollable and that this interpretation depends on the theory of an individual: People who endorse an incremental theory tend to perceive a factor (such as ability) as controllable, while people who hold an entity theory perceive the same property as uncontrollable. Hence, Dweck (2012) assumes a causal chain of processes that starts with implicit theories, which then pave the way for subsequent causal attributions, especially those about controllability. These attributions may then influence affective and behavioral reactions and future expectations towards others.

It is important to note that perceived controllability of a health condition has been identified as an important determinant of affective and behavioral reactions towards others (Schwarzer & Weiner, 1991; Weiner et al., 1988). Uncontrollable origins of illness elicit sympathy and offers of support, whereas controllable origins elicit anger and only little support. Given that implicit theories are strongly tied to attributions of controllability, it is likely that the belief that health is malleable (i.e., an incremental theory of health) may lead to similar reactions towards others. Thus, although an incremental theory of health may have many intrapersonal benefits, on an interpersonal level, it may also lead to unintended side-effects such as an increase in blame and a decrease in social support. Evidence for this reasoning also comes from a study by Ryazanov and Christenfeld (2018), who demonstrated that adopting an incremental theory of empathy was associated with greater blame towards protagonists in a vignette showing a low level of empathy.

In the present research, we wanted to test whether implicit theories of health may increase blame and reduce sympathy and social support towards others who are ill. Thus, going beyond previous research and building on attribution theory, we investigated the cognitive, affective, and, in particular, the interpersonal behavioral consequences of implicit theories of health.

5.2 Study 1

In Study 1, we confronted participants with short vignettes about people suffering from different illnesses. We hypothesized that participants with an incremental theory of health, compared to those with an entity theory of health, will blame others more for their illness; as a result, they would feel less sympathy and feel less inclined to support people who are ill (sequential mediation). To address the generalizability of our findings, we also manipulated whether the individuals described in the vignettes suffered from a mental or physical illness. Prior research has shown that individuals who suffer from mental illness often experience more social stigma (Corrigan et al., 2000; Corrigan et al., 2003), suggesting a main effect of the type of illness on blame, sympathy, and social support. However, we did not predict an interaction effect (i.e., depending on the implicit theory, participants would judge individuals differently who suffer from a mental vs. physical illness). All hypotheses were preregistered (see https://aspredicted.org/blind.php?x=9dy289)

5.2.1 Method

Participants

We recruited 482 participants via participant pool mailing lists, university mailing lists, and various Facebook groups. In line with our preregistration, we excluded participants who did not pass a comprehension check (n = 11; see below), students majoring in psychology or medicine (n = 29), and those who were psychologists or physicians by profession (n = 9). The remaining sample consisted of N = 433 participants (115 male, 317 female, 1 diverse, M_{age} = 28.17, SD = 9.55). The sample size was determined a priori using G*Power 3 (Faul et al., 2007). According to this analysis, 242 participants would ensure a power of 0.8 while testing with an alpha-error of 0.05, supposing the effect is of small size (f = 0.15), and the correlation among repeated measures is .375 (this estimate was based on a

pretest). However, we recruited more participants because we expected that some participants would have to be excluded based on the preregistered criteria.

Design

The study used a 2 (implicit theory: incremental vs. entity) x 2 (illness: physical vs. mental) mixed design. The first factor varied between subjects, whereas the second factor varied within subjects. The dependent variables included blame, sympathy, and social support.

Material and Procedure

The study was conducted online using Qualtrics. Participants were informed that they would take part in a study on 'health attitudes' and that it would involve a reading comprehension task. Participants were then randomly assigned to one of the two between-subjects conditions: they either read a fictitious newspaper article in which health was described as a malleable quality that can be changed (incremental condition) or as a fixed quality that is mostly controlled by genes (entity condition). These articles have been successfully used to manipulate implicit theories of health in previous studies (Schreiber et al., in press). Following the article, participants were asked three true-or-false questions about the article to prove their comprehension of it. If participants could not answer any of the three questions correctly, it was assumed they had not read the article carefully and were therefore excluded from the analysis. After the comprehension check, participants responded to a manipulation check to measure their implicit theory. Participants then read eight case vignettes, presented in random order, about four persons with a physical illness, and four with a mental illness. The physical illnesses comprised skin cancer, spinal disc herniation, diabetes type 2, and cardiovascular disease, whereas the mental illnesses encompassed burnout, bulimia, agoraphobia, and obsessive-compulsive disorder. These illnesses were chosen because they are commonly diagnosed and because a pretest showed that they did not

significantly differ in perceived severity ($N = 30$; $p = .55$). After each vignette, participants responded to measures that assessed blame, sympathy, and social support. Finally, participants provided demographic information and were debriefed.

Measures

Manipulation Check. To test whether the manipulation was successful, participants answered six items about their implicit theories of health (e.g., "No matter who you are, you can significantly change your own health", see Schreiber et al., in press). Answers were given on a 7-point Likert scale anchored from 1 (*strongly disagree*) to 7 (*strongly agree*). After recoding reversed items, a mean score based on the six items was calculated (Cronbach´s α = .87). Higher values indicate a stronger incremental theory of health.

Blame. Three items were used to measure blame (e.g., "I think it's the person's own fault that he/she has this illness"). The items were based on research by Corrigan et al. (2003) and Mantler et al. (2003). All items were rated on a 9-point Likert scale anchored from 1 (*strongly disagree*) to 9 (*strongly agree*) and were averaged for an overall score of blame for all four illnesses. Internal consistency was very high (Cronbach´s $\alpha = .98$ for both physical and mental illnesses).

Sympathy. Sympathy was measured with two items (e.g., "I feel sorry for this person", see also Corrigan, 2003). Both items were rated on a 9-point Likert scale (1 = *strongly disagree* to 9 = *strongly agree*) and averaged to obtain a sympathy score. Internal consistency was high (Cronbach´s $\alpha = .95$ and $= .92$ for physical and mental illnesses, respectively).

Social Support. Four items were used to measure social support (e.g., "How much would you be willing to give advice and information?"), which were based on previous work of Schwarzer and Weiner (1991). Answers were given on a 9-point Likert scale from 1 (*strongly disagree*) to 9 (*strongly agree*). A mean score was calculated to obtain an overall

score of social support. Internal consistency was high (Cronbach´s α = .98 for both physical and mental illnesses).

5.2.2 Results and Discussion

The manipulation check indicated that our manipulation was successful. Participants who were assigned to the incremental condition showed a stronger incremental theory of health (M = 5.60, SD = 0.88) than participants of the entity condition (M = 5.14, SD = 1.03), $t(431) = 4.96$, $p < .001$, $d = 0.48$.

