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Do Parents' Mindsets Matter? – Implicit Theories and Co-Regulation in Preschoolers' Self-Regulation

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List of Scientific Publications

This dissertation is based on the following papers, which are attached in the Appendices.

Appendix A – Paper 1

Stern, M., & Hertel, S. (2020). Profiles of parents' beliefs about their child's intelligence and self-regulation: A latent profile analysis. *Frontiers in Psychology, 11,* 610262. doi: 10.3389/fpsyg.2020.610262

Appendix B – Paper 2

Stern, M., & Hertel, S. (2022). Relationship between maternal scaffolding and preschooler's metacognitive strategies in a problem-solving situation. *Learning and Instruction*. (Revised and Resubmitted)

Appendix C – Paper 3

Stern, M., Erdmann, K.A., & Hertel. S. (2022). Effects of maternal mindsets on parenting behaviors and self-regulatory strategies in four- and five-year-olds. *Developmental Psychology.* (Submitted)

Abstract

Parents and their co-regulatory behaviors play a fundamental role in the development of child self-regulation. Concurrently, influencing factors that explain differences in parents' behavior are insufficiently understood. Implicit theories of individuals are known to significantly determine behavior, motivation, and cognition in several domains. While implicit theories of students have been frequently studied, little research exists on implicit theories of parents. Therefore, the present dissertation aims to examine parents' implicit theories in co- and self-regulatory processes in preschoolers. To this end, a theoretical framework is introduced that integrates the SOMA (setting/operating/monitoring/achievement) model by Burnette et al. (2013) and the three-term standard model by Bornstein et al. (2018). This dissertation presents three empirical papers that explore parents' implicit theories and the interplay of co- and self-regulatory processes.

Paper 1 is based on an online survey and examines how different domains of implicit theories co-occur within parents and are related to demographics, parents' attitudes, and co-regulatory strategies. Three belief profiles with different configurations across domains emerge. Entity theorists have the lowest educational background. Incremental self-regulation theorists report more failure-is-enhancing mindsets, less performance-avoidance goals, and more mastery-oriented strategies than parents in the other profiles.

Paper 2 uses an integrative theoretical framework to analyze different aspects of mothers' scaffolding in mother-child interactions during a problem-solving task. The findings suggest that mothers apply different scaffolding strategies that may enhance children's metacognitive self-regulatory strategies and task performance.

Paper 3 evaluates the effects of mothers' implicit theories in an experimental investigation with six conditions (intelligence-is-malleable, intelligence-is-stable, failure-is-enhancing, failure-is-debilitating, self-regulation-is-malleable, self-regulation-is-stable). The results indicate that parenting behaviors differ in dependence of the study condition. Mothers' implicit theories indirectly affect children's self-regulatory strategies, mediated via parenting behaviors.

In conclusion, this dissertation provides further insight into (1) parents' implicit theories in preschoolers, (2) the domain-specificity and interplay of different domains of implicit theories, (3) the theoretical framework of mothers' scaffolding when studying mother-child interactions, and (4) the development of the SOMA model. The present work offers practical implications for parenting interventions and new avenues for future research.

1 Introduction

Why do some parents support their children's autonomy, whereas others pressure their children in an intrusive manner? How come some parents seek their children to develop skills, whereas others seek their children to outperform peers or conceal lacking abilities? Is there an explanation of how these differences relate to child outcomes? There is a wealth of evidence that parents' co-regulation plays a crucial role in children's learning and development, especially regarding self-regulation. Self-regulation is broadly defined as the internal regulation of behavior, emotion, and cognition to adapt to internal and environmental demands (Raffaelli et al., 2005). The development of self-regulation is a hallmark in early childhood and predicts a range of socio-emotional, academic, and health-related outcomes across the lifespan (Moffitt et al., 2011; Neuenschwander et al., 2012; Valiente et al., 2013). Because of the high relevance of self-regulation, understanding how parents support their children and which factors explain parental co-regulation is essential. A small number of studies suggest that parents' implicit theories, the belief about the malleability of abilities (Dweck & Leggett, 1988), are related to parental co-regulation (e.g., Haimovitz & Dweck, 2016; Matthes & Stoeger, 2018; Moorman & Pomerantz, 2010).

Across diverse contexts, implicit theories have been demonstrated to predict distinct self-regulatory processes (Burnette et al., 2013). Much of the existing research concerning parents' implicit theories has centered on school-age children. However, child self-regulation already rapidly develops during preschool age (Bronson, 2000; Flavell, 1977; Garon et al., 2008; Montroy et al., 2016), and the impact of parents' co-regulation is substantial in this period (Valcan et al., 2018). Therefore, investigating implicit theories as influencing factors of parental co-regulation is of high interest to better understand the role of parental co-regulatory behavior in preschoolers' self-regulation. To contribute to this research field, this dissertation examines the interplay of parents' implicit theories, co-, and self-regulatory processes in preschool children.

The following chapters introduce the central concepts of this dissertation: implicit theories (Chapter 2) and co- and self-regulation in the parent-child dyad (Chapter 3). Then, the dissertation gives an overview of the current research field linking implicit theories, co-, and self-regulation (Chapter 4), and presents the arising research gaps and questions (Chapter 5). After that, it describes the main findings (Chapter 6) of the three empirical papers within this dissertation (see Appendices A, B, and C), and discusses their implications for theory, practice, and further research (Chapter 7).

2 Implicit Theories

Implicit theories of individuals about whether abilities are malleable and thus potentially increasable or are rather stable and thus fixed influence behavior and experience in many ways. This chapter introduces the concept of implicit theories. First, it describes what implicit theories are and which definitions exist. Then, the social-cognitive model by Carol Dweck is presented, and different domains of implicit theories are reviewed.

2.1 Terminology

Along with the broad interest of researchers and different approaches to the topic of implicit theories, numerous terms related to this construct exist in the research literature: implicit theories, meaning systems, worldviews, mindsets, self-theories, naïve theories, lay theories, and implicit beliefs (for a review, see Lüftenegger & Chen, 2017). The various terms originate from different psychological disciplines. For example, social psychological researchers predominantly use the terms naïve theories and lay theories (e.g., Wesnousky et al., 2015). In contrast, the terms implicit theories and mindsets can be found in educational (e.g., Karlen & Hertel, 2021) and developmental psychology literature (e.g., Blackwell et al., 2007), and will be used within this dissertation.

Implicit theories were initially introduced by Carol Dweck and her colleagues and are defined as "core assumptions about the malleability of personal attributes" (Lüftenegger & Chen, 2017, p. 100). These beliefs are typically not consciously formed or reflected and are, therefore, "implicit." They are called "theories" because they are used as frameworks for judging and classifying one's environment like a scientific theory (Spinath & Schöne, 2003). Dweck and colleagues conceptualize implicit theories along a continuum with incremental and entity theories as two ends of a bipolar construct (e.g., Dweck & Leggett, 1988). Individuals with *incremental theories* assume that abilities (e.g., intelligence) are not stable but can be developed by effort (e.g., "You can always greatly change how intelligent you are," Dweck, 2000). In contrast, individuals with *entity theories* view abilities as fixed or uncontrollable traits (e.g., "You have a certain amount of intelligence, and you really cannot do much to change it," Dweck, 2000).

In the last decade, the term *mindset* has found increasing utilization in more and more publications (e.g., Andersen & Nielsen, 2016; Compagnoni et al., 2019; Haimovitz & Dweck, 2016, 2017; Moorman & Pomerantz, 2010; Mrazek et al., 2018; J. Zhang et al., 2020). Mindset

is often a synonym for implicit theories (Bostwick et al., 2017; Lüftenegger & Chen, 2017). Its application is particularly prevalent in popular science literature (e.g., Dweck, 2008b; Ricci, 2016). Nevertheless, the scientific literature lacks a clear definition of this term. It represents a broader construct and does not explicitly include the three aspects (theory, intuitive, unaware) of implicit theories (Lüftenegger & Chen, 2017). However, in analogy to implicit theories, a distinction between *growth mindsets* and *fixed mindsets* is made (Lüftenegger & Chen, 2017; Tarbetsky et al., 2016). How these mindsets (or implicit theories) orient individuals toward goals and predict behavioral patterns is described in the social-cognitive model (Dweck & Leggett, 1988) in the next section.

2.2 The Social-Cognitive Model

The social-cognitive model of achievement motivation by Dweck and colleagues (Dweck, 1986; Dweck & Leggett, 1988) describes how individuals behave in the face of difficulties and failures as a function of implicit theories. As Table 1 shows, individuals pursue different goals depending on their implicit theory. At the same time, implicit theories are independent of perceived abilities: Individuals with incremental theories can perceive their abilities as high or low, as can individuals with entity theories. However, only the combination of entity theories and a low assessment of their present ability level leads to helplessness in the face of failure.

Table 1

The Social-Cognitive Model by Dweck (following Dweck & Leggett, 1988)

Implicit theory	**Goal orientation**	**Perceived present abilities**	**Behavior pattern**
Incremental →	Learning goals	High →	Mastery
		Low →	Mastery
Entity →	Performance goals	High →	Mastery
		Low →	Helplessness

Dweck explains this pattern with the concept of goal orientation. *Goal orientation* describes individual motivation frameworks for specific goals and is a crucial antecedent of behavior in learning and achievement settings (Carver & Scheier, 1998; Dweck & Leggett, 1988). Individuals with incremental theories tend to pursue learning goals. *Learning goals* characterize the efforts to increase knowledge or competence (Elliot, 1999). Incremental theories favor the adoption of learning goals because if individuals view abilities as malleable,

difficult situations appear as learning opportunities. In contrast, individuals with entity theories tend to pursue performance goals. *Performance goals* describe the efforts to show one's abilities or hide insufficient abilities (Elliot, 1999). If individuals see abilities as stable, they try to demonstrate high performances (performance-approach goals) or conceal lacking abilities (performance-avoidance goals).

In the face of challenges, two behavior patterns result from different combinations of implicit theories, goal orientation, and perceived abilities. Individuals with incremental theories and learning goals will display mastery-oriented behavior, independently of their perceived abilities. *Mastery-oriented behavior* is characterized by seeking challenges and high persistence. When pursuing a learning goal orientation, individuals interpret difficulties as feedback of low present abilities. However, when individuals perceive abilities as malleable, further efforts should be successful. Individuals with entity theories will only display mastery-oriented behavior if the perceived present abilities are high. Guided by performance goals and the belief in their own abilities, these individuals will continue to strive. In contrast, when the perceived present abilities are low and perceived as stable, individuals will display helpless-oriented behavior. *Helpless-oriented behavior* involves the avoidance of challenges and low persistence.

The social-cognitive model has significantly inspired the research field of implicit theories (for a meta-analysis, see Burnette et al., 2013). However, empirical studies could not consistently confirm the postulated links of the model. For example, findings concerning the strong relationship between implicit theories and goal orientation are inconsistent. Whereas some studies have provided evidence for these proposed relationships (e.g., Kray & Haselhuhn, 2007; Mangels et al., 2006; Robins & Pals, 2002), others have demonstrated null effects (e.g., Dupeyrat & Mariné, 2005; Maurer et al., 2002; Sarrazin et al., 1996). The following section summarizes empirical findings in more detail and addresses different domains of implicit theories.

2.3 Implicit Theories of Different Domains

Building on the theoretical assumptions of the social-cognitive model, Carol Dweck and colleagues started to examine children's implicit theories of intelligence and their effects on persistence and helpless responses to setbacks (Dweck, 1986; Dweck & Leggett, 1988). Many researchers followed this tradition and have focused on implicit theories of intelligence (e.g., Blackwell et al., 2007; A. Costa & Faria, 2018; Dinger & Dickhäuser, 2013; Diseth et al., 2014;

Jiang et al., 2019; Moorman & Pomerantz, 2010). Across a range of studies, research highlights the important effects of these implicit theories on academic functioning: Incremental theorists, relative to entity theorists, have shown to be more motivated to engage in challenges and master difficulties (Dweck, 2000), predicting better academic performances (Sisk et al., 2018), particularly in the face of challenges (e.g., Blackwell et al., 2007; Dweck & Leggett, 1988; Molden & Dweck, 2006). Implicit theories of intelligence also relate to emotional outcomes such as subjective well-being (King, 2017), negative affect (Pekrun, 2006), and self-esteem (Diseth et al., 2014; Robins & Pals, 2002). For instance, King et al. (2012) have found that holding an entity theory of intelligence positively predicts negative emotions, including anger, anxiety, shame, and boredom while learning.

Individuals can hold different theories in different domains simultaneously (Hertel & Karlen, 2021; Schroder et al., 2016). In the last decades, an increasing interest in other domains of implicit theories has been remarked, distinguishing between *domain-general* implicit theories, such as willpower (Job et al., 2015), learning (Levinthal et al., 2021), or failure (Haimovitz & Dweck, 2016), and *domain-specific* implicit theories, such as writing competence (Karlen & Compagnoni, 2017), math and verbal skills (Muenks et al., 2015), or self-regulated learning (Hertel & Karlen, 2021). Several researchers argue that domain-specific implicit theories are better suited to predict domain-specific behavior than domain-general implicit theories (e.g., Bråten & Strømsø, 2005; Burnette et al., 2013; Hertel & Karlen, 2021; Karlen & Compagnoni, 2017; Schroder et al., 2016). For instance, Hertel and Karlen (2021) have demonstrated that implicit theories of self-regulated learning are more strongly linked to aspects of students' self-regulated learning than implicit theories of intelligence. In addition to the malleability of abilities, some authors distinguish further dimensions of implicit theories, such as the relevance of abilities for special purposes (Hertel & Karlen, 2021; Spinath, 2001) or the compensability of abilities (Spinath & Schöne, 2003).

Implicit theories are often conceptualized at a dispositional level (Dweck, 2008a) and tend to be stable over time (Robins & Pals, 2002). However, they can also be situationally changed by brief instructions in the laboratory (Miele & Molden, 2010; Moorman & Pomerantz, 2010) and taught in intervention programs (Aronson et al., 2002; Blackwell et al., 2007; Yeager et al., 2016). Given the relevance of implicit theories, an important question relates to the socialization of implicit theories, namely, where implicit theories "naturally" come from. Several researchers have argued that children adopt the implicit theories of their parents and teachers (e.g., Haimovitz & Dweck, 2017; Matthes & Stoeger, 2018; Sun, 2015). Empirical evidence, however, does not show a consistent set of findings. In fact, in several studies,

parents' (and teachers') implicit theories (of intelligence) were not significantly linked to children's implicit theories (e.g., Gunderson et al., 2013; Haimovitz & Dweck, 2016, 2017; Park et al., 2016). Haimovitz and Dweck (2016, 2017) argue that implicit theories of intelligence are not visible to children and introduce another domain of parental theories: a parent's *failure mindset*. Failure mindsets refer to the question of whether failure is something that enhances learning and growth (a *failure-is-enhancing mindset*; e.g., "The effects of failure are positive and should be utilized") or something that inhibits these outcomes (a *failure-is-debilitating mindset*; e.g., "The effects of failure are negative and should be avoided"). In a set of studies, Haimovitz and Dweck (2016) demonstrate that these failure mindsets are differently related to parental practices, which seem to shape children's implicit theories.

So far, (educational) research has primarily focused on implicit theories of primary, secondary, and university students and their outcomes on students' learning and academic achievements (e.g., Blackwell et al., 2007; Bråten & Strømsø, 2005; A. Costa & Faria, 2018; Hertel & Karlen, 2021; Matthes & Stoeger, 2018; Yeager et al., 2016). Starting from the question about the socialization of implicit theories, parents have gained growing attention in research. Initially, researchers have examined parents as pedagogical agents who prime children's beliefs (e.g., Haimovitz & Dweck, 2016). Increasingly, parents' implicit theories are studied as predictors of parenting behaviors. For example, initial studies examine how parents' implicit theories affect child outcomes through parental learning-related co-regulatory behaviors (e.g., Matthes & Stoeger, 2018; Moorman & Pomerantz, 2010). These studies are reviewed in Chapter 4. First, the following chapter describes parental co-regulation and its role in child self-regulation in more detail.

3 Co- and Self-Regulation in the Parent-Child Dyad

Parents play a fundamental role in children's socialization. Especially with regard to self-regulation, parents contribute substantially to children's development. This chapter illustrates the interplay of co- and self-regulatory processes in parent-child dyads. For this purpose, first, different concepts and models of self-regulation are presented, and the relevance and development of self-regulation are explained. Then follows an introduction to parental co-regulation and an overview of the relevance of co-regulation for child self-regulation.

3.1 Self-Regulation

3.1.1 Concepts and Models of Self-Regulation

In recent decades, the concept of self-regulation has received considerable attention in academia and has been identified as a central construct in psychology (Vohs & Baumeister, 2013). Many disciplines have conducted parallel research on the topic (Miyake & Friedman, 2012), resulting in different approaches and definitions of self-regulation. Within psychological research, self-regulation has been studied from a neuropsychological (*executive functions*; Barkley, 2001; Diamond, 2013), temperamental (*effortful control*; Rothbart, 1989), affective (*emotion regulation*; Gross, 2014), motivational (*self-control*; Vohs & Baumeister, 2013), and learning perspective (*self-regulated learning*; Pintrich et al., 1993; Zimmerman, 2000). While some researchers are primarily concerned with describing skills or competencies (e.g., Pauen, 2016; Posner & Rothbart, 2000), others are more interested in processes or states (e.g., Carver & Scheier, 1998; Schmeichel & Baumeister, 2004; Zimmerman, 2000). Accordingly, self-regulation is often used as an umbrella term covering different aspects of adaptive behavior (e.g., Matthews et al., 2000). For this dissertation, self-regulation is defined as controlling one's thoughts, emotions, and behaviors to achieve a goal (e.g., Posner & Rothbart, 2000; Zimmerman, 2000).

A frequently described analogy of self-regulation is the heating thermostat. The thermostat is set to a desired temperature (set value, the *setting* process) and continuously measures the current room temperature (actual value, the *monitoring* process). In a negative discrepancy (i.e., room temperature is too cool), heating is activated (the *operating* process). When the desired temperature is reached, the heat supply turns off because there is no difference between the actual and set value. Carver and Scheier (1998) have applied this analogy to human

behavior and identified the three core processes of self-regulation: goal setting (e.g., learning goals, performance goals), goal operating (e.g., mastery-oriented, helpless-oriented strategies), and goal monitoring (e.g., expectations, emotions), describing a feedback loop model of self-regulation. This understanding of self-regulation has been adopted and developed in further process models of self-regulation (e.g., Pintrich, 2004; Schmitz & Wiese, 2006; Sitzmann & Ely, 2011; Zimmerman, 2000). One of the most cited process models is Zimmerman's cyclical phases model (2000), organized into three phases: forethought, performance, and self-reflection. During the *forethought* phase, learners analyze the task, set goals, and choose learning strategies to reach the goals. Self-motivation beliefs (e.g., self-efficacy, outcome expectations, intrinsic interest, goal orientation) build the basis of this phase and influence goal setting and learning strategies. The *performance* phase comprises the execution of the task while monitoring the task progress, self-controlling the effectiveness of strategies, and staying motivated and cognitively engaged. Finally, during the *self-reflection* phase, learners evaluate the performance by comparing actual and set values. They attribute success or failure and generate self-reactions that influence how they will approach the task in later performances. In contrast to process models, component models do not focus on the sequence of the learning process but emphasize different levels and components of self-regulation (e.g., Boekaerts, 1999). However, the numerous definitions and models have in common that they underline three relevant components of self-regulation: cognition (e.g., learning strategies), metacognition (e.g., planning, monitoring, evaluation), and motivation/ volition (e.g., initiative, concentration, persistence; e.g., Dermitzaki et al., 2009).

Three components of self-regulation (cognitive, metacognitive, and motivational strategies) are also distinguished with regard to child self-regulation (Dermitzaki et al., 2009). Cognitive strategies include conceptual and strategic knowledge, such as analyzing and combining tasks or recognizing relevant features of the task. Metacognitive strategies include activities aimed at planning the procedure, self-observation (monitoring), and evaluation of the results. Finally, motivational strategies serve to initiate and maintain self-motivation to maintain interest in the task and remain persistent (Dermitzaki et al., 2009). These strategies have been studied primarily in school-age children (e.g., Dermitzaki et al., 2009; Dignath et al., 2008; Roebers et al., 2014). Initial studies indicate that these strategies can already be observed in preschool children (H. Zhang & Whitebread, 2017) and improved through training (e.g., Perels et al., 2009; Perels & Dörr, 2019).

In research on self-regulation in preschool age, the concept of executive functions has received great attention. Executive functions (EF) can be understood as an umbrella term for

higher-order cognitive processes, which include, for example, inhibitory control (e.g., stopping and overriding a dominant impulse), working memory (e.g., memorizing rules), and cognitive flexibility (e.g., adapting to new rules; Moriguchi & Hiraki, 2013; Roebers, 2017; Willoughby & Blair, 2016). The outcomes of the cognitive processes are manifested mainly at the behavioral level. Thus, executive functions are usually assessed by behavioral measures and are often a synonym for behavioral (or behavioral-related) self-regulation in neuropsychology (Blair & Razza, 2007).

3.1.2 The Relevance and Development of Child Self-Regulation

The ability of self-regulation begins to develop in early childhood and is one of the hallmarks of child development and socialization (Flavell, 1977; Garon et al., 2008; Kopp, 1982; Montroy et al., 2016). The perception and regulation of one's cognitions, emotions, and behaviors are central development tasks (Whitebread, 2019). Successful self-regulation enables goal-directed behavior (Mulder et al., 2009) considered a prerequisite for pursuing long-term goals (Hofmann et al., 2009). A sizeable body of evidence shows that high levels of self-regulation in early childhood predict a range of academic, social-emotional, and health-related outcomes throughout the life span (Blair & Raver, 2015; Blair & Razza, 2007; Gestsdottir et al., 2014; McClelland et al., 2007; Mischel et al., 2011; Moffitt et al., 2011; Neuenschwander et al., 2012; Ponitz et al., 2009; Roebers et al., 2014). High self-regulatory abilities have been linked to positive effects in the school context independent of intelligence (A. L. Duckworth et al., 2010; A. L. Duckworth & Seligman, 2005; Neuenschwander et al., 2012) and serve as a resilience factor for adverse effects of low socioeconomic status (Blair & Raver, 2015; Pino-Pasternak et al., 2019; Sektnan et al., 2010).