A 2 (implicit theory: incremental vs. entity) x 2 (illness: physical vs. mental) Analysis of Variance (ANOVA) on blame demonstrated a main effect of the implicit theory manipulation, $F(1, 431) = 6.85$, $p = .009$, $\eta^2 = .016$. In the incremental theory condition, participants assigned more blame (M = 3.55, SD = 1.47) to ill people compared to participants in the entity theory condition (M = 3.18, SD = 1.45). In addition, there was a main effect of type of illness, $F(1, 431) = 70.35$, $p < .001$, $\eta^2 = .140$, indicating that participants assigned less blame to individuals with a mental illness (M = 3.09, SD = 1.62) than to individuals with a physical illness (M = 3.64, SD = 1.62). There was no interaction between participants' implicit theory of health and type of illness, $p = .729$.

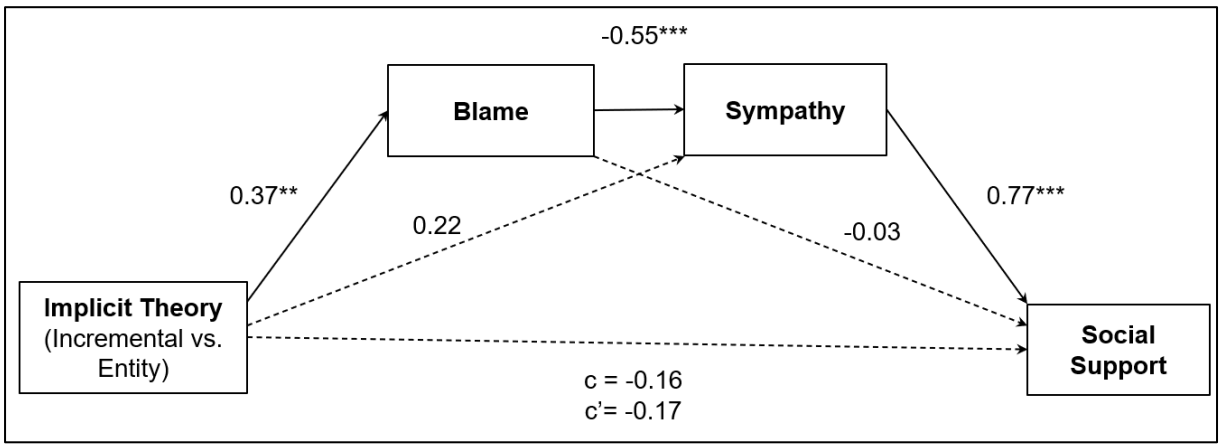
A 2 x 2 ANOVA on sympathy showed neither a significant main effect for implicit theory ($p = .904$) nor a main effect of type of illness ($p = .072$) or an interaction between implicit theory and type of illness ($p = .886$). Similarly, the 2 x 2 ANOVA on social support showed no effect of the implicit theory manipulation ($p = .310$), the type of illness manipulation ($p = .909$), or an interaction effect ($p = .719$).

A serial multiple mediator model using the R package *lavaan* (Rosseel, 2012) demonstrated an indirect effect of the implicit theory manipulation on social support (see Figure 5.1): People in the incremental condition assigned more blame to people who were ill, which was associated with increased sympathy towards ill people, which in turn was

associated with social support, b = -0.16, SE = 0.06, 95% CI [-0.29, -0.04]. Confidence intervals were calculated with 1000 bootstrap resamples.

Figure 5.1

Serial Multiple Mediator Model Predicting Social Support from Implicit Theory, Blame, and Sympathy (Study 1)



Note. Values represent unstandardized path coefficients. c denotes the total effect, c' denotes the direct effect.
** p < .01. *** p < .001.

In sum, the results of Study 1 suggest that individuals with an incremental view of health assign more blame towards people who are ill. Contrary to previous research, we also found that physically (and not mentally) ill persons were blamed stronger for their illness, which might be due to the fact that we tested different illnesses compared to prior research (see also general discussion). Importantly, however, we found no interaction between the implicit theories and the type of illness manipulation; thus, participants assigned more blame towards people suffering from an illness regardless of whether they were physical or mentally ill. An incremental theory of health, however, had no direct influence on sympathy or social support, but we found evidence for a sequential mediation showing that it can indirectly lead to less social support via blame and sympathy.

5.3 Study 2

In Study 2, we wanted to test a possible additional path from implicit theories to social support. It can be argued that believing that health is malleable is also an important precondition for the perceived effectiveness of social support. That is, only when health is believed to be malleable, social support is perceived to be effective. We, therefore, assumed that an incremental theory may also increase *outcome expectancies* (Bandura, 1977, 1986) of social support, sometimes also referred to as response efficacy (Maddux & Rogers, 1983; Rogers, 1975) or offset efficacy (Burnette et al., 2017)[4]. Thus, it seems likely that two opposing paths towards social support exist. First, an incremental theory of health may attenuate social support via attributions of blame and reduced sympathy, as shown in Study 1. Second, an incremental theory may also indirectly amplify social support via an increase in outcome expectancy—the belief that with proper support, change should be possible. Study 2 was designed to test these opposing pathways. Because no interaction of type of illness and implicit theory was found in Study 1, we only included physical illnesses, also to reduce participants' burden of judging too many vignettes. All hypotheses were preregistered (https://aspredicted.org/blind.php?x=wc2dm7)

5.3.1 Method

Participants

Participants (N = 402) were recruited via the online platform Prolific Academic. All participants listed German as their first language, and all received financial compensation for their participation (£1.25). Five participants had to be excluded because they did not pass the comprehension check, which was a preregistered exclusion criterion. The remaining sample

[4] The term *response efficacy* originates from Protection Motivation Theory (Rogers, 1975) and captures the belief that a recommended behavior will be effective in reducing or eliminating a perceived threat. Response efficacy differs from *offset efficacy* because the latter primarily refers to the belief that effort will be rewarded (Burnette et al., 2017). Maddux and Rogers (1983) state that response efficacy can be viewed as an *outcome expectancy*, which is defined as a person's estimate that a given behavior will lead to certain outcomes (Bandura, 1977).

consisted of $N = 397$ participants (210 male, 186 female, 1 diverse, $M_{age} = 30.28$, $SD = 9.77$). Sample size was determined a priori using G*Power 3 (Faul et al., 2007) with an effect size of $d = 0.255$ (based on Study 1), which resulted in a required total sample size of 338 participants to detect a main effect with $\alpha = .05$ and power = .80. We recruited more participants to compensate for potential exclusions.

Design

The study employed an experimental design and assigned participants to one of two experimental groups (implicit theory: incremental vs. entity). The dependent variables included blame, sympathy, outcome expectancy, and social support.