During the early years of life, there is tremendous progress in children's self-regulatory development. Taking an ontogenetic perspective, Kopp (1982) describes how self-regulation progresses from early infancy to the beginning of preschool age. In the early months of life, reflex movements (e.g., turning away from intrusive stimuli) and modulations of arousal states (e.g., self-soothe by thumb-finger sucking) can be observed. Then, infants increasingly modulate sensorimotor behaviors to external stimuli (e.g., reach and grasp). Between twelve and 18 months, children become aware of social and task demands (e.g., defined by caregivers) and learn to control behavior by acting according to these demands. Around 24 months of age, children become able to self-control, which describes behaving according to social expectations and rules even in the absence of parents as external monitors. Children can now control their

actions and delay their impulses over a specific time (e.g., delay of gratification; Kochanska et al., 2001). From three years onwards, children learn to consciously generate and flexibly use different self-regulatory strategies in different situations (Kopp, 1982). Compared to infants and toddlers, preschool and kindergarten children show better control of attention, monitoring, and adoption of strategies (Bronson, 2000). Their focus gradually shifts from exploring a task to achieving goals. Advances in language, cognitive capacity, and effortful control guide children's developmental progress in self-regulation (Bronson, 2000).

In child self-regulatory development, large interindividual differences can be observed. The development of self-regulation depends on an interaction of genetic dispositions (e.g., Eisenberg et al., 2010; Goldsmith et al., 2008), biological factors (e.g., brain maturation in the prefrontal lobe; Moriguchi & Hiraki, 2013), environmental factors (e.g., socioeconomic status; Lengua et al., 2015), child temperament (Rothbart & Bates, 2006), and parenting behaviors (Fay-Stammbach et al., 2014; Valcan et al., 2018). As explained in the following sections, positive parenting behaviors can positively influence child self-regulation by serving as good role models (Bandura, 1977, 1997) and being internalized by children (Demetriou, 2000).

3.2 Parental Co-Regulation

Despite the dramatic improvements in self-regulatory abilities during early childhood (for a review, see Diamond, 2013; Garon et al., 2008), children are still dependent on the support of parents or other caregivers – referred to as co-regulation. Parental *co-regulation* is a broad term that encompasses various behaviors to regulate children's internal states (e.g., Evans & Porter, 2009; Fogel, 1993) and can be categorized into socioemotional and instructional parenting behaviors (Pino-Pasternak & Whitebread, 2010; Valcan et al., 2018).

Socioemotional parenting behaviors contain warmth (e.g., encouragement, affection; Maccoby & Martin, 1983), responsiveness (i.e., appropriate, timely, contingent responses to child's needs/ feelings; Landry et al., 2006), and control (e.g., force, harsh discipline, punishments; Rhee et al., 2015; Roskam et al., 2014). Concerning effects on child development, these behaviors can be divided into positive and negative parenting behaviors (Blair et al., 2011; Valcan et al., 2018). Positive parenting behaviors involve warmth and responsiveness (Bindman et al., 2015; Blair et al., 2011; Valcan et al., 2018), and negative parenting behaviors involve intrusiveness and control (Blair et al., 2011; Meuwissen & Carlson, 2015; Valcan et al., 2018).

Instructional parenting behaviors primarily refer to instructional settings and problem-solving situations where parents support children's cognitive processes, so-called scaffolding.

The concept of *scaffolding* originates from Wood and colleagues (1976), who adapted the scaffolding metaphor to explain the interactive process between adults and children during joint problem-solving activities. The metaphor originates from the construction field, where a scaffold is erected as a temporary structure to build a new structure. Transferred to learning, parents or teachers give temporary support to solve a task that would not yet be possible without support. According to the socio-cultural theory by Vygotsky (1978), learning takes place within the *zone of proximal development* (ZPD), characterized as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). Scaffolding can be understood as strategies used within the ZPD to support development (Mermelshtine, 2017). In a series of studies, Wood and colleagues (1976) identified six scaffolding functions: recruitment of interest, task simplification, direction maintenance, marking critical features, frustration control, and demonstration.

Within the last decades, scaffolding has been studied in various educational and psychological research contexts, resulting in different approaches and operationalizations of scaffolding (Granott, 2005; Mermelshtine, 2017; van de Pol et al., 2010). While some researchers are interested in the processes (e.g., contingency; Bernier et al., 2010; Carr & Pike, 2012; Conner & Cross, 2003) or single aspects of scaffolding (e.g., verbal scaffolding; Landry et al., 2002), others examine scaffolding multidimensionally (e.g., cognitive support, emotional support, transfer of responsibility; Bernier et al., 2010; Neitzel & Stright, 2003). Van de Pol et al. (2010) synthesize the different approaches to an integrative scaffolding framework, including scaffolding intentions, scaffolding means, and the process of scaffolding. *Scaffolding intentions* refer to the activities that are scaffolded, such as children's cognitive (e.g., marking critical features), metacognitive (e.g., planning, monitoring, and evaluating the progress), and affective activities (e.g., frustration control, recruitment of interest). *Scaffolding means* describe how the learning activities are supported, for example, by feedback, hints, instructions, explanations, modeling, and questioning. Combining scaffolding intentions with scaffolding means construe different scaffolding strategies that allow illustrating interaction processes more precisely (Erdmann et al., 2019; van de Pol et al., 2010). The *scaffolding process* is characterized by adjusting the responses to the child's developmental level (contingency), gradually fading out as the child's abilities increase (e.g., providing fewer specific instructions) and transfer more responsibility (e.g., encouraging the child's choices) to enhance child's development (Leith et al., 2018; Mermelshtine, 2017; van de Pol et al., 2010).

3.3 The Relevance of Parental Co-Regulation for Child Self-Regulation

As emphasized in socio-cultural theories, children are assumed to internalize their parents' instructions and co-regulatory strategies and gradually become independent learners (Bernier et al., 2010; Vygotsky, 1978). Several correlational and longitudinal studies indicate direct and indirect relationships between dimensions of parental co-regulation and child self-regulation (e.g., Bernier et al., 2010; Devine et al., 2016; Fay-Stammbach et al., 2014; Hughes & Devine, 2019). Some recent studies indicate bidirectional relationships, showing that children's self-regulation predicts changes in parents' co-regulatory behaviors (e.g., Eisenberg et al., 2010; Merz et al., 2017). Nevertheless, most evidence confirms the unidirectional effects of parent co-regulation on child self-regulatory development, identifying parental co-regulation as a significant predictor of children's later self-regulatory abilities (Colman et al., 2006; Karreman et al., 2006). In this process, children adopt a range of self-regulatory strategies that they can use with increasing flexibility in different situations (Kopp, 1982).

The relevance of parental co-regulation has been examined in different age groups of children, and different conceptualizations of child self-regulation and parental co-regulation have been used. For example, Valcan and colleagues (2018) have conducted a meta-analysis with 42 studies, analyzing the relation between parenting behaviors and EFs in children between 0 and 8 years old. Results indicate that a greater incidence of positive parenting behaviors is associated with higher levels of children's EF, whereas negative parenting behaviors are associated with low child EF (Valcan et al., 2018). Regarding the relationship between EF and cognitive co-regulation (i.e., scaffolding), the researchers emphasize the moderating role of child age: With increasing age, the strength of the positive association between EF and cognitive co-regulation diminishes. This effect may be attributed to greater brain plasticity and a higher susceptibility to environmental experiences during the earlier years (Kolb & Gibb, 2011; Valcan et al., 2018). However, the relevance of scaffolding for child developmental outcomes (e.g., EF, cognitive skills, academic achievements) is evident in infancy (Dilworth-Bart et al., 2010; Landry et al., 2006; Lowe et al., 2014; Mermelshtine & Barnes, 2016), preschool (Smith et al., 2000), and school-age (Mulvaney et al., 2006). Besides EFs, children's self-regulated learning is addressed in researching preschool and school-age. In a systematical literature review, Pino-Pasternak and Whitebread (2010) establish three parental dimensions (autonomy, challenge, contingency) and six parenting behaviors (metacognitive talk; active participation; understanding of control; shifts in responsibility; emotional responsiveness,

contingent instructional scaffolds) that are differentially related to children's motivational and metacognitive behaviors.

Despite the robust body of evidence on the association between parenting behaviors and child self-regulated learning, several challenges for a better understanding exist, such as the diversity of measures and terms (A. L. Duckworth & Kern, 2011), the lack of conceptual clarity (see Chapter 3.1.1 and 3.2) and theoretical frameworks (Pino-Pasternak & Whitebread, 2010). In addition, the antecedents and determinants of parents' co-regulatory behaviors are insufficiently researched. Belsky (1984) argues that context, child, and parent characteristics are relevant to better understand "why (…) parents parent the way they do" (p. 83; see also Bornstein, 2016 for a review). For example, concerning the context, parents' socioeconomic status (SES) influences parenting behaviors, with lower SES being negatively related to parental scaffolding and warmth (Lengua et al., 2014). Child characteristics mentioned in the literature are, for example, the child's age, gender, temperament, or birth order (see Holden, 2019 for a review). Concerning parent characteristics, parental stress or other mental health issues negatively relate to parenting behaviors and child self-regulation: In particular, when parents are under high levels of stress or psychological distress, the use of effective scaffolding strategies is impeded (Choe et al., 2013). In addition, social cognitions, such as self-efficacy, attitudes, and beliefs, are considered to be of great importance (e.g., Bornstein et al., 2018; Gärtner et al., 2018a; Moorman & Pomerantz, 2010; Sanders & Woolley, 2005). The following chapter addresses parents' implicit theories as social cognitions involved in parental co-regulation and child self-regulation in greater detail.

4 Linking Parental Implicit Theories, Co-Regulation, and Child Self-Regulation

After arguing why parental co-regulation is highly relevant in child (self-regulatory) development, this chapter aims to provide a comprehensive overview of the current state of empirical studies linking two central concepts of the present dissertation: implicit theories and co-regulation. These studies are narratively reviewed and then integrated into the current field of research and theoretical frameworks. Finally, research gaps are identified that will be addressed within this dissertation.

The idea of examining implicit theories as predictors of parental co-regulation is relatively new, and studies addressing this idea have been conducted within the last decade. Table 2 lists the respective studies, sorted chronologically, according to the following criteria: sample size, country, domains of implicit theories, measured construct(s) of parenting behaviors, used methods, and main findings. Instead of presenting the different studies in detail, the following sections provide an overview of the current state of evidence, and similarities and differences between studies are remarked so that research gaps become visible.

Overall, nine studies published between 2010 and 2021 have addressed the relation between parents' implicit theories and parenting behaviors. Data were collected in different cultural contexts and continents, including North America (the United States), Europe (Germany, Portugal, Finland), Asia (China, Japan), and Oceania (New Zealand), with two studies having conducted cross-cultural comparisons (Jose & Bellamy, 2012; Levinthal et al., 2021). Most studies include mothers and fathers (except Moorman & Pomerantz, 2010 who assessed mothers only) of primary school students (Jiang et al., 2019; Jose & Bellamy, 2012; Levinthal et al., 2021; Matthes & Stoeger, 2018; Moorman & Pomerantz, 2010). Some studies contain a broad age range of children (Jarsky, 2019; Study 2 of Muenks et al., 2015) or no inclusion criteria concerning child age (Haimovitz & Dweck, 2016; Rutledge et al., 2018; Study 1 of Muenks et al., 2015). Several researchers have assessed domain-general implicit theories such as parents' implicit theories of intelligence (Jarsky, 2019; Jiang et al., 2019; Jose & Bellamy, 2012; Moorman & Pomerantz, 2010; Muenks et al., 2015), implicit theories about learning and general school abilities (Levinthal et al., 2021; Matthes & Stoeger, 2018), implicit personality theories (Rutledge et al., 2018), and failure mindsets (Haimovitz & Dweck, 2016; Jarsky, 2019). Other researchers have taken a more domain-specific approach and assessed parents' implicit theories about their children's math and verbal abilities (Muenks et al., 2015).

Two studies have simultaneously considered two domains of implicit theories (Jarsky, 2019; Muenks et al., 2015). Regarding parenting behaviors, researchers have concentrated on mastery- vs. performance-oriented behaviors (Haimovitz & Dweck, 2016; Moorman & Pomerantz, 2010; Muenks et al., 2015), involvement in child education (Jarsky, 2019; Jiang et al., 2019; Levinthal et al., 2021), reactions to frustration (Jose & Bellamy, 2012), or negative parenting behaviors (such as control and harsh parenting; Jarsky, 2019; Matthes & Stoeger, 2018; Rutledge et al., 2018). A superior number of studies have captured implicit theories and parenting behaviors using questionnaires. In two studies, implicit theories were experimentally manipulated (Haimovitz & Dweck, 2016; Moorman & Pomerantz, 2010). Only one study has observed and coded mothers' involvement in mother-child interaction (Moorman & Pomerantz, 2010). Few studies have also focused on children's behavioral measures, such as helplessness (Moorman & Pomerantz, 2010) and persistence (Jose & Bellamy, 2012), or child academic achievements (Matthes & Stoeger, 2018).

Table 2

Overview of Existing Studies Linking Parental Implicit Theories and Parenting Behaviors

Study	Sample	Implicit theories	Parenting behaviors	Method	Main Results
Moorman & Pomerantz (2010)	79 mothers and their 6–9-year-old child (USA)	IT of intelligence	Unconstructive (e.g., control, performance-oriented) and constructive involvement (e.g., mastery-oriented)	Experiment, behavioral coding, self-report questionnaires	Mothers induced to hold an entity theory (vs. incremental theory) showed more unconstructive involvement and also responded to children's helplessness more unconstructively
Jose & Bellamy (2012)	197 parents and their 7–8-year-old child (New Zealand, USA, China, Japan)	IT of intelligence	Reactions to frustration	Learned helplessness paradigm, self-report questionnaires	Parent persistence and encouragement mediated the positive link between parents' incremental theory and child persistence
Muenks et al. (2015)	Study 1: 300 parents (child age: 1–47 years) Study 2: 109 parents of 6–12-year-old children (USA)	IT of intelligence, IT of math and verbal abilities	Mastery-oriented and performance-oriented behavior	Hypothetical scenarios, self-report questionnaires	Parents' entity theories were negatively related to mastery-oriented and positively to performance-oriented behaviors

Study	Sample	Implicit theories	Parenting behaviors	Method	Main Results
Haimovitz & Dweck (2016)	132 parents[1] (Study 4; USA)	Failure mindsets	Performance-oriented and learning-oriented behaviors	Experiment, hypothetical scenario, self-report questionnaires	Parents induced to hold a failure-is-enhancing mindset (vs. failure-is-debilitating mindset) reported more learning-oriented responses; Parents induced to hold a failure-is-debilitating mindset (vs. failure-is-debilitating mindset) reported more performance-oriented responses
Matthes & Stoeger (2018)	723 parents of fourth-graders (Germany)	IT about child's ability for school	Homework-related conflict, controlling behavior	Self-report questionnaires	Parents' incremental theories predicted less homework-related conflict and less controlling behavior; Parenting behaviors (partially) mediated the link between parents' incremental theories and child academic achievement
Rutledge et al. (2018)	187 parents (M_{age} = 35.4 years) (USA)	Implicit personality theories	Harsh parenting practices	Self-report questionnaires	Parents with entity theories were more likely to select harsh parenting strategies
Jiang et al. (2019)	1,694 pairs of mothers and fathers of 9–11-year-old children (China)	IT of intelligence	Parental involvement in child education	Self-report questionnaires	Mother's implicit theory related to both paternal and maternal involvement, while father's implicit theory related to paternal involvement only; Congruence and discrepancy of parents' IT were differently related to involvement
Jarsky (2019)	234 parents of school-age children (any grade from 1–12) (USA)	IT of intelligence, failure mindsets	Homework-related conflict, controlling behavior	Self-report questionnaires	Parents' IT of intelligence, failure mindsets, and parental controlling behavior predicted homework-related conflict
Levinthal et al. (2021)	19 parents of first- to sixth-graders (Finland, Portugal)	IT about learning	Parental engagement in the home learning environment	Qualitative study, semi-structured interviews	Parents' incremental theories were related to higher engagement with their children's learning

Note. [1]no further demographic information is available. IT = implicit theories.

Across all studies and independent of the domains of implicit theories and aspects of parenting behaviors, parents' entity theories were significantly related to more performance-oriented and negative parenting behaviors. In contrast, incremental theories were positively linked to mastery-oriented behaviors. These findings are consistent with the meta-analytic results by Burnette et al. (2013), including 113 studies across diverse achievement domains and populations. Based on self-control theory (Carver & Scheier, 1998), Burnette and colleagues (2013) introduce the SOMA (setting/operating/monitoring/achievement) model, a theoretical framework for investigating associations of implicit theories with the self-regulatory processes of goal setting (performance and learning goals), goal operating (helpless and mastery strategies), and goal monitoring (negative emotions and expectations), which, in turn, predict goal achievement (see Figure 1). The meta-analytical results indicate that incremental theories (vs. entity theories) relate to goal setting (performance goals, $r = -.151$; learning goals, $r = .187$), goal operating (helpless-oriented strategies, $r = -.238$; mastery-oriented strategies, $r = .227$), and goal monitoring (negative emotions, $r = -.233$; expectations, $r = .157$).

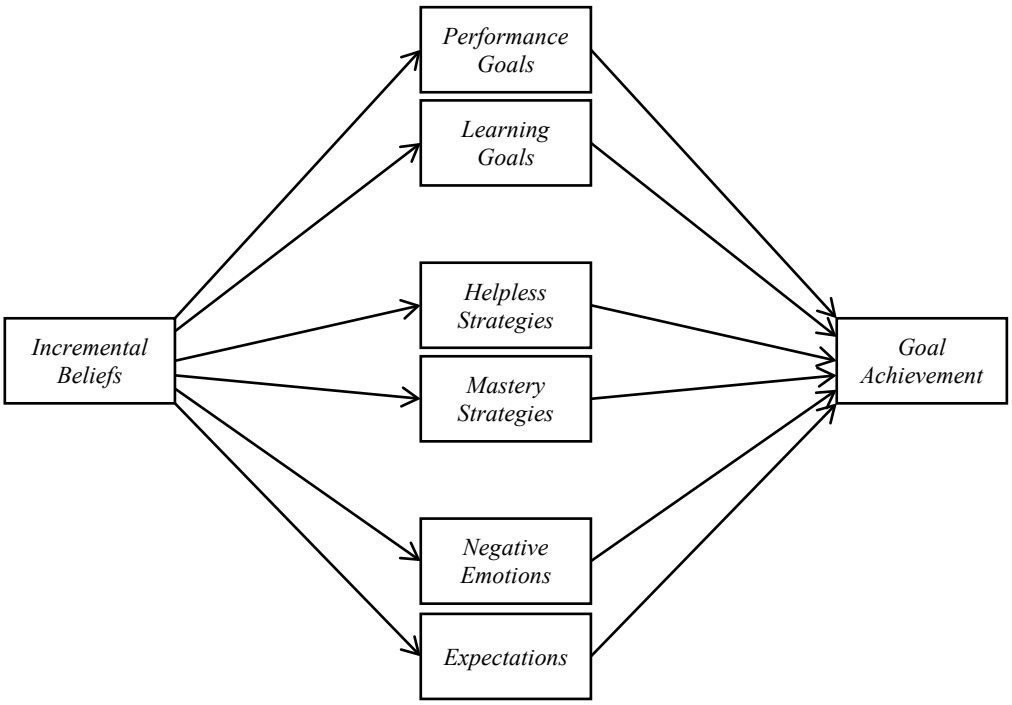

Figure 1. SOMA (setting/operating/monitoring/achievement) model linking implicit theories and self-regulation by Burnette et al. (2013).

Notably, the meta-analytical results indicate that the adoption of mastery-oriented strategies predicts goal achievement ($r = .314$) and strongly mediates the link between implicit theories and achievement. Transferring this model to the above-described studies with child

behavior as goal achievement, it also becomes evident that parents' strategies (i.e., parenting behaviors) mediate the relationship between parents' implicit theories and child behavior (Jose & Bellamy, 2012; Matthes & Stoeger, 2018). However, the SOMA model only describes the links between implicit theories and self-regulation within-subject and does not refer to interactions between subjects. The idea of how parents' beliefs and behavior affect child outcomes is picked up in the three-term standard model of 'parenting cognitions → parenting practices → child adjustment' by Bornstein et al. (2018). The researchers tested this model in an eight-year longitudinal study. They found that parenting cognitions (knowledge, satisfaction, attributing successes) when toddlers were 20 months old predicted increased supportive parenting behaviors when children were four and six years old. Parenting behaviors, in turn, predicted lower classroom externalizing behavior at ten years, independent of several child, parent, and family covariates.

In conclusion, increasing evidence indicates an association between parental implicit theories and co-regulation. Nevertheless, research on this topic is still at the beginning, and at least three research gaps for future research can be identified. First, the studies have mainly examined single domains of implicit theories, focusing on intelligence theories. However, individuals can hold different theories in different domains at the same time (Schroder et al., 2016). This raises questions about how different domains interact and whether certain domains are better suited to predict specific behavior (e.g., Bråten & Strømsø, 2005; Hertel & Karlen, 2021). Second, primarily the parent perspective has been taken into account, and effects on children have been neglected. Following the three-term standard model (Bornstein et al., 2018), studies examining the cascade of parents' implicit theories, parenting behaviors, and child outcomes are highly needed. When looking at child outcomes, distinctions between relevant aspects of self-regulation (e.g., cognitive, metacognitive, motivational; Dermitzaki et al., 2009) are still required (Pino-Pasternak & Whitebread, 2010; Veenman et al., 2006). In addition, there is a great conceptual diversity in terms of parenting behaviors, and underlying theoretical frameworks of how different behaviors interact to affect child behavior are lacking. Third, all presented studies have been conducted in a school context. Parental co-regulation is especially crucial in early childhood and child self-regulation rapidly develops during preschool age (cf. Chapter 3). Therefore, research linking parents' implicit theories to parental co-regulation and child self-regulation in parents of preschoolers is desired. Taken together, this chapter demonstrated the need for further theoretical and empirical efforts, particularly in terms of further domains of implicit theories, relations between parenting behaviors and child outcomes, as well as transferring the previous studies to the context of preschool children.

5 Aims, Research Questions, and Empirical Framework

This dissertation aims to investigate the interplay of parents' implicit theories, co-, and self-regulatory processes in preschool children. For this purpose, the SOMA model by Burnette et al. (2013) is adapted and transferred to parent-child interactions (see Figure 2).