Material and Procedure

The study was conducted online using Qualtrics. The procedure was similar to Study 1. Participants were invited to take part in a study on 'health attitudes' and were informed that it would involve a reading comprehension task. They were then randomly assigned to one of the two experimental groups and either read a newspaper article stating that health can be changed (incremental condition) or cannot be changed (entity condition). The experimental manipulation was followed by the comprehension check and the manipulation check (i.e., the implicit theories of health scale). Participants then received four randomly-presented case vignettes, each of which described a person with a physical illness. The four illnesses comprised skin cancer, a herniated disc, diabetes type 2, and cardiovascular disease. After reading each vignette, participants responded to the dependent measures, which assessed their perceptions of blame, sympathy, and outcome expectancy, as well as social support. Participants then gave demographic information and were presented with an on-screen debriefing form.

Measures

We used the same measures as in Study 1 to assess implicit theories of health (Cronbach´s α = .91), blame (Cronbach´s α = .98), sympathy (Cronbach´s α = .97), and social support (Cronbach´s α = .97). Three items were used to assess outcome expectancy (e. g., "I believe that helping this person would be effective to change his/her condition"). All items were rated on a 9-point Likert scale anchored from 1 (*not at all*) to 9 (*very much*) and were averaged for an overall score of outcome expectancy (Cronbach´s α = .96).

5.3.2 Results and Discussion

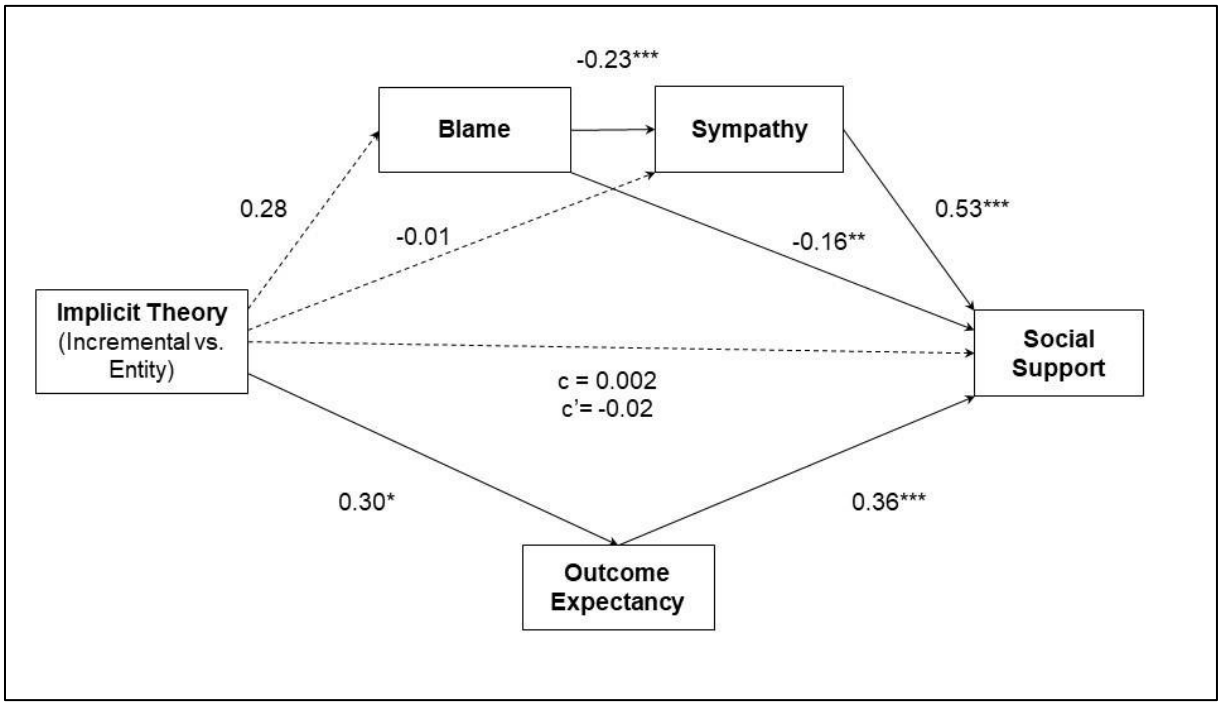
A t-test showed that the manipulation was successful. Participants who were assigned to the incremental condition agreed more strongly that their health was malleable (M = 5.71, SD = 0.88) compared to those who were assigned to the entity condition (M = 4.92, SD = 1.20; $t(395) = 7.43$, $p < .001$, $d = 0.75$). As a tendency, participants in the incremental condition (M = 4.07, SD = 1.46) attributed higher blame to the people described in the vignettes compared to those in the entity condition (M = 3.79, SD = 1.58), but this effect was not significant, $t(395) = 1.84$, $p = .066$, $d = 0.18$). In addition, participants in the incremental condition reported a higher outcome expectancy (M = 6.82, SD = 1.20) than subjects in the entity condition (M = 6.52, SD = 1.28; $t(395) = 2.40$, $p = .017$, $d = 0.24$). There was no significant difference in reported sympathy (incremental condition: M = 6.88, SD = 1.62, entity condition: M = 6.95, SD = 1.44; $t(395) = 0.46$, $p = .649$, $d = 0.05$). Participants also did not differ in their willingness to exhibit social support (incremental condition*:* M = 6.35, SD = 1.65, entity condition*:* M = 6.35, SD = 1.59; $t(395) = 0.01$, $p = .989$, $d = 0.00$).

A serial parallel multiple mediator model using the R package *lavaan* (Rosseel 2012) demonstrated an indirect effect of the implicit theory manipulation on social support through outcome expectancy (see Figure 5.2): An incremental theory of health led to an increase in outcome expectancy, which in turn was associated with increased social support, b = 0.11, *SE*

= 0.05, 95% CI [0.02, 0.20]. Contrary to Study 1, however, we found no (strong) evidence for the opposing path via blame and sympathy, b = -0.03, SE = 0.02, 95%-CI [-0.09, 0.004]. Confidence intervals were calculated with 1000 bootstrap resamples.

Figure 5.2

Serial Parallel Multiple Mediator Model Predicting Social Support from Implicit Theory, Blame, Sympathy, and Outcome Expectancy (Study 2)



Note. Values represent unstandardized path coefficients. c denotes the total effect, c' denotes the direct effect.
* p < .05. ** p < .01. *** p < .001.

5.4 General Discussion

The main aim of this research was to investigate the cognitive, affective, and behavioral interpersonal consequences of implicit theories of health. In a first study, we found evidence that an incremental theory of health increases blaming of others who suffered from an illness. Although no main effect of an incremental theory of health on social support emerged, an incremental theory attenuated social support indirectly via blame and reduced sympathy. In a second study, we demonstrated that an incremental theory of health increases

outcome expectancy; that is, an incremental theory influences the expectation that social support will be effective. We found that an incremental theory can indirectly amplify social support via an increase in outcome expectancy.

The question arises why we found an influence of implicit theories on blame in the first study, but not in the second study. Even if one considers that we have taken a conservative approach in reporting our result (two-sided tests for directed hypotheses), it is remarkable that the effect size was much larger in the first study than in the second study. One reason for these diverging results could be that statistical power was reduced in the second study because we used fewer vignettes. Another reason for this could be that the inclusion of outcomes expectancy has prompted participants to pay more attention to this aspect, which overshadowed the effects of implicit theories on blame.

We also found a main effect of the type of illness on blame in the first study. However, contrary to previous findings (Corrigan et al., 2003; Corrigan et al., 2000), we found that participants blamed people more for physical than for mental illnesses. An important difference between our studies and the existing research is that previous studies primarily focused on illnesses that meet the definition of social stigma, with is characterized by prejudice, discrimination, and pervasive cultural ideologies about certain groups (Goffman, 1963; Major et al., 2018). Mental illnesses in previous research comprised, for example, cocaine addiction and intellectual disability, whereas our research included illnesses such as burnout and agoraphobia. Thus, our findings suggest that people with mental (vs. physical) illnesses are not generally blamed more for their condition, but that such judgments depend on the context and the selected illnesses.

Our research extends prior results regarding the adverse effects of incremental theories on stigmatization in the weight domain (Burnette et al., 2017; Hoyt et al., 2017; Hoyt et al., 2019). First, Study 1 supports the generalizability of previous findings by showing that incremental theories of health also increase blame attributions regarding individuals suffering

from various mental and physical illnesses. Second, we show that incremental theories are not only relevant for blame attributions, but that they are also linked to the willingness to offer social support. Third, we present evidence for an alternative positive indirect effect of how implicit theories promote prosocial behaviors: via increased outcome expectancy. This confirms the relevance of implicit theories for health promotion, as outcome expectancy is an essential predictor for health-promoting intentions and behaviors (Bandura, 1977, 1986; Schwarzer, 2008). Further studies should test whether the effect of implicit theories on outcome expectancy is not only relevant for interpersonal behavior, but whether it is also important for effective self-regulation at the intrapersonal level.

As demonstrated by Hoyt and colleagues (2019) in the weight domain, implicit theories are important to consider when designing public health campaigns or framing health messages. They found that when an incremental message does not only focus on the changeability of weight but also acknowledges that such changes require effort and the use of the right strategies, adverse effects via blame attributions disappear (Hoyt et al., 2019). Similarly, our research (Study 2) revealed that drawing the attention towards outcome expectancy might help to counteract blame attributions. Therefore, health communication should not only focus on the potential for change but should also take into account that people differ in the extent of how easily they can adopt such changes. This may help to counteract the emergence of stigmatization or stereotyping.

Some limitations need to be addressed. First, it would have been helpful to also include a measure of control beliefs. As outlined in the introduction, both constructs—implicit theories and control beliefs—are closely connected (Dweck, 2012), and prior research has shown that the influence of implicit theories on health outcomes is mediated via stronger perceived internal control (Schreiber, et al., in press). Further studies could measure control beliefs to test whether implicit theories have a direct effect on blame attributions and outcome expectancy or whether these effects are mediated via changes in internal control beliefs.

Another limitation is that we measured social support using self-reports. Further studies should test whether implicit theories also impact actual supportive behaviors. For example, participants could be asked whether they would donate parts of their financial study compensation to an organization that supports people suffering from the presented illnesses. Additionally, to rule out potential influences of social desirability or demand characteristics, further studies could include indirect measures of blame, sympathy, and social support.

In sum, the results of this study are in accordance with concerns about the side-effects of health education and prevention (Stroebe, 2011), and also with a new and growing body of research demonstrating that an incremental theory can increase blaming of others for their failures and shortcomings (Burnette et al., 2017; Ryazanov & Christenfeld, 2018). At the same time, we found no indication that an incremental theory also has behavioral consequences such as withholding social support, which might be due to the fact that an incremental theory also increases the expectation that help will be effective (outcome expectancy). In light of the high popularity of interventions aiming at fostering an incremental implicit theory across a wide range of context (Dweck, 2017; Rattan et al., 2015; Yeager et al., 2019), more emphasis should be placed on studying the possible unintended side-effects of implicit theories.

Chapter VI

General Discussion

6.1 Summary of Findings

Previous research regarding implicit theories of general health has mainly focused on the role of incremental theories for health behavior-intentions (Bunda & Busseri, 2019; Thomas et al., 2019). The research presented in this dissertation adds to this literature in several ways. Chapter II shows that implicit theories of health influence the formation of health-related attitudes. Stronger incremental theories are also connected to self-reported health behaviors and can predict the frequency of showing health-promoting behaviors in daily life. Chapter IV shows that an intervention to foster incremental theories of general health increases engagement in health-promoting behaviors. Implicit theories of general health were not only predictive of attitudes and behaviors across domains. Similar to Thomas and colleagues (2019), Chapters II (Study 3) and III (Study 1) show that an incremental theory of general health also relates to healthier food choices. The correlation between implicit theories of general health and self-reported physical activity (Chapter II, Study 1) fits results showing that implicit theories predict subsequently measured physical activity assessed using accelerometers (John-Henderson et al., in press). Extending research on the double-edged sword effect (Burnette et al., 2017; Hoyt et al., 2017; Hoyt et al., 2019), we found that implicit theories of general health have an impact on social support in Chapter V. Similarly, a negative effect of incremental theories on social support via increased blame attributions emerged (Study 1), while an increase in social support was mediated via increased outcome expectancy (Study 2).

The introduced studies provide additional evidence for the relationship between implicit theories and other social cognitive determinants of (health) behavior. While plenty of research already demonstrated the influence of implicit theories on self-efficacy (Busseri & Samani, 2019; Ehrlinger et al., 2017; Tamir et al., 2007), the presented studies provide further evidence for the influence of implicit theories on control beliefs. Especially the relationship and mediating role of internal health locus of control as a result of changes in implicit theories

were observed across different studies (Chapter II, IV). This is consistent with research describing the link between implicit theories of personality and weight with control beliefs (Burnette, 2010; Schleider & Weisz, 2018). The presented studies further show that an incremental theory of general health increases outcome expectancy (Chapter V). The results regarding the impact of implicit theories on instrumental attitudes described in Chapter II (Studies 2 and 4) also support the connection between implicit theories and outcome expectancy. It can be assumed that the behaviors were rated as more beneficial and more important due to higher contingency expectations regarding the influence of these behaviors on health promotion.