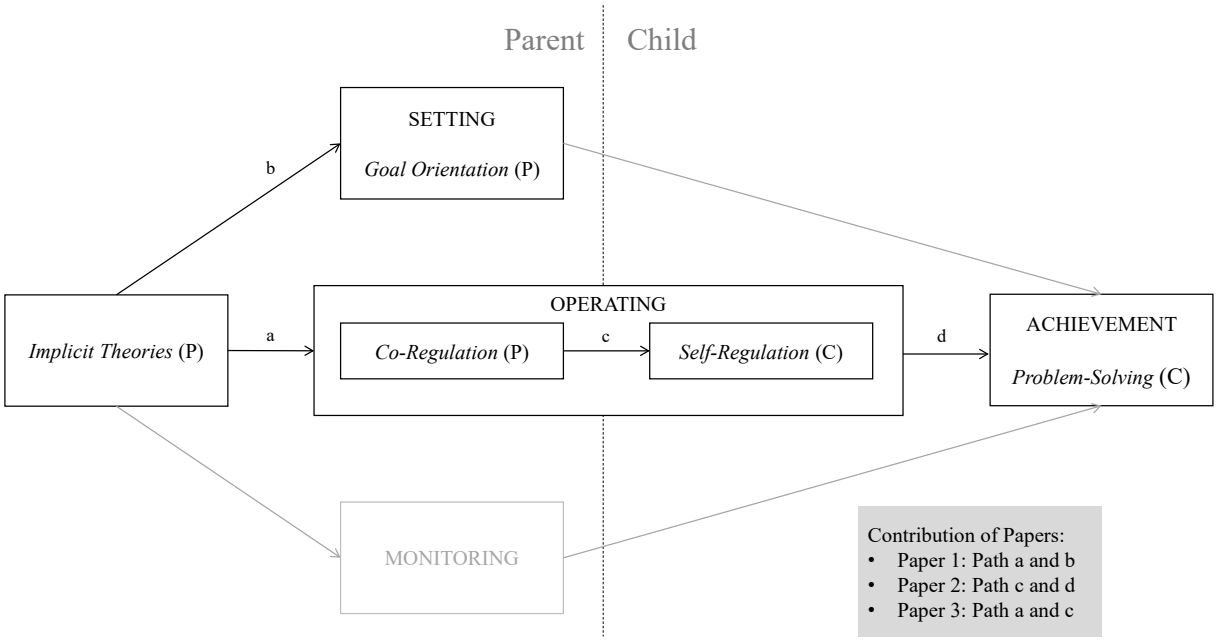

Figure 2. Conceptual model linking implicit theories to co- and self-regulatory processes (adapted SOMA model by Burnette et al., 2013) with illustrated contributions of Paper 1-3 of the present dissertation. The grey lines represent links that were not the focus of the present research questions. P = parent level, C = child level.

The adapted SOMA model, depicted in Figure 2, synthesizes the SOMA model (Burnette et al., 2013) with the three-term standard model of 'parenting cognitions → parenting practices → child adjustment' (Bornstein et al., 2018). Based on the SOMA model, implicit theories are linked to the three core processes of self-regulation: goal setting, goal operating, and goal monitoring (cf. Chapter 4). Following the three-term standard model, the adapted SOMA model further distinguishes between a parent and child level, including a parent-child interaction within the core process *operating*. Thus, the model describes how parents' implicit theories affect parental co-regulation, which, in turn, relates to child self-regulation and problem-solving. It has to be acknowledged that the model is a simplification because only linear and unidirectional effects are assumed. However, feedback loops and bidirectional effects are possible (e.g., Eisenberg et al., 2010; Merz et al., 2017). In addition, the papers of this

dissertation primarily focus on the interplay of implicit theories and goal operating (i.e., parental co-regulation and child self-regulation). The process of goal monitoring is not considered in the present papers but should be included in future studies (see Chapter 7.4).

Three major research questions are derived from the adapted SOMA model. First, how do parents' implicit theories relate to (a) parental co-regulation and (b) parental goal orientation? Second, how does parents' co-regulation behavior relate to (c) preschoolers' self-regulation/ self-regulatory strategies and (d) problem-solving performance? The third research question is a combination of questions 1a and 2c and asks whether parental co-regulation mediates the link between parents' implicit theories and child self-regulation.

Concerning the first research question, initial studies have linked parents' implicit theories to parenting behaviors (e.g., Haimovitz & Dweck, 2016; Matthes & Stoeger, 2018; Moorman & Pomerantz, 2010). These studies have been conducted in school contexts and have examined only single domains of implicit theories (for exceptions see Jarsky, 2019; Muenks et al., 2015), focusing on implicit theories of intelligence. However, parenting behaviors play an essential role even at preschool age, especially with regard to children's self-regulatory development. Since domain-specific implicit theories are more suitable for predicting domain-specific behavior, other domains of implicit theories should be considered in addition to intelligence theories. Therefore, in Paper 1, new scales to capture implicit theories of self-regulation were introduced. Paper 1 examined how implicit theories of different domains co-occur in daily life and are linked to parenting behaviors and attitudes (e.g., goal orientation) in parents of preschoolers. To get a window into the causal role of mothers' implicit theories in shaping parenting behaviors, in Paper 3, mothers' implicit theories of different domains (intelligence, failure, self-regulation) were experimentally manipulated, and effects on parenting behaviors were analyzed.

With respect to the second research question, research indicates a relatively robust relationship between parenting behaviors and child self-regulation. However, there is a lack of conceptual clarity and theoretical frameworks to understand the relationship in more detail. For this purpose, in Paper 2, the integrative scaffolding framework by van de Pol et al. (2010) was applied to the parent-child interactions. It was examined how a set of scaffolding means and intentions form scaffolding strategies and are related to children's problem-solving performance and metacognitive strategies.

Finally, and addressing the third research question, previous studies examining the influence of parents' implicit theories have neglected the effects on child outcomes (e.g., Haimovitz & Dweck, 2016; Muenks et al., 2015). Assuming that parents' implicit theories are

involved in the socialization process of children and based on the three-term standard model of 'parenting cognitions → parenting practices → child adjustment' (Bornstein et al., 2018), the third paper of this dissertation was aimed to explore whether parenting behaviors mediate the link between implicit theories and preschoolers' self-regulation.

To answer these research questions, three papers were conducted. Table 3 gives an overview of the study design (i.e., sample, predictor, criterion, method, type of analysis) of all papers within this dissertation. The first paper presents results from an online survey conducted from March 2019 to July 2019. Parents of three- to six-year-old children were recruited through social-network platforms (Germany-wide) and announcements in kindergartens in Heidelberg, the Rhine-Neckar, and Rhine-Main Metropolitan Region. The study comprised a 20-minute online questionnaire measuring parental implicit theories and attitudes, goal orientation, co-regulatory strategies, and parents' perceptions of their child's self-regulatory abilities. Papers 2 and 3 are based on an experimental investigation conducted from January 2019 to June 2021. Recruitment took place by distributing information letters, such as in kindergartens, medical practices, or sports clubs in Heidelberg and the Rhine-Neckar Metropolitan Region. The experiment had a one-factor between-subject design with six mindset conditions: 1) intelligence-is-malleable, 2) intelligence-is-stable, 3) failure-is-enhancing, 4) failure-is-debilitating, 5) self-regulation-is-malleable, and 6) self-regulation-is-stable. Mothers and their four- or five-year-old child were randomly assigned to one condition, and mothers were induced to hold one of these mindsets via cover stories[1]. A multi-method approach was used to gather information at the mother and child level, including video analyses of behavioral measures during problem-solving, questionnaires, and tasks assessing child behavioral self-regulation and vocabulary. After the experimental manipulation, the problem-solving tasks were solved in mother-child interactions for 10 minutes. Mothers were told to help their child but not solve the tasks independently. After joint problem-solving, the children solved the same tasks without help. The problem-solving tasks consisted of recreating two-dimensional figures with triangles that were blue on one side and yellow on the other.

[1] Cover stories were successfully pretested in a pilot study with $N = 40$ parent-child dyads.

Table 3

Overview of the Three Papers Within This Dissertation

Paper	Kind of study	Sample	Predictor	Criterion	Method	Type of analysis
1	Cross-sectional (online survey)	Parents (N = 137)	Implicit theories of intelligence and SR (malleability and relevance)	Demographics, failure mindsets, goal orientation, co-regulatory strategies (mastery-, helpless-oriented strategies)	AR	Latent profile
2	Cross-sectional (video analysis)	Mothers and preschoolers (N = 132)	SCA means, SCA intentions (autonomy, cognitive, metacognitive support)	Metacognitive SR-strategies (C), problem-solving (MC, C)	MCI T	Path model
3	Experiment	Mothers and preschoolers (N = 177)	Implicit theories of intelligence and SR, failure mindsets	Parenting behaviors (autonomy support, intrusiveness, SCA means), SR-strategies (C, cognitive, metacognitive, motivational)	AR MCI T	(M)ANCOVA Planned contrasts

Note. SR = self-regulation; SCA = scaffolding; C = child; MC = mother-child; MCI = mother-child interaction; T = task; AR = adult report; (M)ANCOVA = (multivariate) analysis of covariance

6 Summary of Empirical Findings

The following sections summarize the empirical findings of the three papers that build the core of this dissertation. The summary focuses on describing the objectives, methodology, and results. Further information regarding the design, methods, and statistics are presented in full length in the appendices.

6.1 Paper 1: Profiles of Parents' Beliefs About their Child's Intelligence and Self-Regulation: A Latent Profile Analysis

The first paper aimed to contribute to the question how parents' implicit theories relate to parental co-regulation and goal orientation (Research Question 1). This paper explored parents' naturally occurring implicit theories in more detail by examining two domains (i.e., intelligence, self-regulation) and dimensions (i.e., malleability, relevance) of implicit theories from a person-centered perspective. First, the study examined whether different belief profiles exist. Second, it was analyzed how the emergent belief profiles (1) differ by background variables (e.g., education, child self-regulation) and (2) are linked to parents' attitudes (failure mindsets, goal orientation) and co-regulatory strategies (mastery-oriented, helpless-oriented). Based on previous research, it was argued that implicit theories about the malleability and relevance of different domains co-occur within persons. In addition, it was expected that different belief profiles would be differently (mal)adaptive for parents' attitudes and co-regulatory strategies.

Parents answered an online survey comprising parents' implicit theories, failure mindsets, and goal orientation. Parents' co-regulatory strategies were measured via the IMpulse-MAnagement from Infancy to Preschool questionnaire (IMMA 1-6; Pauen et al., 2019); parents' perception of their child's self-regulatory competence was assessed with the effortful control scale of the Children's Behavior Questionnaire (CBQ; Putnam & Rothbart, 2006).

Results are based on complete data from 137 parents of three- to six-year-old children. Latent profile analyses indicated that three different belief profiles exist, labeled as *Entity Theorists* (profile 1), *Balanced* (profile 2), and *Incremental Self-Regulation Theorists* (profile 3). The minority of parents (9%, $n = 13$) belonged to profile 1. Parents in this profile differed in their beliefs across domains, displaying an entity theory in the domain of self-regulation and an incremental theory in the domain of intelligence. Most parents (61%, $n = 83$) belonged to

profile 2, engaging in balanced levels of both domains (i.e., intelligence and self-regulation were both rated to be more or less equally malleable and relevant for success). About one-third of the sample (n = 41) reported high incremental self-regulation theories (profile 3). The findings reveal that the profiles differed significantly in parents' educational background and child self-regulation: Entity theorists had the lowest scores on these variables compared to parents of the other profiles. The profiles also differed regarding parents' failure mindsets, goal orientation, and co-regulatory strategies: Incremental self-regulation theorists reported more failure-is-enhancing mindsets, less performance-avoidance goals, and more mastery-oriented co-regulatory strategies than parents in the other profiles.

This paper is the first study examining belief profiles in parents. The results confirm that implicit theories from different domains can co-occur within parents. Regarding parents' attitudes and co-regulatory strategies, entity theorists tended to show maladaptive patterns and incremental self-regulation theorists adaptive patterns. The cross-sectional design and self-report data cannot conclude how the profiles predict actual parenting behavior. Validations of the profiles on other samples with observational measures are desirable.

6.2 Paper 2: Relationship Between Maternal Scaffolding and Preschooler's Metacognitive Strategies in a Problem-Solving Situation

The second paper addressed how parents' co-regulation relates to preschoolers' self-regulatory strategies and problem-solving performance (Research Question 2). Building on the integrative scaffolding framework (van de Pol et al., 2010), the study examined how a set of scaffolding means serves different scaffolding intentions (i.e., support of cognitive activities, metacognitive activities, autonomy), building scaffolding strategies. It was asked how these scaffolding strategies (1) are associated with mother-child task performance and (2) predict children's metacognitive strategies and child-alone task performance. Positive effects from scaffolding means and intentions on (mother-child and child-alone) task performances and metacognitive strategies were assumed. Indirect effects of scaffolding means on task performances and metacognitive strategies, mediated via mothers' scaffolding intentions, were expected.

Participants were videotaped while working on the subtest triangles of Kaufmann's Assessment Battery for Children (KABC II; Melchers & Melchers, 2015). First, mother-child dyads solved the tasks for 10 minutes, and then the children did the same tasks alone for 5 minutes. Mothers' scaffolding during mother-child interactions was coded with a high-

inference rating scheme assessing mothers' scaffolding means (e.g., questions, hints, explanations) and scaffolding intentions (i.e., cognitive, metacognitive, autonomy support). Children's metacognitive strategies during child-alone problem-solving were coded with a subscale of the Strategic Behavior Observation Scale (SBOS; Dermitzaki et al., 2009). In addition, task performance was calculated separately for mother-child and child-alone solving as the number of solved tasks.

Results are based on data from 138 mothers and their four- or five-year-old child. Findings of path model analyses reveal that mothers' metacognitive support was negatively – and autonomy support positively – linked to mother-child task performance. Mothers' scaffolding means served different scaffolding intentions, building two scaffolding strategies. First, mothers using more scaffolding means provided more cognitive support, which was related to lower levels of children's metacognitive strategies (compensatory). Second, mothers using fewer scaffolding means provided more autonomy support, which was related to higher levels of children's metacognitive strategies (autonomy-supportive). Children's metacognitive strategies, in turn, mediated the link between mothers' scaffolding intentions (autonomy and cognitive support) and child-alone task performance.

The paper contributes to a better understanding of maternal scaffolding by looking at different aspects of scaffolding integrally and examining relations with child learning outcomes. Two scaffolding strategies were identified: compensatory and autonomy-supportive. Direct internalizations of maternal scaffolding strategies were not observed in the children. Neurophysiological studies would be valuable to gain a deeper insight into children's learning processes.

6.3 Paper 3: Effects of Maternal Mindsets on Parenting Behaviors and Self-Regulatory Strategies in Four- and Five-Year-Olds

This paper aimed to analyze the differential effects of implicit theories of different domains (intelligence, failure, self-regulation) on parenting behaviors and asked whether parenting behaviors mediate the link between mothers' implicit theories and child self-regulation (Research Question 3). It was expected that mothers with incremental theories or failure-is-enhancing mindsets would show more constructive and less unconstructive involvement in mother-child interaction than mothers with entity theories or failure-is-debilitating mindsets. In addition, it was hypothesized that parenting behaviors mediate the relationship between mothers' implicit theories and children's self-regulatory strategies.

6 Summary of Empirical Findings

Extending the experiment of Moorman and Pomerantz (2010), implicit theories from three domains (intelligence, failure, self-regulation) were induced via cover stories, resulting in six conditions: 1) intelligence-is-malleable, 2) intelligence-is-stable, 3) failure-is-enhancing, 4) failure-is-debilitating, 5) self-regulation-is-malleable, 6) self-regulation-is-stable. Parenting behaviors, including mothers' scaffolding means, constructive (autonomy support), and unconstructive (intrusiveness) involvement, were coded with a high-inference rating scheme during mother-child problem-solving. Children's self-regulatory strategies, including cognitive, metacognitive, and motivational strategies, were rated with the SBOS (Dermitzaki et al., 2009) during child-alone problem-solving. For the manipulation check, mothers completed questionnaires on implicit theories after the mother-child interactions. Child vocabulary was tested as a covariate using the subtest expressive vocabulary from the KABC II (Melchers & Melchers, 2015).

Results are based on complete data of 177 mothers and their four- or five-year-old child. The experimental manipulation was successfully induced. Planned contrasts reveal that mothers in the intelligence-is-stable (vs. intelligence-is-malleable) mindset condition showed more autonomy support. Mothers in the failure-is-debilitating (vs. failure-is-enhancing) mindset condition showed less autonomy support and used more scaffolding means. No significant differences were found in the domain of self-regulation. Mothers' use of scaffolding means fully mediated the link between mothers' failure mindsets and children's motivational strategies.

One central contribution of this paper is the examination of different domains of implicit theories, showing differential effects on parenting behaviors and outcomes in child learning. The results emphasize that especially failure mindsets affect parenting behaviors and child self-regulation. Teaching failure-is-enhancing mindsets could be a promising approach for parent training. However, the study should be replicated in a natural context due to the artificial laboratory setting.

7 General Discussion

Although much knowledge has accumulated about the effects of implicit theories (Burnette et al., 2013; Karlen & Hertel, 2021; Sisk et al., 2018), this research has been heavily one-sided in that a lot is known about the effects of implicit theories in (school-aged) children and students but not in parents. Recognizing that parents and parental co-regulation substantially impact child development – especially during early childhood (Valcan et al., 2018) – the present dissertation sheds light on the interplay of parents' implicit theories, co-, and self-regulatory processes in preschool children. Building on recent conceptual and empirical advances in the field relating implicit theories to self-regulatory processes (see Figures 1 and 2), the present work strived to contribute to three overarching research questions: First, how do parents' implicit theories relate to parental co-regulation and goal orientation? Second, how does parental co-regulation relate to preschoolers' self-regulation and problem-solving performance? And third, do parental co-regulation mediate the link between parents' implicit theories and child self-regulation?

Overall, the respective findings of the three papers of this dissertation complement previous research in different aspects. First, regarding the relationship between parents' implicit theories, co-regulation, and goal orientation, the results suggest that parents with high incremental theories of self-regulation report more mastery-oriented co-regulatory strategies and fewer performance-avoidance goals (Paper 1). Moreover, mothers induced to hold an entity (vs. incremental) theory of intelligence showed more autonomy support in a mother-child interaction, and mothers induced to hold a failure-is-debilitating (vs. failure-is-enhancing) mindset showed less autonomy support and used more scaffolding means (Paper 3). Second, concerning the link of parental co-regulation with preschoolers' self-regulation and problem-solving performance, Paper 2 suggests compensatory and autonomy-supportive scaffolding strategies that are differently related to children's metacognitive strategies and task performance. Third, and with regard to the indirect link of parents' implicit theories to children's self-regulation, Paper 3 indicates that mothers' failure-is-debilitating mindset is indirectly linked to lower motivational self-regulatory strategies in their child, fully mediated by mothers' use of more scaffolding means.

In the following sections, the empirical findings of the papers are discussed, organized by their theoretical and practical implications. Afterward, the strengths and limitations of the present dissertation are evaluated, followed by approaches for future research and closing with a general conclusion.

7.1 Theoretical Implications

7.1.1 Implicit Theories of Different Domains and Parental Co-Regulation

The present dissertation shows that the effects of implicit theories are not limited to children but extend to parents of preschoolers as well. This is important because – with few exceptions (see Chapter 4) – prior research has focused on children's academic functioning (e.g., Blackwell et al., 2007; Dweck, 2000; Dweck & Leggett, 1988; Molden & Dweck, 2006; Sisk et al., 2018) but overlooked the impact that implicit theories have on parental co-regulation. As parental co-regulation is a relevant determinant of child self-regulatory development, factors influencing co-regulation are of high interest. Therefore, the present results offer an important advancement to research on outcomes of implicit theories by showing that these are frameworks of parents' co-regulatory behaviors and goal orientation (Research Question 1).

The present findings contribute to whether individuals can hold more than one theory and whether particular domains of implicit theories are better suited to predict specific behaviors (e.g., Bråten & Strømsø, 2005; Hertel & Karlen, 2021). By including multiple domains of implicit theories (i.e., intelligence, failure, self-regulation), it was possible to examine 1) different configurations of beliefs (i.e., belief profiles; Paper 1) and 2) differential effects of single domains on parents' co-regulation and goal orientation (Paper 3). Expanding previous research that has predominantly treated implicit theories of different domains as independent constructs (Dweck et al., 1995; Haimovitz & Dweck, 2016; Tabernero & Wood, 1999), the findings of Paper 1 suggest that implicit theories of different domains can co-occur within persons. When comparing the emerged profiles, it becomes evident that, on average, most parents hold an incremental theory of intelligence. However, only positive correlations with mastery-oriented strategies were found when parents held a high incremental theory of self-regulation simultaneously to the incremental theory of intelligence. The positive link between incremental theories and mastery-oriented strategies is in accordance with meta-analytic findings using variable-centered methods (Burnette et al., 2013). When examining the effects of implicit theories from different domains differentially (Paper 3), the relationships to parenting behaviors differ depending on the domain. Unexpectedly and in contrast to prior research (e.g., Moorman & Pomerantz, 2010; Muenks et al., 2015), mothers induced to hold an entity theory of intelligence (vs. incremental theory) showed more autonomy support in mother-child interactions. Possibly and referring to the social-cognitive model (Dweck & Leggett, 1988), mothers from this sample might perceive their child's abilities as high, resulting in

mastery-oriented strategies (i.e., higher levels of autonomy support). Regarding the failure domain, another behavioral pattern was activated: Mothers with a failure-is-debilitating mindset used more scaffolding means – especially more instructions – than mothers with a failure-is-enhancing mindset. High levels of instructions rather represent performance-oriented behaviors than learning-oriented responses, confirming the findings by Haimovitz and Dweck (2016). The results of Paper 1 and 3 suggest that – although implicit theories from different domains co-occur – variance is explained by domains that are directly related to the studied behavior. In total, the findings contribute to the debate on domain-general versus domain-specific implicit theories and suggest that research should consider domains that are close to the studied behavior.

7.1.2 Scaffolding Strategies in Mother-Child Interactions: More is not Always Better

This dissertation addresses researchers' critique that theoretical frameworks and conceptual clarity are lacking when parent-child interactions are studied (A. L. Duckworth & Kern, 2011; Mermelshtine, 2017; Pino-Pasternak & Whitebread, 2010). Therefore, the integrative scaffolding framework by van de Pol et al. (2010) was applied to better understand the link between mothers' scaffolding and child self-regulation in problem-solving (Research Question 2). Van de Pol and colleagues' framework integrates the different concepts and approaches of scaffolding and puts different aspects of scaffolding (intentions and means) in relation to each other. The current findings show that a set of scaffolding means serves different scaffolding intentions, building scaffolding strategies. This extends previous research mainly focusing on single aspects of scaffolding (e.g., Wood et al., 1976) or examining how much different scaffolding dimensions explain additional variance (e.g., Neitzel & Stright, 2003; H. Zhang & Whitebread, 2017). The present results support the theoretical assumption that the mere use of scaffolding means does not directly promote children's metacognitive strategies but exerts its influence indirectly, mediated via scaffolding intentions (Erdmann et al., 2019; van de Pol et al., 2010). However, in this dissertation, the use of scaffolding means were negatively correlated with children's metacognitive (Paper 2) and motivational self-regulatory strategies (Paper 3), implying that "more support is not always better" (Pomerantz et al., 2007, p. 373; Landry et al., 2000). Accordingly, the success of parental support seems to be more a question of quality than quantity. The present results support the concept of contingency, suggesting that parental co-regulation should be adapted to children's ability level (Carr & Pike, 2012; Conner & Cross, 2003; Wood et al., 1976; Wood & Middleton, 1975; H. Zhang &

Whitebread, 2017). To better understand the interplay of quality and quantity in parental support, both aspects should be included in theory formation.

7.1.3 Implicit Theories in the Process of Socialization

Finally, this dissertation is the first to argue theoretically and test empirically how parents' implicit theories are related to both parental co-regulation and child self-regulation (Research Question 3). This was made by integrating the SOMA model (Burnette et al., 2013) with the three-term standard model (Bornstein et al., 2018), which complement each other in significant ways. Specifically, the SOMA model acknowledges that implicit theories predict distinct self-regulatory processes within persons. The three-term standard model posits relations between cognitions and behaviors between parents and children. Integrating these two models extends the core process *operating* in Burnette and colleagues' SOMA model (2013) by a second actor (in this case: the child). The present findings reveal that parents' implicit theories do not only affect their own parenting behaviors but also indirectly affect their children's self-regulatory strategies (Paper 3). As the development of these strategies has been identified to be part of children's socialization process (Suchodoletz et al., 2011; Wolters, 2003), parents' implicit theories (indirectly) contribute to this process. Although this relationship remains to be confirmed longitudinally (as required by Bornstein et al., 2018), the present findings suggest that the SOMA model can also be considered at the parent-child level. Therefore, the adapted SOMA model of this dissertation provides a theoretical foundation for future research exploring how parents' implicit theories (indirectly) influence children's self-regulation. How this model could be further developed is described in Chapter 7.4.

Overall, the theoretical contribution of this dissertation to the literature on implicit theories, co-regulation, and child self-regulation is fourfold. This research contributes (1) to the understanding of parents' implicit theories in preschoolers' self-regulation, (2) the domain-specificity and interplay of different domains of implicit theories, (3) the theoretical framework of mothers' scaffolding when studying mother-child interactions, and (4) the further development of the SOMA model by Burnette et al. (2013). In the following sections, the practical implications, as well as strengths and limitations, are discussed.

7.2 Practical Implications

In addition to providing theoretical and empirical contributions, the findings from the current dissertation may offer considerable implications for practice as well, particularly for

parent training. Specifically, the results suggest two approaches for parent training, aiming at (1) parents' implicit theories and (2) parenting behaviors.

First, the present findings have shown that parents' implicit theories are related to different aspects of parenting behavior that are known to be relevant for child self-regulation. Several researchers argue that interventions focusing on parents' cognitions and beliefs (e.g., self-efficacy beliefs, intentions, knowledge) are a promising way to change one's behavior (Bornstein et al., 2018; Gärtner et al., 2018b; Wittkowski et al., 2016). Prior research offers several examples of interventions designed to teach an incremental theory to improve motivation and performance (e.g., Aronson et al., 2002; Blackwell et al., 2007; Good et al., 2003; Yeager et al., 2022). However, these studies have targeted students and teachers and focused on implicit theories of intelligence. The experiment of the present dissertation with a successful manipulation of parents' implicit theories suggests that implicit theories can be implemented in parents of preschoolers as well (Paper 3). In addition, and referring to the domain-specificity of implicit theories, interventions should also address other domains of implicit theories, such as parents' failure mindsets (Haimovitz & Dweck, 2016). Children make many mistakes especially at preschool age as many abilities are still growing. By teaching parents to view failure not as debilitating but rather as enhancing learning and performances, a learning-supportive environment for child development can be created. Based on the mindset x context theory (see Yeager & Dweck, 2020), interventions are most effective in populations who are vulnerable to poor outcomes. According to empirical findings of Paper 1, parents with low educational backgrounds were more likely to belong to the 'Entity Theorists' profile and reported rather maladaptive patterns. In contrast, in Paper 3, an entity theory of intelligence predicted more favorable practices (autonomy support). As mothers in Paper 3 had a high educational background, the inconsistency between studies may be attributed to mothers' educational level and its associated factors (e.g., resources; K. Duckworth & Sabates, 2005). Therefore, when crafting the interventions, one important implication may be to consider the participants' educational background and recruit participants with low educational levels and other risk factors.

Regarding parenting behaviors, the present papers have illustrated that too much parental support (e.g., scaffolding means, cognitive support) can be related to children's lower metacognitive (Paper 2) and motivational strategies (Paper 3). Instead, higher levels of mothers' autonomy support were linked to more metacognitive strategies. These results imply that interventions should sensitize parents that the success of support is less a question of quantity (H. Zhang & Whitebread, 2017) but a question of how parents' support is adapted to children's

abilities within children's ZPD (Vygotsky, 1978). Thus, by actively engaging children in tasks or games, providing opportunities to make mistakes and experiences, and not over-simplifying, parents can support their children in learning how to plan, monitor, and evaluate their processing and stay motivated on the task.

7.3 Strengths and Limitations

This dissertation has several strengths and limitations. The main strength of this dissertation is exploring a topic that is considered to have great relevance and importance in (educational) psychological research (e.g., Burnette et al., 2013) but which is little investigated in parents (see again Chapter 4): implicit theories. The focus on parents of preschool children, in particular, is a further strength because parents play an important role in children's development, especially in the early years (Kolb & Gibb, 2011; Valcan et al., 2018). Furthermore, the dissertation examines parents' implicit theories of different domains (i.e., intelligence, failure, self-regulation) and in different settings (i.e., naturally occurring vs. experimentally induced). Another strength of this dissertation is that an experimental design was used that allows a window into causal relationships between parents' implicit theories and co-regulation. For this purpose, scales for assessing implicit theories of self-regulation (Hertel & Karlen, 2021) were successfully transferred and adapted for parents of preschool children. In addition, scales for assessing parents' failure mindsets were translated and adapted (Haimovitz & Dweck, 2016) and are finally accessible for research in German-speaking samples. Besides, this dissertation is based on a multi-method approach and combines observational and self-report measures on the parent- and child-level. For instance, different aspects of parental co-regulation (e.g., mastery vs. helpless-oriented behaviors, scaffolding, intrusiveness) and child self-regulation (e.g., effortful control, cognitive, metacognitive, motivational) were assessed using established, valid and reliable instruments, such as questionnaires (IMMA 1-6; Pauen et al., 2019; CBQ; Putnam & Rothbart, 2006) and coding schemes (Dermitzaki et al., 2009; Erdmann et al., 2019). Finally, all papers applied different data analysis methods, such as latent profile analyses (Paper 1), path model analyses (Paper 2), and (multivariate) analyses of (co)variance/ planned contrasts (Paper 3). Thus, data analyses were conducted using both variable-centered and person-centered methods.

However, there are also some limitations of the dissertation that need to be mentioned and may offer new directions for future research. The first issue to address is the selectivity of the samples. On the one hand, the selectivity bias refers to the fact that primarily mothers with

a high educational background participated in the studies. This might have affected between-person variability in study variables, limiting statistical power to detect small effects and leading to an underestimation of true effects (Button et al., 2013). In addition, the links were only examined for parents of healthy children, so conclusions cannot be generalized to parents and children with impairments (e.g., prematurity, mental or physical disorders; see Chapter 7.4). On the other hand, the participants were recruited in the South-West of Germany, which reduces the cross-cultural generalizability of the findings. For instance, research suggests that Asian and Western cultures differ in their emphasis on achievement and good grades or individual growth (Sang, 2017), showing that implicit theories can differ between cultures (Jose & Bellamy, 2012). In addition, in some countries, children start school already at the age of four or five, and parents receive performance feedback on their children, which might influence their co-regulatory behaviors and implicit theories. Another limitation is that (despite the experimental design of Paper 3) the data are predominately cross-sectional, and definitive conclusions about causal effects or relationships cannot be drawn. Although many studies examine unidirectional relationships between parental co-regulation and child self-regulation (e.g., Colman et al., 2006; Karreman et al., 2006), some studies also suggest bidirectional relationships (e.g., Eisenberg et al., 2010; Merz et al., 2017). Longitudinal studies with cross-lagged-panel designs are needed to provide more insight into the direction of effects. It is important to note that, concerning Paper 2 and 3, prior experiences and established interaction patterns between mother and child influence the observed mother-child interactions in the laboratory and cannot be considered in isolation. While the papers controlled for a range of covariates, other third variables (e.g., parental stress, personality, perceived abilities) that were not included may also contribute to the relationships. For example, there is some evidence that personality traits are related to implicit theories, with conscientiousness related to incremental theories and neuroticism related to entity theories (Satchell et al., 2017). However, other studies found no substantial relation between the Big Five personality traits (P. T. Costa & McCrae, 2008) and implicit theories (Hertel & Karlen, 2021). A further shortcoming was that parents' implicit theories were always measured via self-report using questionnaires (also increasing the risk of social desirability). Thus, beliefs that are implicit in their nature were captured via explicit measurements. To date, alternative approaches for assessing implicit theories, such as the implicit association test (Mascret et al., 2015), neuroscience methods (Mangels et al., 2006; Moser et al., 2011; Schroder et al., 2017), or the use of computer technologies (for a review on immersive virtual environments, see Nelson & Ketelhut, 2007) are still rare and require significant work for further development (Lüftenegger & Chen, 2017). In addition, when asking

parents about the malleability of self-regulation and intelligence, it is unclear what aspects of the constructs they are referring to or understanding by them, as there is no consistent definition either in the literature or in society.

7.4 Future Directions

Directions for further research on implicit theories and co- and self-regulatory processes can be seen in the following three fields: (1) development and extension of the SOMA model, (2) enhancements of methodological approaches, and (3) transfer to further populations.

Concerning the SOMA model, this dissertation focused explicitly on the interplay between implicit theories and goal operating due to the central role of mastery-oriented strategies in goal achievement (Burnette et al., 2013). However, the other model components should receive increased attention in future studies about parents and parent-child interactions. For example, the research field is inconsistent regarding goal orientations (Dupeyrat & Mariné, 2005; Kray & Haselhuhn, 2007; Mangels et al., 2006; Maurer et al., 2002; Robins & Pals, 2002; Sarrazin et al., 1996) and their role (e.g., mediator or moderator) in the interplay of parental implicit theories and co-regulation. Studies that experimentally manipulate goal orientations and examine their effects on parental co-regulation could provide further insights (Grolnick et al., 2002). In addition, future studies should include parents' goal monitoring (i.e., negative emotions, expectations) when examining the link between implicit theories and co-regulation. In prior research, negative emotions were often reflected in confrontational behaviors (e.g., control) or parent-child conflicts (e.g., Matthes & Stoeger, 2018; Moorman & Pomerantz, 2010), making a clear distinction between parenting behaviors and emotions difficult. Therefore, future research should differentiate the processes (i.e., goal operating and goal monitoring) more thoroughly and examine which emotions and expectations arise in parents as part of their goal monitoring process. Karlen et al. (2020) offer an integrative and holistic framework that combines the interplay of teachers' competencies as self-regulated learners and as agents of self-regulated learning who implement self-regulated learning in the class. This framework should be transferred to parents who, on the one side, need self-regulatory competencies (i.e., setting, operating, and monitoring goals) and, on the other side, are agents of co-regulation to enhance their children's self-regulatory abilities. Karlen and colleagues' framework (2020) could be integrated into the SOMA model by considering all components (i.e., implicit theories; goal setting, operating, monitoring, achievement) from a parent and child level.

Another direction for future research is the enhancement of methodological approaches for assessing implicit theories. Few studies use cognitive neuroscience methods to explain better the underlying cognitive processes and mechanisms related to implicit theories (Mangels et al., 2006; Moser et al., 2011; Schroder et al., 2017). These studies indicate that entity and incremental theorists differ in their electrophysiological responses in attention allocation to errors. For instance, Schroder et al. (2017) examined event-related potentials measuring error-monitoring with school-aged children during a go/no-go task. They found incremental theories linked to greater attention to mistakes and higher post-error accuracy. In addition, recent studies reveal that interventions teaching an incremental theory improve cardiovascular reactivity and cortisol levels during stressful events (Yeager et al., 2021). Using these neurophysiological approaches may also provide fruitful insights into the research field of parent-child interactions, with many mechanisms not being detectable by self-report and behavioral measures alone.

Finally, several studies have theoretically reasoned and empirically shown that implicit theories become particularly active in challenging situations and in individuals at risk for poor outcomes (Blackwell et al., 2007; Burnette et al., 2013; Dweck, 2000; Dweck & Leggett, 1988; Molden & Dweck, 2006; Yeager & Dweck, 2020). For example, depression is a risk factor for ineffective scaffolding, which is linked to lower emotional and behavioral competence and academic readiness in the child (Hoffman et al., 2006; Jahromi et al., 2020). In addition, studies indicate that entity theories predict greater mental distress and depressive symptoms (Howell, 2017; Schleider et al., 2015) and depression also mediates the relationship between entity theories and low performance (Da Fonseca et al., 2009). Therefore, it might be interesting to investigate the interplay between implicit theories and co-regulation in parents with depressive symptoms. Moreover, future studies should provide greater attention to children with special impairments. There is recent evidence that individuals with greater EF deficits and attention deficit hyperactivity disorder (ADHD) report lower incremental theories of self-regulation (Burnette et al., 2020). The authors suggest that the evaluation and development of interventions targeting incremental theories of self-regulation may enhance the self-regulation of individuals with ADHD. Concerning this dissertation, these findings raise the question of whether children's ADHD diagnosis might affect parents' implicit theories and co-regulation. In sum, the results of this dissertation open up many interesting and relevant starting points for further research.

8 General Conclusion

This dissertation extends and complements previous research on implicit theories by explicitly addressing parents of preschool children. This work transfers previous theoretical and empirical evidence from the academic context to the rising field of implicit theories research in parents. By extending the SOMA model, the interplay of parents' implicit theories with co- and self-regulatory processes was examined. The adapted SOMA model provides a helpful framework for further research and interventions. The results emphasize that examining different domains of implicit theories is important because they emerge in different configurations and can differentially predict parenting behavior. Findings suggest that both – incremental and entity theories – can be associated with positive co-regulatory behaviors, such as mastery-oriented strategies or autonomy support. Therefore, relations to parenting behaviors are not straightforward but seem to depend on further factors. Moreover, the findings underline that encouraging and involving children to solve tasks autonomously relates to higher levels of children's self-regulatory strategies. Lastly, parents' implicit theories may be an element in children's socialization process, as they are indirectly linked to children's self-regulation, mediated by parenting behavior. In particular, it can be beneficial when parents view mistakes as a natural part of the learning process, do not provide too much support, and strengthen their child's motivation.

Returning to the questions from the beginning of this dissertation, the present findings provide some approaches that contribute to a better understanding. Implicit theories may explain why some parents transfer more responsibility or are more likely to show too much support. They can also serve as a framework for parents' goal orientation. Finally, parents' implicit theories can indirectly affect their child's self-regulatory strategies in parent-child interactions. Since parents play a key role in their children's education, these early parent-child interactions can shape children's further (self-regulated) learning and development. In conclusion, the presented dissertation demonstrates that mindsets (or implicit theories) *do* matter – already in parents of preschool-age children. The next question will be: "*When* do parents' mindsets matter?"

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Tables

Figures

Appendix A – Paper 1

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Profiles of Parents' Beliefs about their Child's Intelligence and Self-Regulation: A Latent Profile Analysis

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Abstract

This study examined parents' implicit theories of intelligence and self-regulation from a person-centered perspective using latent profile analysis. First, we explored whether different belief profiles exist. Second, we examined if the emergent belief profiles (1) differ by demographic variables (e.g., age, education, child's self-regulation) and (2) are related to parents' failure beliefs, goal orientation (i.e., learning goals, performance-approach goals, performance-avoidance goals), and co-regulatory strategies (i.e., mastery-oriented and helpless-oriented strategies). Data were collected from *N*=137 parents of preschoolers who answered an online survey comprising their implicit theories about the malleability and relevance of the domains (a) intelligence and (b) self-regulation. We identified three belief profiles: profile 1 (9% of the sample) displayed an entity theory, profile 2 (61% of the sample) showed a balanced pattern of both domains of implicit theories, and profile 3 (30% of the sample) was characterized by high incremental self-regulation theories. Analyses showed that parents differed significantly in education and their perception of child self-regulatory competence depending on profile membership, with parents in profile 1 having the lowest scores compared to parents of the other profiles. Differences in parents' failure beliefs, goal orientation, and co-regulatory strategies were also found depending on profile membership. Parents in profile 3 reported failure-is-enhancing mindsets, and mastery-oriented strategies significantly more often than parents in profiles 1 and 2. The results provide new insights into the interplay of important domains of implicit theories, and their associations with parents' failure beliefs, goal orientation, and co-regulatory strategies.

Keywords: Implicit theories; intelligence; self-regulation; parents; latent profile analysis

1 Introduction

Many parents have concrete beliefs about their children's abilities. For example, parents may view their children's abilities as malleable and changeable by effort or rather believe that their children have innate competencies that are relatively fixed and cannot be changed. Parents' cognitions have important short- and long-term effects on parenting practices and child development (Bornstein et al., 2018). More precisely, parents' implicit theories influence parents' goal orientation, their co-regulatory strategies, and consequently their child's self-regulation (Ames & Archer, 1987; Blackwell et al., 2007; Burnette et al., 2013; Grolnick et al., 2002; Jiang et al., 2019; Moorman & Pomerantz, 2010; Pomerantz & Dong, 2006).

Although the importance of implicit theories is evident, relatively little is known about how different domains (e.g., intelligence, self-regulation) and dimensions (e.g., malleability, relevance) of implicit theories co-occur in everday situations affecting parents' attitudes (e.g., failure beliefs, goal orientation) and co-regulatory strategies. This lack of attention to interaction processes of different domains is surprising, given that individuals can hold different implicit theories in different domains and attributes at the same time (Dweck et al., 1995; Haimovitz & Dweck, 2017; Muenks et al., 2015; Tabernero & Wood, 1999). For example, some parents may view their children's ability in one domain (e.g., self-regulation) to be malleable while considering their children's ability in another domain (e.g., intelligence) to be relatively fixed. Other parents may think that both domains of abilities are malleable but that only one of these is relevant for their children's success. To date, research on implicit theories has predominantly focused on implicit theories of intelligence (Dweck, 2000; Moorman & Pomerantz, 2010) while ignoring the domain of self-regulation. Since parents play an important role in children's self-regulatory development, parents' implicit theories of self-regulation should play an important role in predicting self-regulatory processes.

Therefore, this study examined how implicit theories co-occur within parents using latent profile analysis (LPA). LPA is a person-centered approach that aims to identify unobserved subgroups based on the similarity of the sample on observed variables (Collins & Lanza, 2009). The variables used for the LPA comprised two domains of children's abilities: *intelligence* and *self-regulation*, each including two dimensions: *malleability* and *relevance for success*. We then analyzed how the emergent belief profiles are composed with respect to demographic variables. Finally, we explored how different belief profiles relate to parents' attitudes (i.e., failure beliefs, goal orientation) and co-regulatory strategies.

2 Theoretical Background

2.1 Implicit Theories of Abilities

Implicit theories are belief systems about human attributes and abilities that help individuals to explain and understand their world (Lüftenegger & Chen, 2017). There is a long tradition in research following Carol Dweck's social cognitive theory (1988) examining the malleability of abilities. She distinguishes two types of implicit theories: incremental theories and entity theories. *Incremental theories* refer to viewing abilities as malleable and changeable by effort while *entity theories* refer to viewing abilities as innate competencies that are rather fixed. So far, these implicit theories were mainly examined in children and students, showing that incremental theories are related to higher motivation, persistence, adaptive learning strategies, and academic achievement (Blackwell et al., 2007; Dweck & Leggett, 1988).

Although there is a wealth of evidence that implicit theories are relevant determinants of motivation, cognition, and behavior in learning and achievement settings (Blackwell et al., 2007; Burnette et al., 2013), parental implicit theories have gained attention only recently. Parental implicit theories refer to beliefs parents have about the abilities of their children. These can refer to an array of abilities and domains such as intelligence (Dweck, 2000; Pomerantz & Dong, 2006), math and verbal ability (Muenks et al., 2015), or failure (Haimovitz & Dweck, 2016). These implicit theories from various domains can correlate but findings suggest relatively independent constructs (Dweck et al., 1995; Haimovitz & Dweck, 2016; Tabernero & Wood, 1999). This means that individuals can hold an incremental theory in one domain but an entity theory in another domain (Schroder et al., 2016).

In the context of parents, past research has primarily focused on parents' implicit theories of *intelligence* (Dweck, 2000; Moorman & Pomerantz, 2010; Pomerantz & Dong, 2006; Rautiainen et al., 2016). The interest in the domain of intelligence originates from broad evidence suggesting that implicit theories of intelligence have important effects on academic and emotional functioning (for a meta-analytic review see Costa & Faria, 2018). Inspired by research about children's implicit theories of intelligence, researchers have asked if parents' implicit theories are also consequential for children's implicit theories as well as parents' learning and achievement-related behaviors (e.g., Rautiainen et al., 2016) as parents' play an important role in children's socialization (Taylor et al., 2004). Initial studies indicate that parents' incremental theories predict children's outcomes (e.g., children's incremental theories, achievement) and parental learning-related behaviors (Matthes & Stoeger, 2018; Moorman & Pomerantz, 2010; Muenks et al., 2015; Pomerantz & Dong, 2006).

In children's development, intelligence is not the only significant domain that influences parents' and their children's beliefs and in turn the associated consequences. The concept of *self-regulation* receives high attention in both scientific and popular scientific literature and is known as a central construct of psychology (Vohs & Baumeister, 2013). Self-regulation is defined as the ability "to regulate affect, attention, and behavior to respond effectively to both internal and environmental demands" (Raffaelli et al., 2005, p. 54). Self-regulation develops in early childhood and predicts a range of social-emotional, health-related, and academic outcomes (McClelland & Cameron, 2012; Moffitt et al., 2011; Neuenschwander et al., 2012; Valiente et al., 2013). However, what individuals believe about the malleability and relevance of self-regulation remains largely unexplored. Initial studies indicate that these implicit theories of self-regulation are associated with self-regulatory processes such as goal orientation and learning strategy use (Hertel & Karlen, 2019; Stern et al., 2020), and influence effort and perseverance (Mrazek et al., 2018).