The presented studies suggest that (1) implicit theories of general health seem to be more strongly connected to health-promoting behaviors compared to refraining from health-threatening behaviors (Chapter II). Further, (2) implicit theories of general health seem to best predict health promotion across domains, in contrast to behavior in a single health domain, like food choices. This is indicated by the relatively small correlation between implicit theories and food choices presented in Chapter III (Study 1) and the missing total effect of our implicit theories manipulation on food choices in Chapter II (Study 3). Domain-specific approaches appear to be better for describing the relationship between implicit theories and health promotion in single health behavior domains or for health-threatening behaviors (like smoking). However, implicit theories of general health are a relevant determinant that can inform research or interventions that target multiple health behavior change (Prochaska et al., 2008).

6.2 Theory Integration: The ILOS-Model of Health Promotion

As outlined throughout this dissertation, I argue that existing models of health overlook an important precondition of health promotion—that is, implicit theories of health. The integration of implicit theories into models of health promotion is essential based on the

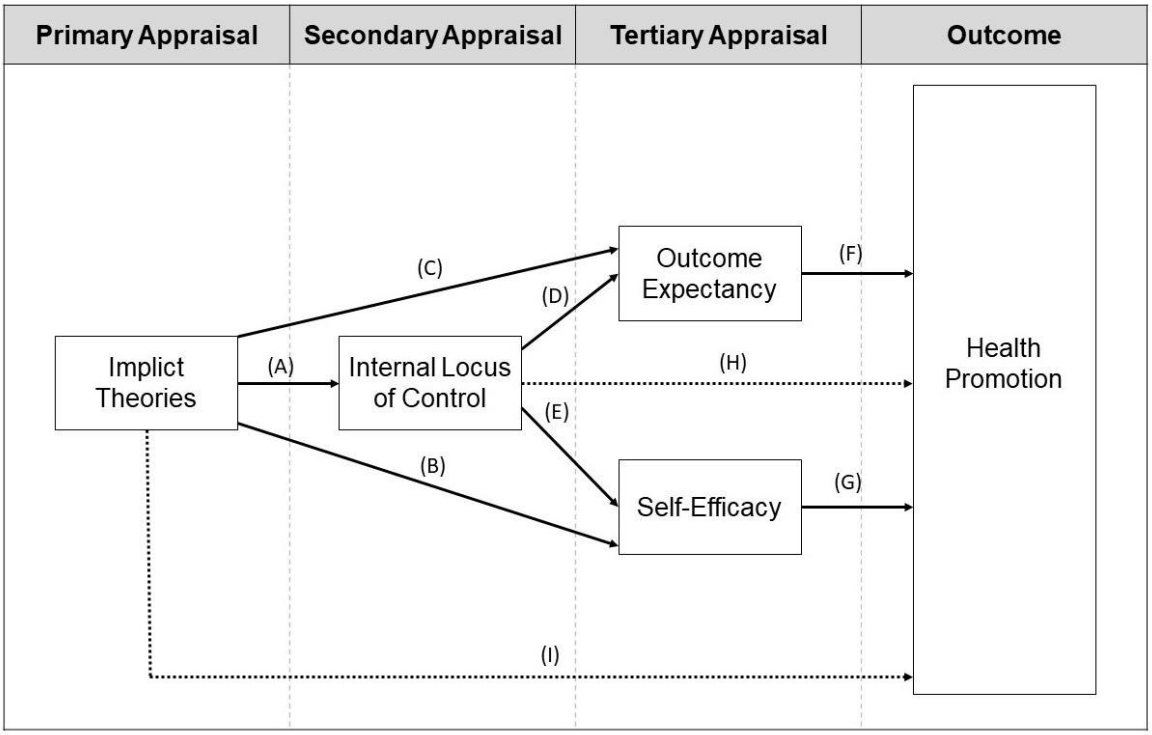
following three arguments: Firstly, a large body of research shows that implicit theories affect intentions and behaviors in specific health domains as well as across multiple health behavior domains (e.g., Chapters II-V). Secondly, implicit theories influence not only health-promoting outcomes but also influence other social cognitive determinants of health promotion, like locus of control, outcome expectancy, and self-efficacy (e.g., Chapters II, IV, and V). Thirdly, the latter mentioned determinants are all grounded on the assumption that health is a malleable construct. However, this assumption has not yet been addressed explicitly in existing models of health promotion.

To integrate implicit theories to the prediction of health promotion, I suggest the *ILOS-Model* depicted in Figure 6.1. ILOS refers to the variables included in this model: **I**mplicit theories, **L**ocus of control, **O**utcome expectancy, and **S**elf-efficacy. The ILOS-Model conceptualizes the formation of health behavior-intentions or engagement in health-promoting behavior as the result of a three-step appraisal process, whereby the individual steps build on one another. The first appraisal relates to the question of whether health is perceived as changeable or stable (implicit theory). The second appraisal relates to the question of whether such changes depend on one's behavior or lie outside of one's control (locus of control). The third appraisal relates to questions of whether one knows which behaviors are effective in achieving health changes (outcome expectancy) and whether one perceives oneself as capable of engaging in these behaviors (self-efficacy).

I further argue that viewing health as changeable (i.e., having an incremental theory of health) is a necessary precondition for the second appraisal. Because without viewing health as changeable questions regarding the controllability of such changes could logically not occur. Similarly, perceiving health changes as controllable (i.e., having an internal locus of control) is the necessary precondition for the third appraisal. Without thinking that one's actions influence health changes, questions regarding how and whether one is capable of pursuing these changes are implausible.

Figure 6.1

The ILOS-Model to Explain the Influence of Implicit Theories, Locus of Control, Outcome Expectancy, and Self-Efficacy on Health Promotion



Empirical evidence exists for nearly all pathways in the ILOS-Model. The influence of implicit theories on internal locus of control (A) has been demonstrated several times in this dissertation (Chapter I, Chapter IV) as well as in previous research (Burnette, 2010; Schleider & Weisz, 2018). The influence of implicit theories on self-efficacy (B) has been shown repeatedly (Busseri & Samani, 2019; Ehrlinger et al., 2017; Fitz et al., 2015; Orvidas et al., 2018; Tamir et al., 2007). While evidence for the influence of implicit theories on outcome expectancy (C) was only available indirectly (Hoyt et al., 2019; Thomas et al., 2019), Chapter V (Study 2) substantiates this pathway. The influence of implicit theories on instrumental attitudes (Chapter II, Studies 2 and 4) can also be seen as support for this pathway, although outcome expectancy was not measured explicitly in these studies. Evidence for the influence of locus of control on outcome expectancy (D) and self-efficacy (E) is mainly correlational (O'Hea et al., 2009; Roddenberry & Renk, 2010; Waller & Bates, 1992). However, from a

logical perspective, it is reasonable to assume that an internal locus of control is a requirement for the development of outcome expectancy and self-efficacy (see above).