However, research suggests that it is not only the question of whether parents believe that abilities are malleable (Stern et al., 2020); another important dimension of implicit theories is the question of the abilities' *relevance for success* (Spinath, 2001). Individuals can hold different opinions about how relevant abilities are for the success in particular tasks, (e.g., the relevance of intelligence for school achievement; (Schlangen & Stiensmeier-Pelster, 1997; Spinath & Schöne, 2003). Inspired by Wigfield and Eccles' expectancy-value theory of motivation (2000), it can be assumed that the belief about the relevance of a certain ability is an important predecessor of motivation and influences behavior. For example, if parents believe that a certain ability is a relevant variable for their children's success in a specific context, they will promote and support their children's development. These beliefs, in turn, may affect the relation between implicit theories about the malleability of abilities and behavior: Only if individuals believe that a certain ability is a relevant variable individuals' incremental or entity theories may become effective (Spinath & Schöne, 2003). Malleability and relevance for success seem to be moderately correlated dimensions of implicit theories that both have beneficial effects explaining links between implicit theories and learning-related outcomes (Hertel & Karlen, 2019; Stern et al., 2020). However, a simultaneous consideration of both dimensions is rare in the context of research concerning parents' implicit theories.

2.2 Implicit Theories and Failure Beliefs

Implicit theories are most powerful in challenging and demanding situations (Blackwell et al., 2007; Dweck & Leggett, 1988). Dweck and Leggett (1988) argue that implicit theories

are related to the attribution of failure and individuals' behaviors: Individuals with an incremental theory attribute failure to a lack of effort. Incremental theorists are more likely to persist through failure as they see failure as an opportunity for learning. In contrast, individuals with an entity theory attribute failure to a lack of ability. Entity theorists tend to give up in the face of failure because they see failure as a sign of being incompetent (Blackwell et al., 2007; Dweck & Leggett, 1988; King, 2017).

In the context of parents, failure beliefs are of special interest. Especially during early childhood, children are still developing their skills and are often in the face of failure. Here, parents play an important role to support their children and enable them to solve challenging tasks (Bernier et al., 2010). Haimovitz and Dweck (2016) have identified two different failure beliefs of parents: a failure-is-enhancing mindset and a failure-is-debilitating mindset. Parents with a *failure-is-enhancing mindset* view failure as "an enhancing experience that facilitates learning and growth […, while parents with a *failure-is-debilitating mindset* believe] that failure is a debilitating experience that inhibits learning and productivity" (Haimovitz & Dweck, 2016, p. 860). Empirically, these beliefs relate to parenting practices and children's intelligence theories: Parents, who view failure as debilitating show more performance-oriented responses, report less support for their children`s learning, and more concerns about their children's performance and lack of ability compared to parents with a failure-is-enhancing mindset (Haimovitz & Dweck, 2016). Moreover, parents with a failure-is-debilitating mindset have children who believe that intelligence is fixed. However, the link between parents' failure beliefs and parents' implicit theories is not well understood so far. There is some evidence that parents' implicit theories and failure beliefs are independent constructs, whereas there is also some suggestion that parents' entity theories are positively correlated to their failure-is-debilitating mindsets (see Haimovitz & Dweck, 2016). The question also arises if the relation between implicit theories and failure beliefs is domain-specific. More specifically, some parents, for example, may believe that failure is debilitating to develop self-regulatory abilities but enhancing to increase intelligence. Therefore, it seems important to examine these mechanisms in more detail and take further domains and dimensions of implicit theories into account (e.g., implicit theories of self-regulation) to better understand how parents' implicit theories and failure beliefs are related.

2.3 Implicit Theories and Goal Orientation

Implicit theories are significantly linked to goal orientation (Burnette et al., 2013): Individuals perceiving abilities as malleable pursue *learning goals* to increase their skills, while

individuals holding an entity theory pursue performance goals to secure positive judgments (*performance-approach goal orientation*) or avoid challenging tasks to prevent negative judgements (*performance-avoidance goal orientation*) (Dweck, 1986). Applied to parenting, parents with learning goals want their child to develop skills, whereas parents with performance goals want to demonstrate their children's competences (performance-approach) or avoid situations where their child might perform worse than others (performance-avoidance) (Mageau et al., 2016). Parental goal orientation affects parents' co-regulatory strategies (e.g., autonomy support, control; Gonida & Cortina, 2014; Mageau et al., 2016) as well as children's beliefs, motivation, and performance (Gottfried et al., 1994; Grolnick et al., 2002; Gunderson et al., 2013). For example, parents with performance goals provide more controlling behavior to their children compared to parents with learning goals (Grolnick et al., 2002). While performance-avoidance goals have proved predominantly maladaptive (e.g., poor performances, test anxiety, low help-seeking behavior; for a review see Moller & Elliot, 2006), performance-approach goals can have both positive and negative effects (Mageau et al., 2016).

Meta-analytical findings by Burnette et al. (2013) with 113 studies across diverse contexts and populations suggest positive associations between incremental theories and learning goals as well as between entity theories and performance-avoidance goals. No substantial relation for performance-approach goals was found. In contrast, in the specific context of parents, the effect of learning goals but not of performance-avoidance goals could be confirmed (Stern et al., 2020). One explanation might be that parents' performance-avoidance goals were low overall. Moreover, parents' implicit theories about the relevance of abilities might play an important role, as these have been found to be positively correlated with parents' performance-approach goals (Stern et al., 2020). Previous research has especially used incremental theories of intelligence to predict goal orientation and ignored implicit theories about the relevance of abilities. A simultaneous consideration of two domains of implicit theories about the malleability *and* relevance of abilities might explain the complex pattern of associations between parents' implicit theories and goal orientation.

2.4 Implicit Theories and Co-Regulatory Strategies

Parents' co-regulatory strategies, in the sense of attempts to modify children's thoughts, emotions, and behavior (Colman et al., 2006; Pauen, 2016), are especially relevant in early childhood when self-regulatory abilities are developing and children are still dependent on their parents' support (Bernier et al., 2010; Kopp, 1982; Valcan et al., 2018). While *mastery-oriented co-regulatory strategies* (e.g., warmth, inductive discipline, scaffolding, autonomy support) are

associated with higher self-regulatory abilities, *helpless-oriented co-regulatory strategies* (e.g., control, intrusiveness) are related to lower self-regulatory abilities of children.

Research across different domains and populations has shown that a person's implicit theory predicts mastery- and helpless-oriented strategies (Burnette et al., 2013). Applied to parenting, one may assume that parents with incremental theories are more likely to use mastery-oriented strategies that help their child to learn (e.g., remaining encouraging; holding discussions; calling for self-regulation) because the child's abilities reflect learning processes that can be promoted. In contrast, entity theorists may tend to employ helpless-oriented strategies (e.g., using negative pressure for example by forcing the child to comply; giving in) as a reaction of poor performances that reflect stable abilities and consequently permanent deficits. This line of reasoning is substantiated by evidence that parents' implicit theories are important determinants of parents' co-regulatory strategies: Parents who believe that abilities (e.g., intelligence, math, and verbal abilities) are stable show more controlling and performance-oriented behaviors than parents with incremental theories (Moorman & Pomerantz, 2010; Muenks et al., 2015). Nevertheless, it is unclear whether the effects are stronger for some parents than others because past studies used experimental manipulations (Moorman & Pomerantz, 2010) or measured limited demographic characteristics (Muenks et al., 2015). Using a person-centered approach and examining belief profiles and their relations to parents' co-regulatory strategies could help close this research gap.

2.5 Sociodemographic Group Differences in Implicit Theories of Abilities

Regarding sociodemographic variables that shape parents' implicit theories, empirical investigations are rare. Increasing research examines group differences in implicit theories by demographic variables such as gender, age, and educational level. However, it is still under debate if and how demographic variables are and should be related to implicit theories. Gender is mostly unrelated to implicit theories (Burnette et al., 2013; Jiang et al., 2019; Muenks et al., 2015; Pomerantz & Dong, 2006). Anyhow, parents' gender may shape parents' implicit theories, as mothers' and fathers' values and understanding of their children's upbringing may disagree (e.g., Lareau, 2000). Parents' implicit theories may also differ by their children's gender: Parents are more prone to attribute boys' achievement to talent and girls' achievement to effort (e.g., Eccles et al., 1990). Furthermore, some researchers argue that girls (especially high-achieving girls) have a lower tendency for new and difficult tasks and attribute failure to a lack of ability (i.e., holding entity theories), compared to boys who tend to hold incremental theories (Chen, 2012; Diseth et al., 2014; Dweck, 1986). Concerning age differences, some

studies report that young students tend to overestimate their skills (Hasselhorn, 2005) and therefore hold incremental theories more likely (Chen, 2012). Given that beliefs stabilize with age, no age differences are expected for adults (Jiang et al., 2019; Pomerantz & Dong, 2006). Regarding parents' educational level, some studies point out that parents' incremental theories are linked to a higher level of education (Jiang et al., 2019; Muenks et al., 2015; Pomerantz & Dong, 2006). Other researchers (Rautiainen et al., 2016) argue that parents with an academic education tend to hold an entity theory because they support the theory of natural giftedness (Räty & Snellman, 1998) but could not support this hypothesis empirically. Finally, the question arises on how parents' perceptions of their children's competence affect parents' implicit theories. Haimovitz and Dweck (2017) have found that parents' perceptions of their children's competence are partly related to parents' implicit theories. Research from extended literature shows that implicit theories of intelligence are largely unrelated to one's actual personality and intelligence (Spinath et al., 2003). Overall, these results represent high inconsistency and more studies are needed to illuminate the contribution of person-specific characteristics.

2.6 A Person-Centered Approach to Implicit Theories

The current study uses a person-centered approach by studying patterns of implicit theories in parents. Whereas *variable-centered approaches* (e.g., regressions, path analysis) examine relationships among variables on average, *person-centered approaches* describe relationships among persons by identifying subpopulations depending on their scores on multiple variables of interest (Lubke & Muthén, 2005). The latent profile analysis (LPA) is one of the person-centered approaches and offers several advantages. First, the number of profiles result from empirical fit indices that specify the optimal number and the researcher does not have to determine a number a priori. Second, individuals are not assigned to a specific profile absolutely, but each individual's probability of memberships for each profile are calculated. LPA is particularly suitable for exploratory research questions and is increasingly used in research on beliefs and attitudes, for example, students' implicit theories and epistemic beliefs (Chen, 2012; Hertel et al., 2019), or parents' self-efficacy beliefs (Junttila & Vauras, 2014). This method is particularly useful in this field of research, as individuals may hold different beliefs and attitudes in various domains simultaneously, which results in different configurations of beliefs. Using a variable-centered method might conceal important results and implications. To our knowledge, no study has used LPA to examine implicit theories of abilities in parents so far.

We assume that implicit theories about the malleability and relevance of different domains may co-occur within persons. The present study aims to explore those individual belief profiles that naturally arise among parents of preschoolers. As already described, some parents may hold incremental theories (or entity theories) in different domains at the same time, whereas other parents may hold incremental theories in one domain but entity theories in the other domain, for example. Thus, we examine whether different profiles of implicit theories of intelligence and self-regulation exist. Moreover, we argue that different profiles are differentially adaptive or maladaptive concerning parents' attitudes (i.e., failure beliefs, goal orientation) and co-regulatory strategies (i.e., mastery- and helpless-oriented strategies). Past research using a variable-centered method shows that parents' incremental theories are beneficial to learning goals and co-regulatory strategies while entity theories enhance performance-oriented behaviors and children's helplessness (Jiang et al., 2019; Moorman & Pomerantz, 2010; Muenks et al., 2015). However, when incremental and entity theories co-occur within different domains, the positive effects of incremental theories in one domain might be less strong when parents hold entity theories in another domain. Similarly, incremental theories in one domain might partly counteract the effects of entity theories in the other domain. Therefore, we examine which of the emergent belief profiles are most adaptive for parents' attitudes and behavior. More precisely, three different research questions guided the present study:

1) What different belief profiles emerge from measures of parents' implicit theories of intelligence and implicit theories of self-regulation?
2) How do these emergent belief profiles differ by parents' and children's demographic variables?
3) How do these emergent belief profiles relate to parents' failure beliefs, goal orientation, and co-regulatory strategies?

3 Methods

3.1 Participants

Two hundred and fifty-four persons were recruited for an online survey study by social-network-platforms and announcements in kindergartens in southwest Germany. The study was created with the online tool Soscisurvey (Leiner, 2019) and distributed via https://www.soscisurvey.de. As an incentive, participants were offered attractive lottery prizes (six vouchers worth 50 to 150 Euro). For the present study, we recruited parents of children

aged three to six years. One hundred and fifty-two persons finished the questionnaire, leading to a dropout rate of 40% that is slightly higher than the reported average rate of 34% for online studies (Musch & Reips, 2000). The increased dropout rate might be due to technical problems when filling out the questionnaire on smartphones. Fifteen persons were excluded from the analysis because of implausible response patterns, distractions, or not complying with the inclusion criteria (child's age: three-to-six years), leading to a final sample of 137 parents (87% mothers). Parents' mean age was 37.42 years (*SD* = 4.85) and they had at least one child (75%). The majority of parents had at least a higher technical college qualification (79%), worked part-time (80%), and were not single parents (95%). Parents were asked to refer to their child aged three to six years when filling out the questionnaire; the mean age of the child was 4.65 (*SD* = 1.08); 55% of the parents thought about their daughter.

3.2 Measures

Implicit theories of self-regulation. We used the recently modified and validated *Parents' Implicit Theories of Self-Regulation scale* (PITSR, Stern et al., 2020), assessing parents' malleability and relevance theories of self-regulation. The two dimensions were assessed by three items, using a five-point-scale adapted to the item content: *malleability* of their child's self-regulation (e.g., "My child has a certain ability to self-regulate and this … cannot be changed / can be changed.", α = .75) and *relevance* of their child's self-regulation for success (e.g., "Good performance of my child… does not require competencies in self-regulation / does require competencies in self-regulation.", α = .73). Higher values indicated more agreement of an incremental theory and higher relevance of self-regulation for success.

Implicit theories of intelligence. We used modified scales assessing parents' implicit theories of intelligence ("Skalen zur Erfassung subjektiver Überzeugungen zu Bedingungen von Erfolg in Lern- und Leistungskontexten", SE-SÜBELLKO-ST, Spinath & Schöne, 2003; Stern et al., 2020). Two dimensions were assessed by three items that could be answered using a five-point-scale adapted to the item content: *malleability* of their child's intelligence (e.g., "My child possesses a certain amount of intelligence and this … cannot be changed / can be changed.", α = .90) and *relevance* of their child's intelligence for success (e.g., "Good performance of my child… does not require a lot of intelligence / does require a high amount of intelligence.", α = .71). Higher values indicated more agreement of an incremental theory and higher relevance of intelligence for success.

Failure beliefs. We used scales assessing parents' failure beliefs (Haimovitz & Dweck, 2016), translated and adapted them by referring specifically to their child's failure experiences.

Three items described a failure-is-enhancing mindset (e.g., "Experiencing failure facilitates my child's learning and growth", α = .82) and three items described a failure-is-debilitating mindset (e.g., "Experiencing failure debilitates my child's learning and growth", α = .77). All items were rated on a scale ranging from *extremely untrue* (1) to *extremely true* (5). Items of the failure-is-debilitating mindset were reverse-scored and averaged with all items to a composite score. Thus, higher numbers indicated a more enhancing view of failure.

Goal orientation. We used scales assessing parents' goal orientation ("Skalen zur Erfassung der Lern- und Leistungsmotivation"-Questionnaire, SELLMO, Spinath & Schöne, 2019) and adapted them for parents of preschoolers by removing school references. Three dimensions of goal orientation were assessed by eight items each: *learning goals* (e.g., "It is important to me that my child acquires a deep understanding of the content.", α = .69), *performance-approach goals* (e.g., "It is important to me that my child shows that s/he masters the contents.", α = .84) and *performance-avoidance goals* (e.g., "It is important to me that nobody notices when my child does not understand the content.", α = .83). All items were rated on a scale ranging from *totally disagree* (1) to *totally agree* (5).

Co-regulatory strategies. We used the revised version of the IMpulse-MAnagement from Infancy to Preschool questionnaire (IMMA 1–6; Pauen et al., 2019) for assessing parents' responses to their child's behavior. M*astery-oriented strategies* were assessed with four items of the dimension *praising* (e.g., "I praise her/him explicitly when s/he does what I desire.", α = .84), five items of the dimension *negotiating/ discussing* (e.g., "I negotiate a solution with the child when s/he does not do what I desire.", α = .75), four items of the dimension *distraction* (e.g., "I try to distract her/him when s/he is frustrated because of not achieving what s/he has planned.", α = .84), and three items of the dimension *call for self-regulation* (e.g., "I tell her/him not to get upset when s/he is frustrated because of not achieving what s/he has planned,", α = .71). One item of *call for self-regulation* was excluded due to poor internal consistency. *Helpless-oriented strategies* were assessed with four items of the dimension *giving in* (e.g., "I give up when s/he does not do what I desire.", α = .89), and eleven items of the dimension *negative pressure* (e.g., "I force the child to comply when s/he does not do what I desire.", α = .89). All items were rated on a scale ranging from *never* (1) to *always* (6).

Child's self-regulation. Parents' perception of their child's self-regulatory competence was assessed with the subscale *Effortful Control* of the German very short form of the Children's Behavior Questionnaire (CBQ; Putnam & Rothbart, 2006). Parents reported their child's reaction or behavior in the past six months in different situations on twelve items (e.g., "Is good

at following instructions.", α = .68) on a scale ranging from *extremely untrue* (1) to *extremely true* (7).

3.3 Analysis

Belief profiles were created through Latent Profile Analysis using Mplus 7.31 (Muthén & Muthén, 2014). Latent Profile Analysis identifies latent homogenous groups (profiles) of individuals that have similar values on the clustering variables (latent profile indicators) by using probabilistic models of subgroup membership (Vermunt & Magidson, 2004). In the present study, four latent profile indicators were used: incremental theory of intelligence, relevance theory of intelligence for success, incremental theory of self-regulation, and relevance theory of self-regulation for success.

Model fit statistics were calculated to identify the number of profiles (Geiser, 2010; Williams & Kibowski, 2016), including Entropy values, Akaike's Information Criterion (AIC), Bayesian Information Criterion (BIC), and sample size adjusted BlC (aBIC) with higher Entropy values and lower AIC, BIC, aBIC indicating better fit. Lo-Mendell-Rubin (LMR), where *k* and *k*–1 number of profiles were compared, was also conducted. Furthermore, the characteristics of each profile (e.g., size) and interpretability were also considered in the final solution.

In order to explore how the emergent belief profiles differ by demographic variables, parents' goal orientation, failure beliefs, and co-regulatory strategies (see research questions two and three), Mplus' auxiliary (BCH) function was employed. The BCH method uses a weighted multiple group analysis and estimates the association between the categorical latent variable and the dependent continuous variable using the assigned profile memberships, considering that these contain classification errors (Bakk & Vermunt, 2016). Moreover, in order to examine the association between the latent profiles and the dependent categorical variables (e.g., gender), Mplus' auxiliary (e) function was applied. This approach is based on the Wald chi-square test of statistical significance and uses a pseudo-class method testing the equality of means across profiles (Wang et al., 2005).

4 Results

4.1 Latent Profile Analysis of Implicit Theories

In order to identify profiles of parents' implicit theories of intelligence and self-regulation, latent profile analyses were conducted. Five models with one to five profiles were

conducted for model comparisons. Model fit statistics for the optimal number of profiles in the latent profile analysis are displayed in Table 1.

[Please insert Table 1 here]

Model fit statistics provided inconsistent results for the optimal number of profiles. AIC and aBIC values were lowest for the five-profile solution, indicating that five profiles were optimal. LMR was not significant for solutions with more than three profiles, suggesting a three-profile solution. Entropy increased from two to three profiles and then declined, suggesting a three-profile solution, too. BIC values were lowest for the three-profile solution, which demonstrated that this was the optimal number of profiles. In sum, most of the model fit statistics provided the three-profile solution. Furthermore, the three-profile solution produced a number of interesting comparisons between profiles and had the clearest interpretation. Therefore, the preferred model is a three-profile solution.

4.2 The Latent Profiles

Figure 1 illustrates the three latent profiles and their means on implicit theories on intelligence and self-regulation. The emerged profiles are labeled according to the interpretation of findings as *Entity Theorists*, *Balanced*, and *Incremental Self-Regulation Theorists*. As shown in Figure 1, the profiles differ most in their incremental theories of self-regulation.

[Please insert Figure 1 here]

Parents in profile 1 (9% of the sample, n = 13) reported that their child's intelligence is malleable and moderately relevant for success, while their child's self-regulation is rather stable and relevant for success. Parents in this group showed the lowest values in their incremental theories of self-regulation and thus exhibited the greatest differences in this variable compared to parents in profiles 2 and 3. We refer to this profile as *Entity Theorists*.

Parents in profile 2 (61% of the sample, n = 83) showed similar levels in their incremental theories in both domains as well as in their relevance theories in both domains. They reported that their child's intelligence and self-regulation are neither particularly stable nor malleable or notably relevant for their child's success, reflecting balanced levels of both domains of implicit theories. We refer to this group as *Balanced*.

Parents in profile 3 (30% of the sample, n = 41) showed the highest values in their incremental and relevance theories of self-regulation. Regarding their incremental and relevance theories of intelligence, this profile showed a similar pattern to profiles 1 and 2. We label this profile as *Incremental Self-Regulation Theorists*.

4.3 Differences Between Latent Profiles on Demographic Variables

The data in Table 2 show the means for all of the demographic variables by latent profiles and the full sample. Significance tests for group differences using the pseudo-class method for categorical variables (e.g., gender) and the BCH method for continuous variables (e.g., age) are also reported in Table 2.

[Please insert Table 2 here]

Parents in profile 1 showed the most significant differences from other parents. Parents in this profile had the lowest mean score in parent education compared to parents in the other profiles. This means that 47% of the parents in profile 1 had a university degree, whereas, in profiles 2 and 3, 70% and 83% of the parents were academics, with the differences between profile 1 and profile 3 being statistically significant (χ^2=5.37, p=.020). Furthermore, parents in profile 1 reported the lowest self-regulatory competence of their child compared to parents in the other profiles, and these differences were statistically significant (profile 1 vs. 2: χ^2=6.79, p=.009; profile 1 vs. 3: χ^2=5.39, p=.020). Finally, we found on a descriptive level, that parents in profile 1 were younger, and had fewer and younger children, even though these differences were not statistically significant.

Although the contrasts between profiles 2 and 3 were not statistically significant, almost all parents of profile 3 were mothers (93%), whereas 15% of profiles 1 and 2 were fathers. Moreover, profile 3 had the lowest percentage of daughters (46%) and the highest amount of children (M=2.07, SE=0.13) compared to parents in profiles 1 and 2.

4.4 Differences Between Latent Profiles on Failure Beliefs, Goal Orientation, and Co-Regulatory Strategies

The data in Table 3 show the means for failure beliefs, goal orientation, and co-regulatory strategies by profile membership. The first column represents the overall mean for the full sample, and subsequent columns represent the means by latent profiles. In order to explore how the profiles differ by parents' failure beliefs, goal orientation, and co-regulatory strategies, equality tests of means across profiles using the BCH procedure were conducted. Results of the overall chi-square test as well as the pairwise single-comparisons between groups are reported in the subsequent column of Table 3.

[Please insert Table 3 here]

The analysis was clearest in distinguishing parents in profile 3 from the other parents. Table 3 shows that parents in this profile reported a failure-is-enhancing mindset significantly more often compared to profil 2 (χ^2=8.74, p=.003) and pursued performance-avoidance goals

less likely than parents in profile 2 (χ^2=4.56, p=.033). Regarding co-regulatory strategies, parents in profile 3 showed higher values in mastery-oriented strategies. More precisely, parents in profile 3 had higher values in negotiating (χ^2=3.99, p=.046) compared to parents in profile 2, and significantly higher values in call for self-regulation than parents in profile 1 (χ^2=7.25, p=.007).

Descriptively, parents in profile 1 had the lowest failure-is-enhancing mindset and learning goal orientation. Furthermore, parents in this profile showed the lowest mean scores for praising, and call for self-regulation as well as the highest value for distraction compared to the other two profiles. As shown in Table 3, the multivariate analysis indicated that at least one of these differences between profiles were statistically significant (χ^2=6.56, p=.010). On a descriptive level, we also found that parents in profile 1 reported to give in and negotiate least compared to parents in the other profiles even though this difference was not significant.

Profile 2 is characterized by higher values in performance-avoidance goals, which significantly differ from parents in profile 3 (χ^2=4.56, p=.033). They showed the lowest mean score in distraction compared to the other two profiles, with the differences between this profile and profile 2 being statistically significant in the multivariate analysis (χ^2=6.56, p=.010).

5 Discussion

The present study examined parents' implicit theories of intelligence and implicit theories of self-regulation simultaneously from a person-centered perspective. We expected that different belief profiles exist and analyzed how the emergent belief profiles are composed concerning demographic variables. Finally, we assumed that the emergent belief profiles differ concerning parents' attitudes (i.e., goal orientation, failure beliefs) and co-regulatory strategies (i.e., mastery- and helpless-oriented strategies).

5.1 Belief Profiles

The results of the LPA showed that three profiles of implicit theories exist and that most parents (61%) engage in balanced levels of the both examined domains of implicit theories (profile 2). The minority of parents (9%) displayed an entity theory (profile 1), while about one-third of the parents (30%) reported high incremental self-regulation theories (profile 3). The profiles overlap a good deal with the groups observed by Hertel et al. (2019) who studied implicit theories of intelligence and self-regulated learning in students. The groups of Hertel et al. (2019) only differ from the results of the current study in the composition of the group sizes that may result from different research contexts.

The results of the present study support the hypothesis that implicit theories of different domains can co-occur within persons. Although 60% of the parents reported both domains (i.e., intelligence and self-regulation) to be more or less equally malleable and relevant for success (profile 2), 40% of the parents differed in their beliefs across domains. Parents in profile 1 hold an incremental theory in the domain of intelligence while holding rather an entity theory in the domain of self-regulation. Parents in profile 3 perceived the malleability and relevance of their child's self-regulation to be much higher compared to the domain of intelligence.

Overall, most parents across profiles believed that intelligence and self-regulation are rather malleable and relevant for success, reflecting a ceicling effect. Nevertheless, the greatest differences between profiles became visible in parents' incremental theories of self-regulation. Compare, for example, profiles 1 and 3. Although both groups were nearly identical in their implicit theories of intelligence, their implicit theories of self-regulation diverge. One explanation might be that parents of preschoolers get to observe and experience situations more often in which their child's self-regulation becomes more obvious (e.g., respond to external demands, face prohibitions, deal with failure; see Pauen et al., 2019) than their child's intelligence (that might become more evident later in school life). In early childhood, self-regulatory competencies are developing (Kopp, 1982; Posner & Rothbart, 2000) and parents recognize interindividual differences in children (Bechtel et al., 2016; Pauen et al., 2019). These individual experiences and observations might result in the observed interindividual differences in parents' incremental theories of self-regulation. Thus, this finding highlights the importance of considering implicit theories of self-regulation beyond the more general implicit theories of intelligence.

Based on the demographic statistics, parents with entity theories (profile 1) were significantly less educated and rated their child's self-regulatory abilities as lower than parents with high incremental theories (profile 3). These results are in line with research using variable-centered methods (Haimovitz & Dweck, 2016; Jiang et al., 2019; Muenks et al., 2015; Pomerantz & Dong, 2006) finding associations between parents' implicit theories, education and children's competencies. Our findings suggest that interventions targeting parents' implicit theories might especially address low educated parents. As parents' educational attainment is a significant predictor of children's self-regulatory abilities (for a meta-analysis see Lawson et al., 2018), interventions are substantial to promote child self-regulation and to buffer the potential negative effect of low educational attainment. However, the associations between profile membership and children's self-regulatory abilities are possible in both directions (i.e., profile membership predicting child self-regulation and vice versa). For example, parents with

entity theories view their child's self-regulation as stable, show less support for their child, which may result in lower self-regulatory abilities. Otherwise, parents with low self-regulated children may observe less progress and therefore believe that self-regulation is stable. In contrast, parents with high self-regulated children have observed child development and, therefore, think that self-regulation is malleable. As this study is limited to cross-sectional data, we cannot draw any conclusions on the directions of effect. Therefore, these mechanisms have to be addressed in further research.

5.2 Relations Between Latent Profiles and Parents' Attitudes and Co-Regulatory Strategies

The third research question aimed to examine whether the latent belief profiles were associated with parents' attitudes and co-regulatory strategies. Our findings suggest that parents in different profiles show differentially adaptive or maladaptive patterns concerning their attitudes and co-regulatory strategies. Parents in profile 3 showed the most adaptive attitudes and behaviors compared to the others. They reported to hold more failure-is-enhancing mindsets and to engage in less performance-avoidance goals. These findings are in line with research using variable-centered methods (Burnette et al., 2013; Haimovitz & Dweck, 2016). Regarding co-regulatory strategies, our results add to Moorman and Pomerantz's (2010) findings that parents with high incremental theories (profile 3) report not less helpless-oriented strategies but more mastery-oriented strategies such as praising, negotiating, and call for self-regulation compared to the other profiles. The only exception emerged for distraction with parents in profile 1 showing higher values than parents in profile 3. As distraction can be both adaptive (Manimala et al., 2000; Stern et al., 2018) as well as maladaptive (Dahlquist & Pendley, 2005) in different situations, the context seems to be a relevant factor. As distraction was measured in a more context-general way in this study, future research should examine parents' distraction strategies in specific situations. Besides, the relation between profile membership and distraction strategies might also be related to children's self-regulatory abilities and failure beliefs: Parents who believe that self-regulation is stable engage in distraction strategies in order to avoid frustration and failure since the child cannot self-regulate due to low self-regulatory abilities (see profile 1). Thus, these parents believe that failure is debilitating because failure cannot enhance stable abilities. One may argue that this pattern can be an adaptive response when abilities are low and stable because parents do not overstrain their child. Actually, ample evidence indicates that self-regulatory abilities are malleable (Bernier et al., 2010; Huizinga et al., 2006; Kopp, 1982) and can be enhanced by training and interventions (Diamond et al., 2019; Diamond & Lee, 2011; Kaminski et al., 2008; Walk et al., 2018).

Although there is empirical evidence that parents' incremental theories of intelligence are negatively associated with controlling and performance-oriented behaviors (Moorman & Pomerantz, 2010), our results show that holding an incremental theory in one domain is not the only important predictor. The positive effects of parents' incremental theories of intelligence might be less strong when parents hold an entity theory in the domain of self-regulation at the same time (see profile 1). This finding supports the assumption that implicit theories of self-regulation are stronger predictors for domain-related attitudes and behavior than more general implicit theories of intelligence. Here, parents' implicit theories of self-regulation counteracted the effects of the domain of intelligence.

5.3 Limitations and Further Research

Our study should be interpreted in the light of their limitations. First, we used data from one single sample of preschoolers' parents and did not replicate the emerging profiles in a second, larger sample, which raises the question of generalization. Anyhow, our three-profile solution is supported by studies examining implicit theories in students (Hertel et al., 2019). Nevertheless, future research should study implicit theories in other samples of parents and examine whether the profiles are the same as in our study. Moreover, even though we did not find any age differences in our sample of three to six years old children, it would be interesting to examine the relations in other age groups, for example, in parents of toddlers or school-aged children. Here, more research is needed.

Second, one might be concerned about the recruitment of the sample via the Internet because we finally could not validate participants' status as parents. However, most of the participants were recruited via announcements in kindergartens. Thus, we may assume that only parents participated. Nonetheless, we cannot rule out a selection bias of the sample because the caption of the study was related to the role of self-regulation in early childhood. The study might especially have addressed parents who believe that self-regulation is malleable and highly relevant, explaining the high ceiling effect of implicit incremental theories of self-regulation. Furthermore, the sample shows a high proportion of mothers and high-educated parents. In future studies, other cultural contexts and a higher proportion of fathers should be considered. A validation of the emerging profiles in other cultural contexts might be an important next step in further research. For example, cross-cultural studies with Chinese and Finnish students illustrate both similarities and differences in students' implicit theories with regard to academic achievement (Zhang et al., 2019; Zhang et al., 2020). As this study was conducted with a German sample, the question arises if different profiles would emerge when

other cultural contexts would be considered: Cross-cultural studies with parents show that Chinese parents seem to emphasize good grades and competition in comparison to Western parents who place a high value on individual growth (Sang, 2017; Tobin et al., 1989). Therefore, considering different cultural contexts might have important implications for parents' belief profiles.

Third, our study is a cross-sectional study that does not allow any causal interpretation of findings. Future research could use an experimental design where implicit theories of multiple domains can be manipulated, and their effects on parents' attitudes and behavior can be examined. Besides, future research could examine if the profiles are stable or if parents change profile membership over time. Here, it would be interesting to analyze factors that predict changes in profile membership as well as associated changes in parents' attitudes and behavior, for example by using analytical techniques such as latent transition analysis.

Finally, we relied on self-reports of all study variables which may increase the risk of common-method variance (Podsakoff et al., 2012) and may be associated with problems of social desirability explaining the null effects for helpless-oriented strategies. We took several steps to reduce social desirability. Data were collected anonymously, participants were asked to fill out seriousness checks, and those who reported not having answered seriously and conscientiously were excluded from the analyses. Additionally, we included a questionnaire testing social desirability, thus ruling out that no social desirability bias as well as no significant correlations with parents' implicit theories were found. However, future studies should also include observational methods to assess parent-child-interactions.

5.4 Conclusion

Our study showed that implicit theories of intelligence and self-regulation occur in different configurations within parents, with 60% of the parents holding a balanced profile. These differences in belief profiles of parents were also associated with differences in their attitudes and co-regulatory strategies. Incremental self-regulation theorists emerged as the most adaptive configuration for parents' attitudes and strategies, whereas entity theorists showed rather maladaptive patterns. Our results emphasize the crucial role of implicit theories of self-regulation. This knowledge can be used for interventions targeting parents' implicit theories. By illustrating that children's self-regulation is malleable and relevant for success, adaptive configuration for parents' attitudes and strategies can be promoted. This might in turn impact children's implicit theories, learning, and development (Blackwell et al., 2007).

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Table 1

Model Fit for the Optimal Number of Profiles in the Latent Profile Analysis

Number	AIC	BIC	aBIC	LMR	*p*	Entropy
1	1146.987	1170.347	1145.038	-	-	-
2	1125.608	1163.567	1122.441	30.154	0.0182	0.858
3	1089.257	1141.817	1084.873	44.540	0.0066	0.952
4	1087.035	1154.194	1081.432	11.745	0.2290	0.903
5	1070.718	1152.478	1063.898	20.777	0.6242	0.919

Note. AIC=Akaike's Information Criterion. BlC=Bayesian Information Criterion. aBlC=sample size adjusted BlC. LMR=Lo-Mendell-Rubin adjusted LRT Test.

Table 2

Means and Standard Errors (in Parentheses) of Demographic Variables by Latent Profiles

Variable	Full sample		Profile 1[a]		Profile 2[b]		Profile 3[c]		Overall χ^2	Profile 1 vs. 2	Profile 1 vs. 3	Profile 2 vs. 3
Parent Characteristics												
Gender[1] [female]	.87	(0.03)	.85	(0.10)	.85	(0.04)	.93	(0.04)	2.24	0.00	0.54	2.13
Age[2] [years]	37.42	(0.45)	27.90	(4.53)	30.50	(1.97)	32.92	(2.28)	1.22	0.98	0.27	0.64
Education[1]	.79	(0.03)	.47	(0.14)	.70	(0.13)	.83	(0.06)	**5.75***	1.45	**5.37***	0.80
Number children[2]	1.93	(0.06)	1.85	(0.22)	1.88	(0.07)	2.07	(0.13)	1.85	0.02	0.82	1.73
Child Characteristics												
Gender[1] [female]	.55	(0.04)	.53	(0.14)	.59	(0.06)	.46	(0.08)	1.74	0.14	0.22	1.86
Age[2] [years]	4.65	(0.09)	4.40	(0.27)	4.61	(0.12)	4.81	(0.17)	1.80	0.49	1.60	0.87
Self-regulation[2] [parent-report]	5.34	(0.06)	4.91	(0.18)	5.37	(0.08)	5.47	(0.11)	**6.98***	**5.39****	**6.79***	0.48

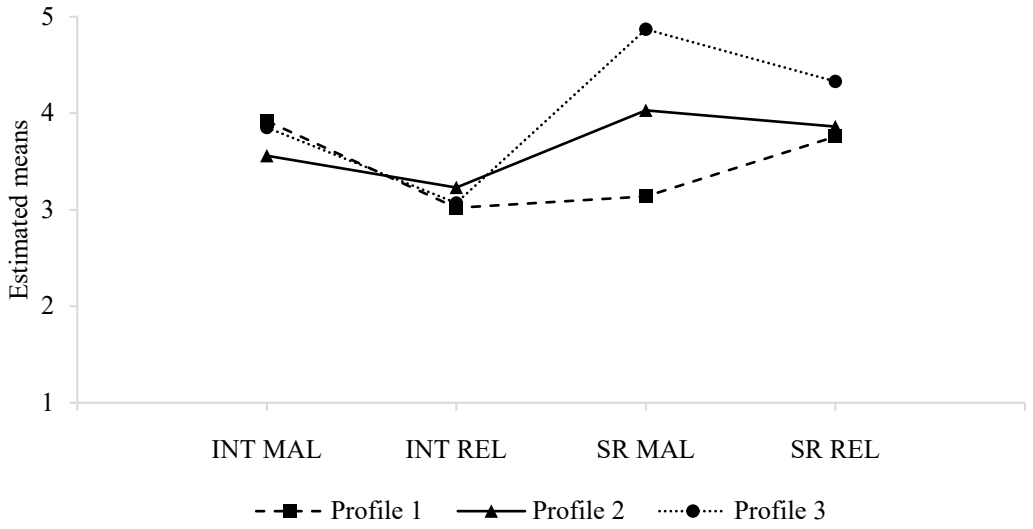
Note. Means are based on weighted data. Significance tests for group differences are based on [1]pseudo-class method or [2]BCH method with two *df* for the overall test and one *df* for the pairwise tests. Statistically significant values are printed in bold; $^{*}p<.05$; $^{**}p<.01$. [a] Entity Theorists (9%). [b] Balanced (61%). [c] Incremental Self-Regulation Theorists (30%).

Table 3

Means and Standard Errors (in Parentheses) of Failure Beliefs, Goal Orientation, and Co-Regulatory Strategies by Latent Profiles

Variable	Full sample		Profile 1[a]		Profile 2[b]		Profile 3[c]		Overall χ^2	Profile 1 vs. 2	Profile 1 vs. 3	Profile 2 vs. 3
Failure-is-enhancing mindset	3.88	(0.07)	3.65	(0.25)	3.76	(0.08)	4.19	(0.12)	**9.58****	0.16	**3.86***	**8.74****
Goal orientation												
Learning goals	4.33	(0.04)	4.22	(0.01)	4.29	(0.05)	4.44	(0.06)	**5.21**†	0.41	**3.59***	**3.55**†
Performance-approach goals	3.03	(0.06)	3.02	(0.15)	3.01	(0.07)	3.06	(0.12)	0.11	0.02	0.04	0.10
Performance-avoidance goals	2.07	(0.05)	2.00	(0.16)	2.16	(0.07)	1.91	(0.09)	**4.72**†	0.87	0.23	**4.56***
Mastery-Oriented Strategies												
Praising	4.83	(0.08)	3.95	(1.08)	4.70	(0.09)	5.04	(0.15)	4.42	0.47	0.99	**3.73***
Negotiating/discussing	4.17	(0.06)	4.00	(0.19)	4.11	(0.07)	4.37	(0.11)	**4.96**†	0.28	**2.86**†	**3.99***
Distraction	3.31	(0.08)	3.85	(0.25)	3.16	(0.10)	3.46	(0.15)	**8.07***	**6.56***	1.83	**2.98**†
Call for self-regulation	3.09	(0.09)	2.64	(0.15)	2.94	(0.20)	3.24	(0.16)	**7.26***	1.40	**7.25****	1.40
Helpless-Oriented Strategies												
Giving in	2.39	(0.07)	2.19	(0.21)	2.42	(0.09)	2.40	(0.13)	0.99	0.98	0.69	0.02
Negative pressure	3.57	(0.06)	3.60	(0.13)	3.57	(0.09)	3.57	(0.12)	0.04	0.03	0.00	0.04

Note. Means are based on weighted data. Significance tests for group differences are based on BCH method with two *df* for the overall test and one *df* for the pairwise tests. Statistically significant values are printed in bold; $^{*}p<.05$; $^{**}p<.01$. [a] Entity Theorists (9%). [b] Balanced (61%). [c] Incremental Self-Regulation Theorists (30%).



Note. INT MAL = Implicit theories of intelligence malleability; INT REL = Implicit theories of intelligence relevance; SR MAL = Implicit theories of self-regulation malleability; SR REL = Implicit theories of self-regulation relevance; Profile 1 (Entity Theorist): *n* = 13 (9%); Profile 2 (Balanced): *n* = 83 (61%); Profile 3 (Incremental Self-Regulation Theorists): *n* = 41 (30%)

Figure 1. Three-Profile Solution for the Latent Profile Indicators.

Appendix B – Paper 2

This is the revised and resubmitted version of the following article:

Stern, M., & Hertel, S. (2022). Relationship between maternal scaffolding and preschooler's metacognitive strategies in a problem-solving situation. *Learning and Instruction*. (Revised and Resubmitted)

Appendix B – Paper 2

Running head: SCAFFOLDING AND SELF-REGULATORY STRATEGIES

Relationship Between Maternal Scaffolding and Preschooler's Metacognitive Strategies in a Problem-Solving Situation

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Abstract

This study examined how mothers' scaffolding predicts preschoolers' metacognitive strategies and task performance. N=132 preschoolers and their mothers participated in the study. Problem-solving tasks were solved in mother-child interactions and independently. Mothers' scaffolding (means; cognitive, metacognitive, autonomy support) and mother-child task performance were coded during mother-child interactions. Children's metacognitive strategies and task performance were coded during child-alone problem-solving. Path-model analyses found that mothers' metacognitive support was negatively – and autonomy support positively – associated with mother-child task performance. Mothers' scaffolding means served different scaffolding intentions, building two scaffolding strategies: (1) Mothers using more scaffolding means provided more cognitive support, which was related to lower levels of children's metacognitive strategies. (2) Mothers using fewer scaffolding means provided more autonomy support, which was related to higher levels of children's metacognitive strategies. This study demonstrates the importance of examining scaffolding strategies and shows that different scaffolding strategies may be relevant in joint and child-alone problem-solving.

Keywords: self-regulation; metacognitive strategies; maternal scaffolding; task performance.

1 Introduction

In recent decades, a considerable amount of research has explored children's self-regulated learning (SRL; for a meta-analysis, see Dent & Koenka, 2016). Self-regulatory abilities improve rapidly during preschool (Garon et al., 2008), and are related to preschoolers' strategic behaviors in problem-solving (Pino-Pasternak & Whitebread, 2010; H. Zhang & Whitebread, 2017). Sociocultural theory (Vygotsky, 1978) suggests that parents play a fundamental role in promoting children's SRL. According to this theory, children gradually internalize their parents' co-regulatory strategies and become more able to regulate independently (Bernier et al., 2010). In particular, parents' scaffolding is related to children's self-regulatory abilities and task performance in problem-solving contexts (e.g., Erdmann et al., 2019; Pino-Pasternak & Whitebread, 2010; H. Zhang & Whitebread, 2017).

Despite the repeatedly documented relationship between parents' scaffolding and children's SRL, the specific mechanisms by which scaffolding influences children's strategic behaviors have been less systematically explored. A recent study found that parents' contingency was the only independent predictor of children's SRL (H. Zhang & Whitebread, 2017). However, this did not consider the potential for interplay between single aspects of parents' scaffolding. For example, research suggests that combining scaffolding means with scaffolding intentions results in scaffolding strategies that enhance children's problem-solving efforts in parent-child interactions (Erdmann et al., 2019; van de Pol et al., 2010). Whether this interplay also affects children's metacognitive strategies in child-alone problem-solving is unclear. Therefore, the present study links different aspects of mothers' scaffolding (means and intentions) to preschoolers' metacognitive strategies using path model analyses.

Scaffolding

The concept "scaffolding" describes an instructional interaction during problem-solving that enables learners to solve a task that they could not resolve unassisted (Wood et al., 1976). Scaffolding is based on the theory of the "zone of proximal development" (ZPD), which concerns the distance between a child's actual and potential development (Vygotsky, 1978). Researchers assume that children learn through interaction with experienced adults or peers, gradually becoming independent learners by internalizing the observed strategies (Bernier et al., 2010). Scaffolding has been conceptualized and examined in different contexts, including cognitive (Granott, 2005), educational (van de Pol et al., 2010), and developmental psychology (Hammond et al., 2012), and there are multiple definitions and measures. The term "scaffolding" was first used in a series of studies by Wood and colleagues (1976; 1975), who

examined levels of instruction given by mothers in interactions with their 3–5-year-old children, who were working on problem-solving tasks. These tasks (constructing a three-dimensional wooden pyramid) were beyond the children's current abilities but could be completed with some help. The results show that the optimal level of support is one level above the children's ability level, reflecting children's "region of sensitivity." Researchers following this approach have explored parental contingency, describing how parents adapt their responses according to their children's performance (Carr & Pike, 2012; Conner & Cross, 2003; Meins, 1997). In a second approach to scaffolding theory, the parents' verbal input is defined as "scaffolding," providing information about associations between objects and actions (e.g., Landry et al., 2002). This approach focuses more on the content of parents' verbal instructions (e.g., encouragement, informative feedback, hints) and less on how contingent the parents' behavior is (e.g., Landry et al., 2002; Lowe et al., 2013). A third approach explores scaffolding multidimensionally, including different dimensions, such as (meta-)cognitive support, emotional support, and autonomy support (Bernier et al., 2010; Hughes & Ensor, 2009; Neitzel & Stright, 2003). These different dimensions are said to target specific aspects of children's learning and development. For example, autonomy support may enhance children's agency, while emotional support may benefit children's frustration control (Mermelshtine, 2017). Although the approaches have similarities, the different conceptualizations pose challenges to scaffolding research.