The influence of outcome expectancy and self-efficacy on health promotion (F, G) is documented well in research regarding the Health Action Process Approach (Schwarzer, 2008) and the Social Cognitive Theory (Bandura, 1977). Direct effects of implicit theories (H, section 1.3) and health locus of control (I, section 1.2.2) on health-promoting outcomes are documented well. However, I assume that these effects should be strongly mediated via outcome expectancy and self-efficacy as a direct effect of implicit theories on health-promoting outcomes often disappears or decreases when other mediators are included in the prediction (e.g., Chapter II, Study 2; Ehrlinger et al., 2017; Orvidas et al., 2018).

It is important to note that the ILOS-Model aims to be a parsimonious model instead of an exhaustive one. Therefore, the ILOS-Model focuses on variables consistently emerging in most models of health behavior change (control beliefs, outcome expectancy, and self-efficacy) and for whom empirical evidence regarding the relationship with implicit theories exists. Other variables like social norms or environmental factors are not included (a) as these variables are only considered in a few models and (b) because evidence regarding the relationship between these variables and implicit theories is yet missing. Also, for reasons of parsimony, the ILOS-Model currently does not contain pathways between outcome expectancy and self-efficacy—as suggested by the Health Action Process Approach (Schwarzer, 2008) or the Social Cognitive Theory (Bandura, 1989)—and does not differentiate further in terms of health-promoting outcomes (intention, attitude, behavior). Before adding additional variables or pathways, it is essential to test the ILOS-Model in its present form empirically first. In its current form, the ILOS-Model does not aim to explain the highest amount of variance in health behavior. It instead serves as a conceptual model to describe the relationship between the included social cognitive determinants of health promotion and may guide further research regarding implicit theories and health.

6.3 Limitations and Implications

This section discusses limitations of the presented work in this dissertation as well as of implicit theories research in general. Also, inferences are drawn on how these limitations could be overcome in future research. A particular focus lies on a clearer separation of related constructs at an empirical level. A better separation between related constructs as well as studying their interrelation is also an important prerequisite for future research on the proposed ILOS-Model.

6.3.1 Refinement of Measures, Manipulations, and Delimitation

I suggest that future research in the field of implicit theories should put a stronger emphasis on the delimitation between implicit theories and related cognitions—like locus of control, self-efficacy, and outcome expectancy—as well as on studying the interrelation between these constructs. Especially the distinction between implicit theories and control beliefs is essential, because of the conceptual closeness of both constructs. It is crucial to develop distinct measures and manipulations to examine the unique predictive value of implicit theories to predict related outcomes.

Current measures, experimental manipulations, or intervention materials in implicit theories research often conflate changeability and control beliefs. For example, most scales to measure implicit theories are derived from Dweck's suggestions (Dweck, 1999). Dweck further differentiates between self-forms (e.g., “No matter who *you* are, *you* can change your intelligence a lot.”) and other-forms (e.g., “No matter what kind of person *someone* is, *they* can always change very much.”) of implicit theory measures. It is important to deliberately weigh up the decision for one of the two forms, as these determine whether an egocentric and generalized assessment of changeability is measured (Dweck, 1999). For example, a person could think that a given attribute or characteristic is changeable in general but that this person

believes that this does not apply to themselves. These differing judgments ("I can change" versus "People can change") are associated with expectations regarding self-efficacy.

Furthermore, the classical items to measure implicit theories do not only capture assumptions regarding changeability. They also assess control beliefs, as they claim that the source for change lies in oneself (or people themselves). It is essential to use items that measure changeability without referring to the sources of change, which only requires slight adjustments of items. For example, items like "No matter who you are, your intelligence can change a lot" or "Your intelligence is something about you that does not change very much" could be used. Such items would help to investigate more precisely the impact of changeability assumptions without addressing control.

The conflation between changeability and controllability is often even more pronounced when authors construct their measures of implicit theories. For example, Verberg and colleagues (2019) aimed to measure "[…] beliefs in the malleability of their emotions, behaviors, and intelligence […]" (p. 5). However, five of the six items to measure the malleability of emotions and behaviors focused on control (e.g., "I can learn to control how I feel"; "I control my behavior"). A similar intermix of constructs exists in other scales (e.g., implicit theories of emotions; Tamir et al., 2007).

Similarly, many manipulations and intervention materials in implicit theories research often conflate features of controllability or outcome expectancy. The materials usually focus on the necessary steps to achieve changes in a given domain or include testimonials or examples focusing on individuals who were able to achieve changes by showing specific behaviors (e.g., Blackwell et al., 2007; Burnette & Finkel, 2012; Schleider & Weisz, 2016b; Yeager et al., 2014). It is important to note that this critique also applies to our research, as we based our measure on Dweck's items and used similar intervention and manipulation materials. This is also because, on an operational level, developing ecologically valid or persuasive materials to change implicit theories without elaborating on how such changes can

be achieved is difficult. A potential way to influence implicit theories without addressing control beliefs or outcome expectancy would lie in confronting participants only with health changes without providing further information regarding how these changes can be achieved. For example, future research could make use of before and after pictures or statements like "Peter lost 20 pounds in one year", or "Daniel reduced his cigarette consumption from one package to only five cigarettes per day". Such items or pictures make malleability salient, without indicating how such changes can be achieved.

Besides emphasizing the differentiation between constructs, it is critical to focus on the interrelation between these connected cognitions, as suggested by the ILOS-Model. Elaborating on how these constructs act in concert might be more suitable to predict and understand health promotion. In our research, as well as in other research, including mediators—like locus of control or self-efficacy—when predicting health-related outcomes often results in a decrease or disappearance of the direct effects of an implicit theories measure or manipulation on the outcome (Chapter II, Study 2; Ehrlinger et al., 2017; Orvidas et al., 2018). Although this contradicts the relevance of implicit theories for health promotion at first glance, such findings help to explain how the impact of implicit theories on health promotion unfolds. Outcome expectancy and self-efficacy are more strongly connected to health behaviors and intentions compared to locus of control and implicit theories. This is not surprising since outcome expectancy and self-efficacy are assumptions that directly relate to behaviors. When considering implicit theories and control beliefs as a precondition for the set-up of such behavior-related assumptions, their relevance for health promotion is equally important. Considering implicit theories and control beliefs as a necessary precondition for the set-up of behavior-related cognitions, but as an insufficient precondition for predicting actual outcomes, helps to explain why some implicit theories manipulations are unsuccessful (Chapter II, Study 3; or Bunda & Busseri, 2019).

6.3.2 Effect Sizes

Across the presented studies, effect sizes of the relationship between implicit theories and health-promoting outcomes were relatively small. It is important to note that effect sizes were smaller when predicting variables in a single domain compared to health promotion across domains. This fits the notion that the predictive power of implicit theories is higher when focusing on more specific and targeted approaches (Dweck, 2012; Rydell et al., 2007). However, this also contradicts Schroder and colleagues' (2016) finding that a latent variable based on implicit theory measures across health-related and -unrelated domains was similarly useful to predict mental health symptoms across different mental health screening instruments as specific implicit theory measures. Especially when focusing on multiple health behavior change, implicit theories of general health might serve as a more efficient way to promote health across different domains compared to domain-specific implicit theories. However, domain-specific approaches should be recommended when focusing on promotion in an individual health domain.

The magnitude of effect sizes is also criticized for implicit theory interventions in the academic context (Sisk et al., 2018). Nevertheless, even small effects can have meaningful consequences, especially when it comes to public health or large-scale educational programs. Even if only a few individuals benefit from fostering incremental theories, this can have decisive consequences for these individuals (see section 4.4.2; Funder & Ozer, 2019; Yeager et al., 2014). The predictive value of implicit theories might also be more reliable when mediating variables—like those suggested in the ILOS-Model—are considered in a prediction, or when focusing on the indirect effects conveyed by these variables.

The obtained small effect sizes could further be a result of a sample bias in the presented studies. The studied participants already held strong incremental theories, reported good health, and showed a high level of health behavior engagement. This has reduced variance in implicit theories and the studied outcomes. Therefore, only small effects were to

be expected statistically, since the potential for further increases in these variables was limited (see max-con-min-principle, Kerlinger & Pedhazur, 1973). The raised concerns regarding effect sizes are not limited to the studies presented in Chapter II to V, but also relevant for other research regarding implicit theories and health (e.g., Bunda & Busseri, 2019; Orvidas et al., 2018). Therefore, a meta-analysis regarding the influence of implicit theories in the health domain would be very useful to evaluate the overall magnitude of effects.

6.3.3 Definition of Health

A limitation that is especially relevant for implicit theories of general health is the impreciseness in the use of the term *health*. Even in psychology and medicine, multiple definitions exist for health ranging from "the absence of illness" to "a state of complete physical, mental and social well-being" (see, e.g., Huber et al., 2011). Confronting participants with items focusing on the changeability of health without providing further instruction about the meaning of health leaves much room for interpretation and causes an uncontrollable source of variance on measurement level (Kerlinger & Pedhazur, 1973). For example, if health is interpreted as the constant *change* between phases of being ill and phases without an illness, this would already entail an incremental mindset, especially when considering that every adult has experienced the process of getting ill and recovering several times throughout life (e.g., getting and recovering from a cold). On the other hand, health could be interpreted as the absence of a protracted illness or of specific symptoms, the subjective feeling of *feeling well*, or an evaluation of the sufficiency of acting accordingly to health recommendations. These interpretations have different implications for assumptions about changeability and stability. Therefore, items to measure implicit theories of health should be precise, or a short definition of health should be provided when doing such research. This would help to control an additional source of error variance that stems from differences in interpreting the measure.

6.3.4 Origins of Implicit Theories

Another way to increase effect sizes when promoting incremental theories lies in studying individuals who hold stronger entity theories, as they would benefit more from an incremental theories manipulation or intervention. Therefore, it is essential to study factors that lead to the development of entity versus incremental theories. Auster-Gussman and Rothman (2018), as well as Thai and colleagues (2018), found that holding entity theories of weight and smoking is related to older age, less income, lower level of education, and being part of a non-white minority. The relationship between older age and entity theories might relate to the fact that for older individuals, it is more likely that they have experienced more unsuccessful attempts to lose weight or to quit smoking. Further, the body's metabolism changes with age (Vaughan et al., 1991), and overriding long-learned habits or developing new behavioral routines becomes more challenging with older age (Carstensen & Hartel, 2006; Purdie & McCrindle, 2002). Less-educated individuals might have problems to understand and use health-related information and to put recommendations into action (Cutler & Lleras-Muney, 2006). Being part of a minority can lead to problems in understanding and applying health-related information—especially when the information is not provided in ones' native language. Being part of a less privileged population group and having a lower income can further restrict the accessibility to health-promoting resources (e.g., sports classes, addiction counseling; see Auster-Gussman & Rothman, 2018).

Implicit theories of general health might relate to similar socio-economic variables, as weight and addictive behaviors are an essential aspect of health. Experiencing longer-lasting diseases (either by oneself or close others) may also lead to the development of stronger entity theories. Accordingly, Bernecker and Job (2019) argue that implicit theories are constructed based on experiences in life. Experiencing immutability or mutability in health is a likely basis for the development of a stronger incremental versus entity theory of health. Similarly to self-efficacy (Bandura, 1977), implicit theories may be learned based on the execution of or

refraining from health behaviors and the associated experience or absence of health changes. The identification of factors that affect the formation of implicit theories is crucial (a) to identify target groups that would benefit most from an incremental theories intervention and (b) to counteract the development of an entity theory at an early stage (see also section 3.6.1). However, before giving a universal recommendation that promoting incremental theories is always good, it is essential to examine circumstances under which incremental theories might be less functional.

6.3.5 Maladaptive Effects of Incremental Theories

Most research on implicit theories shows that holding a stronger incremental theory is connected to positive outcomes in different domains. However, especially in the health domain, some results suggest potential deleterious effects. While stronger incremental theories decrease stigmatization and body shame via increased efficacy beliefs (Burnette et al., 2017; Hoyt et al., 2019) and increase supportive behaviors via increased outcome expectancy (Chapter V, Study 2), adverse effects on these variables were found via increased blame and responsibility attributions (Chapter V, Study 1; Burnette et al., 2017; Hoyt et al., 2017). To further examine this double-edged sword effect, research should also test whether incremental theories increase blame attributions in other domains. This could be especially relevant in interpersonal evaluation contexts. For example, a teacher with an incremental theory of intellectual abilities might rate a student's poor performance as a result of laziness. This can result in even harsher judgments regarding the student's performance in contrast to when the teacher would assume that the student just is not able to improve. In extreme cases, a strong focus on incremental theories could lead to overlooking potential learning disorders when academic failures are solely attributed to a lack of effort or the use of wrong strategies. Attributing the absence of health changes as a lack of effort or wrong strategy use—in an incremental sense—might lead to overlooking severe underlying diseases or deficiencies which impede health changes.