Van de Pol et al. (2010) scrutinized the different areas of scaffolding, and they provide an integrative framework that includes the process of scaffolding, scaffolding means, and scaffolding intentions. This framework originates from research on teacher-student interactions but was recently adapted and applied to parent-child interactions (Erdmann et al., 2019). According to van de Pol et al. (2010), contingency, fading (i.e., the gradual withdrawal of scaffolding), and transfer of responsibility (also: autonomy support) are key characteristics of the *scaffolding process*. Parents gradually transfer responsibility for the performance by decreasing the amount of support they are giving. Parents' autonomy support depends on the children's level of competence and development. For example, when the child shows a good understanding of the task, the parent decreases their support and provides the opportunity for the child to independently find a solution. Different scaffolding strategies are used as part of the scaffolding process, further distinguished into scaffolding means and scaffolding intentions. *Scaffolding means* describe *how* scaffolding takes place, involving asking questions; giving hints, instructions, feedback, and explanations; and encouraging transfer. Scaffolding researchers argue that scaffolding means are essential for describing interactions more precisely

(van de Pol et al., 2010). However, the use of such scaffolding means "does not automatically imply the occurrence of scaffolding" (p. 275). Therefore, another aspect refers to *what activities* (e.g., cognitive, metacognitive, affective) are scaffolded (van de Pol et al., 2010). Authors describe this aspect as the focus of scaffolding or *scaffolding intention* (van de Pol et al., 2010). For example, cognitive structuring and reducing the degrees of freedom are used to support learners' cognitive activities (van de Pol et al., 2010). Transferred to parent-child dyads, parents' *cognitive support* promotes children's cognitive activities in problem-solving situations by structuring or simplification. When the intention is to support children's metacognitive activities, parents provide *metacognitive support*, such as suggesting how to proceed with the task. While van de Pol et al. (2010) treat *autonomy support* as a process variable, we argue that child autonomy can also be seen as an activity that parents aim to support: promoting autonomy is intended to actively engage the child in the learning process. Scaffolding means occur in combinations with scaffolding intentions. For instance, "the modeling of key ideas is described as a means to scaffold the cognitive activities of students together with the intentions of cognitive structuring or reduction of the degrees of freedom" (van de Pol et al., 2010, p. 277). Transferred to parent-child dyads, parents ask task-related questions or point to relevant features of the task to enhance their children's cognitive activities. In this way, scaffolding means support certain scaffolding intentions (i.e., the more questions are used, the more cognitive support is given), reflecting scaffolding strategies (van de Pol et al., 2010). Erdmann et al. (2019) provide empirical evidence for this theoretical assumption by examining the link between parental scaffolding and parent-child problem-solving performance. Their findings indicate that parents' use of scaffolding means (i.e., questions, hints, instructions, and feedback) is indirectly related to dyadic problem-solving performance, partially mediated via parents' cognitive support. Thus, parents' use of scaffolding means serves their children's cognitive activities and enhances dyadic problem-solving. Nevertheless, no conclusions can be drawn about whether these scaffolding strategies predict children's metacognitive strategies and child-alone problem-solving.

Children's SRL and Parental Scaffolding

Research is increasingly linking parental scaffolding to children's SRL (e.g., Neitzel & Stright, 2003; Pino-Pasternak & Whitebread, 2010). SRL is a strategic, self-reflective process that yields effective learning, including the active regulation of cognitive strategies (Pino-Pasternak & Whitebread, 2010), the initiation of actions and self-motivation, and the use of metacognitive strategic behaviors (Zimmerman, 2008). *Metacognitive strategies* are essential

components of SRL, as they encompass the skills needed to plan (i.e., how to achieve a goal), monitor (the progress), and evaluate (e.g., the (un)reached goal) one's actions (Winne, 2001), which enhances problem-solving performance (Dermitzaki et al., 2009) and academic success (Veas et al., 2019). SRL is not only a significant predictor of important learning outcomes, it is also highly sensitive to interventions and can be successfully promoted. Most studies have focused on school-age children (Pino-Pasternak & Whitebread, 2010), with some highlighting the kindergarten period as crucial for children's self-regulatory development (Bronson, 2000). Children's learning begins long before school starts (Vygotsky, 1978) and can be enhanced in playful interactions (Whitebread, 2012). Therefore, researchers are increasingly emphasizing the underestimation of preschoolers' SRL (Whitebread, 2012; H. Zhang & Whitebread, 2017). We acknowledge that, along with metacognitive strategies, children's cognitive and motivational strategies are essential components of SRL (Dermitzaki et al., 2009). However, since research has shown that preschoolers' metacognitive strategies are the main predictor of children's learning outcomes (H. Zhang & Whitebread, 2017), the focus of the current study lies on children's metacognitive strategies.

Autonomy support and children's SRL. Parents' autonomy support is defined as behaviors to value and empower children's independent efforts, choice, and involvement in problem-solving (Grolnick & Ryan, 1989; Pino-Pasternak & Whitebread, 2010). Early studies have shown that children's engagement in metacognitive behaviors is closely related to parents' ability to encourage children's autonomy. For example, Gauvain and Rogoff (1989) conducted a study with 5- and 9-year-old children, who were asked to plan a route in a model grocery store with another person (a peer or an adult) or who worked independently, without any support. The results demonstrate that the children who worked in dyads with shared task responsibility developed the most efficient routes in later individual problem-solving. The authors assumed that shared task responsibility might result in cognitive gains, which would affect the children's SRL. Neitzel and Stright (2003) have also shown that mothers' autonomy support predicts children's task persistence and behavior control. High levels of responsibility allow children to use their cognitive skills and experience themselves as "active participants in the learning process" (Neitzel & Stright, 2003, p. 149). The relationship between parents' autonomy support and children's self-regulatory abilities is evident over time, even with control for other factors – such as children's prior achievement (e.g., Wang et al., 2007) and parental education (Joussemet et al., 2005). Research indicates that children's self-regulatory abilities partially mediate the link between parents' autonomy support and children's achievement (Bindman et al., 2015).

Cognitive support and children's SRL. Cognitive support refers to activities that structure or simplify a task in relation to the child's ZPD (Vygotsky, 1978). Parents' cognitive support is reported to provide children with important learning strategies (Mermelshtine, 2017) and to predict children's metacognitive talk, monitoring, and help-seeking (Neitzel & Stright, 2003), even after controlling for parents' education and reasoning skills (Stright et al., 2009). In contrast, H. Zhang and Whitebread (2017) could not confirm a link between parents' level of cognitive support and children's self-regulatory strategies. The authors emphasize that the success of parents' scaffolding is not a question of the quantity of cognitive support, but rather depends on how well parents' support reflects the child's level of competence and development (van de Pol et al., 2010). Thus, there is a notable difference between the quantity and quality of parents' scaffolding (Wood & Middleton, 1975). Although H. Zhang and Whitebread (2017) examined the predictive power of different dimensions of parental scaffolding (i.e., cognitive support, emotional support, contingency) for children's self-regulatory strategies, they did not analyze the potential interplay between these dimensions to understand the underlying processes.

Metacognitive support and children's SRL. Metacognitive support aims to scaffold children's metacognitive activities, such as planning, monitoring, and evaluation (Erdmann et al., 2019; van de Pol et al., 2010). For example, learners' strategy use and planning can be supported by making suggestions for how to work on the task and providing instructional assistance. Parents' metacognitive support is related to higher metacognitive strategies in children, such as better monitoring, detecting and self-correcting errors, and adjusting learning strategies (Neitzel & Stright, 2003; Stright et al., 2009). In addition, metacognitive support is positively correlated with children's cognitive development (Erdmann et al., 2019). It has been suggested that structuring the task into single steps (i.e., cognitive support) is important for children to effectively use their parents' metacognitive information (Stright et al., 2009).

The Present Study

Research has identified parental scaffolding as having a significant effect on children's performance in problem-solving, academic outcomes, and specific self-regulatory strategies. However, the literature on parental scaffolding has either focused on describing single aspects of scaffolding (e.g., Wood et al., 1976) or examined how much additional variance is accounted for by different scaffolding dimensions (by using hierarchical regression analysis; e.g., Neitzel & Stright, 2003; H. Zhang & Whitebread, 2017). Previous research has less systematically explored the combination of different aspects of scaffolding. However, the combinations of

aspects may be of particular interest, as parents do not engage in isolated behaviors when supporting their children. Since any combination of a scaffolding mean with a scaffolding intention forms a scaffolding strategy (van de Pol et al., 2010), the number of scaffolding strategies is too great to explore separately. Therefore, the present study examines how a set of scaffolding means serve different intentions (i.e., support of cognitive activities, metacognitive activities, and autonomy), building scaffolding strategies. The current study investigates how these strategies are related to children's problem-solving and metacognitive strategies.

While most research examining children's SRL has focused on school-age children (e.g., Pino-Pasternak & Whitebread, 2010), the present study centers preschool children, as kindergarten age is crucial for self-regulatory development (Bronson, 2000) and improvement in problem-solving abilities. At the same time, children of this age still often need the support of their parents. Therefore, to understand the role of parental scaffolding in the development of children's self-regulatory strategies, it is important to study the effects of scaffolding at an age when children are not yet in school and are still experiencing instruction-based interactions at home (Mermelshtine, 2017). In addition, to remove the potential for gendered differences between maternal and paternal figures (Parke, 2013), the current study focuses on mothers as primary caregivers.

This study poses two research questions. A graphical representation of all hypotheses can be found in Figure 1.

(1) How is maternal scaffolding associated with mother-child task performance?

We argue that maternal scaffolding intentions (i.e., cognitive, metacognitive, autonomy support) positively relate to mother-child task performance. We expect higher mother-child task performances when mothers structure or simplify a task (i.e., cognitive support; Neitzel & Stright, 2003), suggest how to solve a task (i.e., metacognitive support; Erdmann et al., 2019), and/or actively involve the children in a task (i.e., autonomy support; Grolnick et al., 2002) (H1).

Transferring the ideas of van de Pol et al. (2010) to the context of mother-child interactions, we hypothesize that mothers' scaffolding intentions will mediate the relationship between the use of scaffolding means and mother-child task performance (H2). Replicating the findings of Erdmann et al. (2019), we assume that the set of scaffolding means will serve different intentions, forming scaffolding strategies.

(2) Does maternal scaffolding relate to children's metacognitive strategies and child-alone task performance?

Consistent with earlier research (Dermitzaki et al., 2009; H. Zhang & Whitebread, 2017), we expect children's metacognitive strategies (i.e., planning, monitoring, evaluation) to predict children's task performance (H3).

In accordance with existing evidence (Gauvain & Rogoff, 1989; Neitzel & Stright, 2003; Stright et al., 2009), we expect mothers' cognitive, metacognitive, and autonomy support to predict children's metacognitive strategies, such that the more support mothers give, the greater use the children make of metacognitive strategies in the subsequent task (H4).

Extending prior research (Erdmann et al., 2019; van de Pol et al., 2010) and illustrating scaffolding means to serve a certain function (i.e., building a scaffolding strategy), we further hypothesize that mothers' use of scaffolding means will be indirectly associated with children's metacognitive strategies, as mediated by cognitive, metacognitive, and autonomy support (H5).

Given the existing evidence (Bindman et al., 2015; H. Zhang & Whitebread, 2017), we further hypothesize that mothers' scaffolding intentions will be indirectly related to children's task performance, as mediated by children's metacognitive strategies (H6).

2 Method

2.1 Participants

The sample included *N*=138 mother-child dyads. Data for six dyads were not included in the analysis because the participants did not meet the inclusion criteria (did not speak German, *n*=1; were too young, *n*=1) or the children were uncooperative (*n*=4), resulting in a final sample of *N*=132 mother-child dyads. The mothers ranged in age from 27 to 50 years (*M*=38.76 years, *SD*=4.40 years). The children (55% female) were four or five years old[3] (*M*=4.80 years, *SD*=0.56 years, range=4.00–5.92 years), and 80% had at least one sibling (*M*=1.07, *SD*=0.78, range=0–4). No siblings were included in the sample, and mothers were only allowed to participate with one child. The family social class index was applied, taking into account the mothers' school education, professional education, and current professional status, following the procedure proposed by Winkler and Stolzenberg (2009). With scores of 3–8 indicating low, 9–14 moderate, and 15–21 high socioeconomic status, the sample includes families primarily from a high socioeconomic background (*M*=15.32, *SD*=2.77, range=6.00–19.00).

[3] In Germany, school entry age is 6 or 7 years, so the present sample consists exclusively of preschool children.

2.2 Procedure

Data were collected within the scope of an experimental study on mothers' implicit theories[4]. The assessment took place in a laboratory setting in the university and lasted approximately one hour. The whole procedure was video recorded. The assessment started with a parent-child interaction (T1, 10 minutes), including several problem-solving tasks from the subtest "triangles" from the German version of the Kaufmann's Assessment Battery for Children II (Melchers & Melchers, 2015). In these problems, children are asked to re-create two-dimensional patterns using foam triangles that are blue on one side and yellow on the other. The test measures visual cognitive abilities and understanding of spatial relationships and is similar to familiar games such as puzzles, tangram, and Lego. The tasks were chosen to be moderately challenging but were not intended to overburden the children so that both maternal scaffolding and children's SRL are required. To initiate the mother-child interactions, the mothers were instructed: "You are allowed to support your child, but please do not solve the problems on your own." This instruction enabled the mothers to decide how much or how little support to give their child. Afterwards, the children solved the same tasks without their mothers' support (T2, 5 minutes), followed by two tasks testing the children's vocabulary and behavioral self-regulation. At the same time, the mothers filled out questionnaires. The study protocol was approved by the Faculty Ethics Committee, and written informed consent was obtained from all mothers.

Coder training. All ratings were done by experienced coders, who had a psychology degree and substantial expertise in coding parent-child interactions. The procedure for the coder training included three phases. In phase 1, a theoretical overview of the constructs was given. In phase 2, the coding scheme was introduced and behavioral examples for each scale were discussed. In the third phase, the raters performed test codings using data from a pilot study and then discussed their results each week. A moderator attended the discussions and mediated conflicts. Solutions for the conflicts were recorded in a memo protocol and reviewed by the moderator. Phase 3 continued until a common understanding was reached. The training was then completed, and 20 randomly selected videos (of each measure) were double coded by two independent raters.

[4] Mothers' implicit theories were experimentally manipulated by presenting short information about the subtest "triangles" before the mother-child interactions started. The experimental design aimed to explore implicit theories as determinants of scaffolding. As this was not focus of the current study, the effects of the experimental manipulation on implicit theories were not considered in the present analyses.

2.3 Measures

Task performance: The numbers of solved tasks were calculated separately for the mother-child (T1) and child-alone (T2) problem-solving performances. Tasks were rated as solved if the form and color were correct. A maximum of 22 points could be achieved for a solved task. Interrater reliability was excellent (ICC=1.00).

Rating of mothers' scaffolding: Mothers' scaffolding during the 10-minute interactions (T1) was coded, using a high-inference rating scheme (Erdmann et al., 2019). Four aspects of scaffolding were rated on two levels: *how* scaffolding takes place (use of scaffolding means) and *what* activities are scaffolded (scaffolding intentions: cognitive support, metacognitive support, autonomy support). All items were rated on a 5-point scale, ranging from 1=*not at all* to 5=*very often,* with average mean scores produced for each scale. The scale for mothers' *use of scaffolding means* included six items referring to how often the mother asked questions; gave hints, instructions, feedback, and explanations; and encouraged transfer to the child in the problem-solving task (Cronbach's α =.64). "Questions" were conceptualized as a scaffolding mean that structures the task and cognitively engages the child and, for example, refer to the aim of the task (e.g., "What should we do?"), to the shapes and colors of the triangles (e.g., "What color is this?"), or to the course of action (e.g., "Which one next?"). "Hints" (verbal and nonverbal) give information relevant to achieving the aim, without giving away the solution (e.g., "There is one missing!"). "Instructions" include descriptions or demonstrations of further steps, focusing on problem-solving actions (e.g., "Turn the triangle a little more!"). "Feedback" may refer to mistakes (in a constructive way) and may be given, for example, on progress (e.g., "Great, now you've built the bottom row!"), or results (e.g., "Look, the two on the template are blue, but this one is yellow. That is wrong."). "Explanations" provide information that complements or justifies decisions or solutions (e.g., "This doesn't fit because the triangles' long side has to be at the bottom."). "Transfer" means applying what has been learned to new situations (e.g., "You can build this part as in the previous task") or using existing knowledge (e.g., from other games) or skills in the new situation (e.g., "This forms a pyramid, like in the book we read"). The *cognitive support* scale included two items ("The mother structures the situation, i.e., verbalizes how to proceed, etc." and "The mother simplifies the task for the child according to the zone of proximal development, e.g., by subdividing the task into smaller steps, or if necessary, by demonstrating possible actions"; Spearman Brown[5] =.81) referring to the learning strategies provided by the mothers (e.g., reduction in degrees of freedom when

[5] The Spearman-Brown coefficient is the recommended reliability measure for two-item scales, referring to Eisinga et al. (2013).

needed). The *metacognitive support* scale comprised two items ("The mother makes suggestions on how to work on the task" and "The mother formulates interim results and discusses the task progression"; Spearman Brown[1] =.60), targeting the children's metacognitive activities, such as planning, monitoring, and evaluation. Mothers' *autonomy support* contained six items that described the extent to which the children were allowed to solve the task autonomously ("The mother lets the child decide how to work on the task," "The mother picks up on the child's ideas and actions," "The mother actively engages the child in the problem-solving task," "The mother encourages the child to work on the task independently," "The mother gives the child opportunities to identify errors independently," and "The mother gives the child opportunities to correct errors independently"; Cronbach's α=.89). Interrater reliability was excellent (Koo & Li, 2016) for the scales of *scaffolding means* (ICC=.99), *cognitive support* (ICC=.99), *metacognitive support* (ICC=.94), and *autonomy support* (ICC=.99).

Children's metacognitive strategies: Children's self-regulatory strategies were coded during the 5-minute, child-alone problem-solving task (T2). Three strategic behaviors (planning, monitoring, and evaluation) on the metacognitive strategic behaviors subscale of the "Strategic Behavior Observation Scale" (SBOS; Dermitzaki et al., 2009) were adapted for the problem-solving task. *Planning* was assessed as the degree to which the child worked with a clear plan, ranging from "approaching the task as trial and error" (e.g., triangles are turned and twisted at random) to "working with a clear plan, using time effectively" (e.g., follows the same systematically, solution-oriented action sequence for almost all figures). *Monitoring* included a rating of the degree to which the child examined the solution process, ranging from "working haphazardly, does not monitor his activities toward the solution" (e.g., repeatedly uses the same strategy to get to the solution even though it does not succeed) to "examines the solution process closely, selects appropriate next step" (e.g., reflects and adapts strategies). As an indicator of *evaluation,* children's awareness of errors was rated on a scale from "does not realize errors" to "has full awareness of errors and tries to correct them." The degree to which the strategic behaviors were evident was described on a 4-point Likert-scale, ranging from 1 (behavior is rare or absent) to 4 (full evidence of the behavior). This score was then averaged to find a mean for the children's metacognitive strategies (Cronbach's α=.77). Interrater reliability was computed using ICC on 20 videos. Interrater reliability was good (Koo & Li, 2016) for *planning* (ICC=.84), *monitoring* (ICC=.83), and *evaluation* (ICC=.92).

2.4 Statistical Analyses

Preliminary analyses were conducted to determine whether gender and age had affected the measures. Two-sample t-tests indicate no significant differences between boys and girls in their task performances, metacognitive strategies, or mothers' scaffolding (i.e., cognitive support, autonomy support). However, mothers used more scaffolding means with boys (M=2.46, SD=0.42) than with girls (M=2.32, SD=0.37), $t(130)=2.08$, p=.040, d = 0.66, and showed a greater tendency for metacognitive support in boys (M=2.07, SD=0.73) than in girls (M=1.87, SD=0.59), $t(130)=1.72$, p=.088, d = 0.39. Mother's age was not related to any of the observational measures. In contrast, child's age was significantly related to all study variables, except metacognitive support (see Table 1).

Potential problems with multicollinearity were examined using the variance inflation factor (VIF; Franke, 2010). The VIF is the inverse of unexplained variance, with values ≥10 indicating potentially harmful collinearity. All predictor variables had VIFs of <10 and correlations of <.80, suggesting the absence of multicollinearity.

To answer the two research questions, two path models were conducted using lavaan in R (Rosseel, 2012). The first research question addresses the relationship between maternal scaffolding and mother-child task performance. The first path model specifies mothers' scaffolding intentions as direct predictors of mother-child task performance. In addition, mothers' scaffolding intentions (i.e., cognitive, metacognitive, autonomy) are specified as mediating variables between mothers' scaffolding means and mother-child task performance. Child age and gender are included as covariates in all regression equations. The second research question addresses the relationship between maternal scaffolding, child metacognitive strategies, and child-alone task performance. In the second path model, mothers' scaffolding intentions are specified as direct predictors of children's metacognitive strategies. Children's metacognitive strategies are specified as mediating variables between mothers' scaffolding intentions and children's task performance. Child age and gender are included as covariates in all regression equations. Because mothers differed in how much they assisted in the joint problem-solving, potential training effects for the children in child-alone problem-solving could vary. Therefore, mother-child task performance (at T1) is controlled for children's task performance (at T2). Standardized regression coefficients were used for direct effects. As the indirect effect estimates generally do not follow normal distribution, 95% bias-corrected confidence intervals (Bc CI) were examined for indirect effects. Bootstrapping does not rely on normality assumptions, is based on resampling, and corrects for biases in the central tendency of the estimates. For the following analyses, bootstrapping with 5,000 samples was used. When

the upper and lower bound of the Bc CI did not contain zero, effects were considered to be significant (Preacher & Hayes, 2008).

3 Results

3.1 Descriptives

Descriptive statistics and bivariate correlations of all independent and dependent variables are shown in Table 1. Children's metacognitive strategies are positively related to mother-child and child-alone task performance and mothers' autonomy support. Additionally, children's metacognitive strategies are associated with lower levels of mothers' use of scaffolding means and cognitive support. Similarly, child-alone task performance is positively correlated with mothers' autonomy support and negatively related to mothers' scaffolding means and cognitive support.