As outlined in section 3.6.1, incremental theories can also lead to overestimating the potential for changes or unrealistic optimism (Fitz et al., 2015; Weinstein, 1980). Although incremental theories, stronger outcome expectancy, or more optimism would generally serve a motivating function, this can backfire when the assumptions become too extreme or unrealistic. As found by Fitz and colleagues (2015), for non-smokers, incremental theories were related to stronger expectancies to try smoking in the future. This can be a result of overestimating the ease of quitting and underestimating the addictive potential of nicotine (Fitz et al., 2015).

Furthermore, incremental theories could serve as justification for engaging or not refraining from health-threatening behaviors. For example, incremental theories of smoking were more strongly related to intentions or motivation to quit but less predictive of quitting attempts (Sridharan et al., 2019a; Thai et al., 2018; Thai et al., in press). It seems that smokers with an incremental theory think that they can easily quit, but they might also think that they can quit just as well at a later time. Our findings that implicit theories were not related to health-threatening behaviors (Chapter II) points in a similar direction. The belief in the changeability of health and the related increased frequency of showing health-promoting behaviors could serve as a justification for why health-threatening behaviors are not perceived as risky or could be changed easily in the future. Therefore, studying the relationship between implicit theories and such balancing behaviors (see Dohle & Hofmann, 2019) could be investigated in future research.

It is necessary to take into account that individuals differ in their change potential in different domains. For example, intellectual abilities can be impeded by intellectual disabilities, weight changes strongly depend on the metabolic system, and changing addictive behaviors depends on morphological changes in brain structures. In such cases, an incremental theory might be less adaptive, especially when this view leads to ignoring such limitations or when efforts are invested in changing aspects of oneself that can only change to

a small extent. Moreover, although incremental theories have also been found to be adaptive when experiencing failure or setbacks (Burnette & Finkel, 2012; Dweck, 2012), it might be that a quantitative approach has overlooked individuals who experience constant failures over long periods. For example, imagine an individual who is unsuccessfully trying to lose weight over a long period, while investing much time and effort in visiting sports courses, trying different types of diets, seeing that all other peers are losing weight easily, and being confronted with interventionists, media campaigns, or self-help books preaching an incremental theory. For this person, constant failure would be extremely threatening for their self-concept. Especially in the weight domain, an extreme focus on incremental messages counteracts trends of body positivity or accepting oneself and might relate negatively to wellbeing (see Donaghue, 2009).

A final implication for potential maladaptive effects of incremental theories relates to the fact that most research on implicit theories is biased, given its focus on positive changes or improvements that go along with a belief in changeability. However, holding an incremental theory also entails that things can change for the worse. Especially in the health domain, this is relevant for individuals who already have a given medical condition or for individuals of older age. For those groups, it might be more important to maintain a given health status or to prevent medical conditions from getting worse than to improve their health. I argue that in such cases, an entity theory is more functional and more self-serving as it conveys a sense of security. Especially when taking into account that for older or already impaired individuals, a deterioration in health is more likely to occur, while at the same time, the potential to counteract deteriorations on a behavioral level becomes more and more difficult. Implicit theories research in the health domain should, therefore, study the functionality of incremental theories in older populations or for individuals who have some kind of impairment or suffer from a disease. A combination of implicit theories research and regulatory focus theory (Higgins, 2005) could stimulate further research. In a promotion focus, incremental theories

could be more functional, whereas stronger entity theories could be more useful when a prevention focus is present (see Sevincer et al., 2014; Sue-Chan et al., 2012).

6.3.6 Uniformity in Terminology

Elaborating on the relevance of implicit theories for health promotion is often difficult because of the inconsistent use of terminology. For example, implicit theories are also framed as *mindsets* or *lay theories*. All three terminologies are misleading to some extent, and the field of implicit theories research would benefit from agreeing on a uniform terminology. The term lay theory is misleading as lay theories also refer to other kinds of beliefs (section 2.1.1; see also Zedelius et al., 2017). Further, the term *lay* contradicts the use of bias-free language as it implies that the holder of such theory does not have any proper knowledge in the given domain (Stevenson, 2010). As most of the characteristics studied in implicit theories research are neither completely changeable nor completely stable, one cannot elaborate on whether a layperson has the wrong or right theory. Further, it is wrong to assume that only laypeople hold such theories, given that experts or researchers in the field of *lay theories* also hold these beliefs.

In a similar vein, the use of mindset is ambiguous as mindsets also exist regarding other features. Research using the term mindset often frames incremental theories as *growth mindsets* (e.g., Burnette et al., 2020; Orvidas et al., 2018). However, the measures used when accessing these *growth* mindsets are often based on Dweck's (1999) items that measure changeability, not growth. The term growth mindset is misleading as this does not consider that changeability assumptions also bear the potential for deterioration or decreases in an area (see also section 6.3.5). Finally, the use of *implicit* theories is misleading, as the theories are usually measured using self-report questionnaires that require an explicit elaboration of one's own beliefs (Bernecker & Job, 2019). This contradicts definitions of implicit cognitions as unconscious and without phenomenal awareness (Reingold & Ray, 2005).

A suggestion for a more precise terminology would be the use of the term *change theories*—or *change mindsets* or *change beliefs*. Such terms directly emphasize what type of belief is studied. Agreeing on a uniform terminology would benefit research on a procedural level as this will help to identify related research as well as it will make literature search, writing of reviews, or conducting meta-analyses much easier.

6.4 Conclusion

Implicit theories have a significant impact on health promotion. In addition to the effects of implicit theories in specific health domains, this work introduces eight studies which provide further evidence for the relevance of implicit theories of general health as an essential determinant of health promotion in multiple health behavior domains. While the health domain-specific approaches might serve best to predict health promotion in individual health domains, fostering implicit theories of general health could be an effective and economical way to promote health across domains and could encourage people to adopt a more health-conscious lifestyle. The introduced ILOS-Model elaborates on the interconnection between implicit theories and other variables that are relevant for health promotion (locus of control, outcome expectancy, and self-efficacy). I propose that this model can enrich research on implicit theories on a conceptual level and may stimulate the development of further interventional approaches. I suggest that implicit theories research should pay a stronger emphasis on delimitating implicit theories from other related constructs while also studying the interrelation between them. Additionally, it is crucial to examine which factors lead to the formation of an incremental versus entity theory of health. This would help to identify population groups that would benefit most from the promotion of an incremental theory and thus counteract insufficient health-related cognitions and behaviors.

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