3.2 RQ1: Relationship Between Maternal Scaffolding and Mother-Child Task Performance

The results of the first path model are illustrated in Figure 2. Variables in this model explain 40% of the variability in mother-child task performance (at T1). The results show that mothers' metacognitive support is negatively (β=-.14, p=.032) – and mothers' autonomy support positively (β=.15, p=.038) – related to mother-child performance (H1). There is no significant relationship between mothers' cognitive support and mother-child task performance.

Indirect effects of mothers' scaffolding means on mother-child task performance, as mediated by mothers' scaffolding intentions (i.e., cognitive, metacognitive, autonomy support), are displayed in Table 2 (row 1-3). Mothers' metacognitive support mediates the relationship between mothers' scaffolding means and mother-child task performance (H2). No significant effects are found for cognitive support and autonomy support.

3.3 RQ2: Relationship Between Maternal Scaffolding, Child Metacognitive Strategies, and Child-Alone Task Performance

The results of the second path model are illustrated in Figure 3. Variables in the model explain 34% of the variability in children's metacognitive strategies and 66% of the variance in child-alone task performance (at T2). The results show that children's metacognitive strategies are positively related to child-alone task performance (H3; β=.53, p<.001). In addition, mothers' cognitive support is negatively associated with child-alone task performance (β=-.16, p=.017). Mothers' autonomy support positively predicts children's metacognitive strategies (H4; β=.19, p=.024), whereas cognitive support negatively predicts children's

metacognitive strategies (H4; β=-.20, p=.019). Mothers' metacognitive support has no significant association with children's metacognitive strategies.

Indirect effects of mothers' scaffolding means on children's metacognitive strategies, as mediated by mothers' scaffolding intentions, as well as the indirect effects of mothers' scaffolding intentions on child-alone task performance, as mediated by children's metacognitive strategies, are displayed in Table 2 (row 4-9).

Mothers' cognitive and autonomy support mediate the relationship between their use of scaffolding means and children's metacognitive strategies (H5). When the effect of mothers' cognitive and autonomy support is taken into account, the direct effect of mothers' scaffolding means on children's metacognitive strategies becomes insignificant, indicating a full mediation.

Children's metacognitive strategies significantly mediate the relationship between mothers' cognitive support and child-alone task performance (H6). The direct effect of mothers' cognitive support on child-alone task performance declines but remains significant when children's metacognitive strategies are added in the model, suggesting partial mediation.

Children's metacognitive strategies also mediate the relationship between mothers' autonomy support and child-alone task performance (H6). When the effect of children's metacognitive strategies is controlled, the direct effect of mothers' autonomy support on children's task performance becomes insignificant, indicating full mediation.

4 Discussion

Building on the theoretical framework of van de Pol et al. (2010), the present study examined how a set of scaffolding means serve different scaffolding intentions (i.e., support of cognitive activities, metacognitive activities, and autonomy), forming scaffolding strategies, and how these strategies are linked to children's task performance and metacognitive strategies. We designed two problem-solving situations. In the first, mothers and children worked on several problem-solving tasks together. The children were then asked to solve the same tasks independently. The research questions asked 1) how maternal scaffolding is associated with mother-child task performance and 2) whether maternal scaffolding relates to children's metacognitive strategies and task performance when children solve tasks independently.

4.1 Maternal Scaffolding and Mother-Child Task Performance

First, we examined the relationship between maternal scaffolding and mother-child task performance during joint problem-solving. In support of H1, we found positive associations between maternal autonomy support and mother-child task performance. The findings suggest

that higher levels of autonomy support are related to higher performance, which is in accordance with previous evidence. For example, Grolnick et al. (2002) found that dyads with autonomy-supportive mothers achieve better performances than dyads with less autonomy-supportive mothers. In addition, autonomy support seems to have positive long-term effects on children's self-regulatory development (Bernier et al., 2010; Matte-Gagné et al., 2015).

Unexpectedly, mothers' cognitive support was unrelated to the number of tasks solved by joint problem-solving. In contrast, Erdmann et al. (2019) found a positive relationship between cognitive support and task performance. Comparing the two studies, it is evident that the parents in Erdmann et al. (2019) gave more cognitive and less autonomy support than the mothers in the current study. One reason for the inconsistent findings could be that Erdmann et al. (2019) observed parental scaffolding with full-term and preterm children during toddlerhood. Preterm birth is related to differences in parental scaffolding such as more intrusiveness and control (e.g., Clark et al., 2008). In addition, for toddlers, structuring and simplifications (i.e., cognitive support) might be more important for joint task success than in preschool children, due to the child's level of cognitive development (Conner & Cross, 2003).

In contrast to our expectations, a negative relationship was found between metacognitive support and mother-child task performance. This could indicate that the mothers spent more time supporting their children's metacognitive activities than focusing on the number of solved tasks. Research shows that metacognitive skill acquisition takes time and effort (Veenman et al., 2006), resulting in temporarily lower task performance. In the current study, mothers were instructed to help their children but not to solve the tasks independently. In addition, they knew that their child would have to solve the same tasks independently, after the joint problem-solving exercise. Therefore, the mothers may have focused more on their children's understanding and autonomy, rather than putting them under pressure to complete as much as possible. However, the effect of mothers' metacognitive support on mother-child task performance is in the small range, as defined by Cohen (1992), which could be because the mothers provided relatively little metacognitive support overall. One explanation for this may relate to the task type. Future research examining *when* parents provide metacognitive support in various kinds of tasks is needed (H. Zhang & Whitebread, 2017). In relation to the interplay between mothers' scaffolding means and scaffolding intentions (H2), we found mothers' metacognitive support to mediate the relationship between scaffolding means and mother-child task performance. Although this effect was small, the results indicate that scaffolding means are positively associated with metacognitive support, supporting the findings of Erdmann et al. (2019). Overall, only small correlations between mothers' scaffolding and joint task

performance were found. This raises the question which other aspects of scaffolding, such as affective support, should be considered. The following section discusses whether mothers' scaffolding in joint problem-solving predicts children's metacognitive strategies and task performance in child-alone problem-solving.

4.2 Maternal Scaffolding, Child Metacognitive Strategies, and Child-Alone Task Performance

The second research question addresses the relationship between maternal scaffolding, children's metacognitive strategies, and task performance in child-alone problem-solving. In support of H3, the children's metacognitive strategies were related to child-alone task performance. In particular, children with high metacognitive strategies performed better and solved more tasks than children with low metacognitive strategies did. It is argued that metacognitive strategies help to reduce task complexity, especially in challenging tasks (H. Zhang & Whitebread, 2017). For example, when children always start a task by building the lower part of the figure, they create a helpful framework for the tasks that follow. Solving the task by trial and error (i.e., low planning) is less effective and can be highly time-consuming, thus fewer tasks can be solved. These findings expand on earlier research by Dermitzaki et al. (2009) with school-age children, showing that metacognitive strategies can already be observed in preschoolers. Furthermore, the present study supports the findings of H. Zhang and Whitebread (2017), which highlight the predictive value of metacognitive strategies for task performance in Chinese kindergarten children. Thus, the relationship between metacognitive strategies and children's task performance seems evident in different cultural contexts.

The children's metacognitive strategies in child-alone problem-solving were predicted by mothers' autonomy support in the mother-child interactions. This finding confirms H4 and is in line with existing research (Gauvain & Rogoff, 1989; Neitzel & Stright, 2003; Stright et al., 2009). When children's autonomy is encouraged in joint problem-solving, they show more metacognitive strategies when working alone. When children are more involved in joint problem-solving, they use their experiences in the subsequent child-alone problem-solving tasks. Accordingly, children self-regulate when their mothers step back and encourage them to work independently. The question of the factors influencing mothers' autonomy support needs more attention. According to the three-term "standard model" (Bornstein et al., 2018), parenting cognitions – such as goal orientation (Grolnick et al., 2002), implicit theories (Stern & Hertel, 2020), and parental self-efficacy (Meunier et al., 2011) – play a crucial role in predicting parenting practices and child development. For example, Grolnick et al. (2002) show that

mothers induced to emphasize child learning are less controlling than mothers induced to emphasize child performance. Further research is needed to explore the interplay between parenting cognitions and autonomy support in more detail.

Unexpectedly, though, the mothers' cognitive support was negatively related to children's metacognitive strategies. This finding contrasts with reports of positive relationships between parents' cognitive support and children's metacognitive strategies (Neitzel & Stright, 2003). We expected the children to internalize the cognitive structuring that their mothers displayed through their cognitive support. However, some mothers might have excessively limited the children's freedom during the task, and consequently, the children may have lacked metacognitive strategies when working on their own, resulting in lower levels of planning, monitoring, and evaluation. Children who experience more cognitive support are probably slower when working independently because they have to assimilate the initiated learning process experienced during the joint problem-solving phase. Nevertheless, the behavioral observation methods used in the current study do not allow to assess the underlying cognitive processes occurring during and after the mother-child interactions. To describe these processes more precisely, the use of cognitive neuroscience methods may be a potential next step. For example, studies could investigate whether mothers' scaffolding leads to the activation of certain learning-process-related brain areas in the child. Promising first results suggest that parent-child interactions affect the structural development of the child's brain (e.g., Takeuchi et al., 2015). However, the hypothesis of a positive link between mothers' cognitive support and children's metacognitive strategies could not be confirmed. H. Zhang and Whitebread (2017) argue that the quantity of the parent's cognitive support is less relevant, and results rather depend on how well the support matches the child's level (contingency). Therefore, future studies should test this hypothesis by controlling for child's ability level and examining how parents adapt their support to their child's performances.

Contrary to our hypotheses, the mothers' metacognitive support was not predictive of the children's metacognitive strategies, despite being intended to increase the children's metacognitive activities, such as planning, monitoring, and evaluation (Erdmann et al., 2019; van de Pol et al., 2010). It is possible that the time between the joint and child-alone problem-solving was too short, such that the children were unable to internalize the observed strategies. Meta-analyses of children's SRL intervention studies provide evidence that interventions are more effective when they are longer (Dignath & Büttner, 2008). This is especially true at kindergarten age, when children's metacognitive abilities are just beginning to develop (e.g., Veenman et al., 2006), thus more intensive training over a longer period might be necessary.

However, the mothers provided relatively little metacognitive support overall, as reflected by the low mean score for this measure. On the one hand, the absence of metacognitive support might reflect the mothers' uncertainty about how much to support their children in this unfamiliar test situation. For instance, research indicates that mothers' beliefs affect the support they provide during joint problem-solving (e.g., Moorman & Pomerantz, 2010). On the other hand, we assessed the quantity rather than the quality of mothers' metacognitive support, and the mothers may not have structured the task adequately to allow the children to make effective use of the metacognitive information (Stright et al., 2009). Future research assessing both the quantity and quality of mothers' metacognitive support is needed.

In line with van de Pol et al. (2010), we hypothesized that mothers' use of scaffolding means would serve a certain function in mother-child interactions (H5). The present results indicate that the relationship between scaffolding means and children's metacognitive strategies is mediated by two scaffolding intentions: autonomy support and cognitive support. Mothers' use of scaffolding means was negatively related to autonomy support: mothers who transferred less responsibility used more scaffolding means. To date, scaffolding means have been studied in relation to their interplay with (meta)cognitive support (Erdmann et al., 2019) but not with autonomy support. We found that mothers' use of scaffolding means was not directly related to children's metacognitive strategies but mediated by autonomy support. This finding indicates that the use of scaffolding means is a less-direct predictor of children's metacognitive strategies, exerting its influence indirectly via autonomy support. Second, mothers' scaffolding means was positively associated with cognitive support: when mothers use more scaffolding means, they also show more cognitive support. Since this strategy was negatively related to children's metacognitive strategies, one might assume that mothers show more cognitive support to compensate for difficulties and to initiate learning processes (in the sense of a compensatory effect; e.g., Zhang, 2021). In order to generate first insights into the assumption of a compensatory effect, additional analyses with children's executive functions as an indicator of self-regulatory abilities (i.e., using the Head-Toes-Knees-Shoulders Task by Ponitz et al., 2008) were conducted. Those analyses suggest that mothers used more scaffolding means in children with lower self-regulatory abilities (see Supplementary Material for details on the additional path model), thus compensating for difficulties. As children's self-regulatory abilities were not fully examined, further studies are needed that explore compensatory effects more deeply. In summary, two scaffolding strategies are identified. First, mothers who use fewer scaffolding means show more autonomy support, which is related to a higher use of metacognitive strategies by children in child-alone problem-solving. Second, mothers who use more

scaffolding means also show more cognitive support, which is related to a lower use of metacognitive strategies by children when working alone. As mothers might have multiple scaffolding strategies when supporting their children, there is a need for additional studies exploring maternal patterns in scaffolding strategies (e.g., by using profile analyses; Stern & Hertel, 2020).

For the present study, we assumed that the use of scaffoldings means precede scaffolding intentions because scaffolding means act through different activities and serve different functions (e.g., using more or less scaffolding means to support children's (meta)cognitive activities). However, social psychologists argue that intentions precede behavior (cf. theory of planned behavior, Ajzen, 1991). It has to be acknowledged that we assessed the scaffolding intentions not on a mental but on a behavioral level. This means that we derived specific intentions from supporting certain activities (e.g., autonomy support), following the conceptualization by van de Pol et al. (2010). The advantage of assessing scaffolding intentions on a behavioral level is that the mother-child interactions are not interrupted to ask about mothers' intentions. Moreover, it can be assumed that mother's support of certain child activities is a better predictor of child behavior than mother's mental states (cf. intention-behavior gap; Sheeran & Webb, 2016). To get a comprehensive picture of the relationship between these constructs, future research should expand the presented theoretical model by including scaffolding intentions on a mental and behavioral level.

Finally, we examined whether mothers' scaffolding strategies are linked to higher child-alone task performance. In support of H6, the findings indicate that mothers' autonomy support is indirectly linked to children's task performance, as mediated by children's metacognitive strategies. This finding is supported by work with school-age children. For instance, Bindman et al. (2015) found an indirect contribution of mothers' autonomy support to children's achievement. In addition, our findings suggest that mothers' cognitive support is negatively related to children's task performance. This finding was surprising at first glance and contradicts our hypothesis that cognitive support provides children with essential learning strategies (Mermelshtine, 2017) and leads to successful task performance. Two explanations might account for the negative relationship between mothers' cognitive support and children's task performance. First, the children's task performance was examined immediately after the mother-child interactions. Thus, as mentioned earlier and in line with H. Zhang and Whitebread (2017), the time between joint and child-alone problem-solving was very short and the metacognitive strategies may not have directly benefited from the cognitive support received (i.e., too much simplification and structuring leaves children not knowing how to solve the task

independently), resulting in low task performance. Second, the mothers' behavior can be described as adaptive: mothers provide more cognitive support to children who cannot solve many tasks independently. Accordingly, mothers behave in a compensatory manner, meaning that children with weaker problem-solving abilities require more maternal help, representing a compensatory effect. This finding is consistent with studies reporting negative effects of parental learning support on children's school performance (e.g., Y. Zhang, 2021).

4.3 Limitations

The current research has several limitations that should be considered when interpreting the findings. The first limitation concerns the correlational design of the study, which does not allow any causal conclusions. Longitudinal and experimental designs are needed to examine the causal relations between mothers' scaffolding, children's metacognitive strategies, and task performance. Although the test situation was designed to have a high ecological validity, the laboratory setting may have influenced the mother-child interactions. This raises the question of whether the findings reflect mothers' habitual scaffolding or were influenced by the specific situation in the laboratory context. In addition, as we only used one problem-solving task, the results may be task-dependent. Therefore, future research should include multiple tasks, with different demands, and control for the basic cognitive skills of both the mother and child. Second, our scaffolding rating concerns only the mothers' behavior and does not indicate the children's subsequent responses in the mother-child interactions. The use of micro-analytical approaches (e.g., Carr & Pike, 2012; Neale & Whitebread, 2019) could help to analyze the mother-child interactions more deeply and enable a comparison between the children's metacognitive strategies in joint and child-alone problem-solving. In addition, the presented effects are relatively small, and any conclusions should be drawn with caution. However, the study is one of the first to examine maternal scaffolding among preschoolers, focusing not on single aspects of scaffolding but rather analyzing scaffolding strategies integrally. A potential next step may be a further examination of the patterns of maternal scaffolding, such as using profile analyses (Stern & Hertel, 2020) to obtain a deeper understanding. In addition, scaffolding means were combined to one scale for data reduction purposes. Thus, future studies may differentiate the different scaffolding means to illustrate specific combinations with scaffolding intentions, building further scaffolding strategies (see Table 1 of the Supplementary Material). The third limitation concerns the question of generalization: the sample comprises mothers with high socioeconomic status and "typically" developing children. Future research should examine relationships in lower socioeconomic status families and include children at

increased risk of adverse developmental outcomes, such as preterm children or children with psychological or mental anomalies. A secondary finding of this study was that the mothers used more scaffolding means with boys than with girls. This gender-related variation may derive from the mothers' responses to differences between boys and girls (e.g., brain maturity, temperamental differences; see Leaper, 2002) or from the gender-stereotyped behaviors of the mothers (Leaper, 2002). Additionally, the effects may be related to only mothers as primary caregiver were observed. Evidence suggests that mothers and fathers differ in their parenting styles (Parke, 2013). Further studies should also include fathers to examine any potential effects of parental gender.

5 Conclusion

The study enhances the existing scaffolding literature by focusing on a) the age group of preschool children and b) scaffolding strategies, rather than single aspects of scaffolding. We examined mothers' scaffolding (intentions and means) in mother-child interactions and analyzed 1) how maternal scaffolding is associated with mother-child task performance and 2) whether maternal scaffolding relates to children's metacognitive strategies and task performance when children solve tasks independently. Mothers' metacognitive support was negatively – and autonomy support positively – associated with mother-child task performance. Two pathways were identified for the relationship between mothers' scaffolding and children's metacognitive strategies and task performance: autonomy support and cognitive support. Mothers' use of scaffolding means served different scaffolding intentions, building two different scaffolding strategies. Mothers who use more scaffolding means also provide more cognitive support, which is related to lower levels of children's metacognitive strategies when working alone. Mothers who use fewer scaffolding means provide more autonomy support, which is related to higher levels of children's metacognitive strategies when working alone. Our results indicate that children do not immediately internalize their mothers' scaffolding strategies after short mother-child interactions. Exploring the underlying mechanisms from a neurological perspective may be a promising method of investigating whether mothers' scaffolding initiates learning processes that are not yet visible in the children's behavior. This study demonstrates the importance of examining scaffolding means and intentions, indicating that different strategies may be relevant for joint and child-alone problem-solving. With this knowledge, parents and teachers can respond better to children and thus help to enhance their self-regulation abilities.

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Table 1

Pearson-Correlations and Descriptives of Independent and Dependent Variables

			Correlation							
	M	*SD*	1	2	3	4	5	6	7	8
1. Mother age [years]	38.76	4.40	-							
2. Child age [months]	57.64	6.77	.14	-						
3. Mother-child task performance (T1)	9.27	3.27	.07	.54**	-					
4. Child-alone task performance (T2)	5.99	3.62	.12	.51**	.64**	-				
5. Metacognitive strategies	2.81	0.83	.12	.50**	.52**	.75**	-			
6. Scaffolding means	2.39	0.40	-.04	-.34**	-.43**	-.45**	-.37**	-		
7. Cognitive support	2.63	0.92	-.13	-.22*	-.31**	-.38**	-.26**	.53**	-	
8. Metacognitive support	1.96	0.67	-.04	-.04	-.19*	-.07	.06	.28**	.42**	-
9. Autonomy support	3.72	0.99	.11	.18*	.24**	.33**	.29**	-.47**	.01	.21**

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

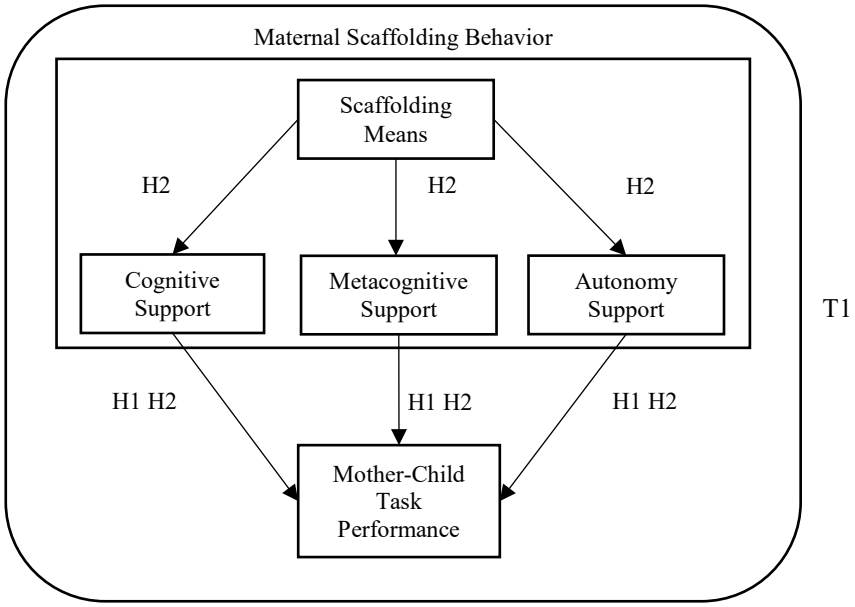
Table 2

Indirect Effects

	b	*SE*	*ß*	*95% Bc CI*
1. Scaffolding means → Cognitive Support → Mother-Child TP	-0.39	0.42	-.05	(-1.30, 0.37)
2. Scaffolding means → Metacognitive Support → Mother-Child TP	-0.33	0.21	**-.04**	(-.87, -0.001)
3. Scaffolding means → Autonomy Support → Mother-Child TP	-0.58	0.35	-.07	(-1.34, 0.04)
4. Scaffolding means → Cognitive Support → META	-0.22	0.10	**-.10**	(-0.44, -0.04)
5. Scaffolding means → Metacognitive Support → META	0.07	0.06	.03	(-0.02, 0.21)
6. Scaffolding means → Autonomy Support → META	-0.19	0.09	**-.09**	(-0.37, -0.02)
7. Cognitive Support → META → Child-Alone TP	-0.42	0.19	**-.11**	(-0.79, -0.06)
8. Metacognitive Support → META → Child-Alone TP	0.32	0.23	.06	(-0.12, 0.79)
9. Autonomy Support → META → Child-Alone TP	0.37	0.17	**.10**	(0.04, 0.71)

Note. TP = Task performance; META = Metacognitive strategies. 95% Bias corrected confidence intervals (Bc CI) and standard errors (SE) were calculated based on a bootstrap estimation approach with 5000 samples.

Research Question 1



Research Question 2

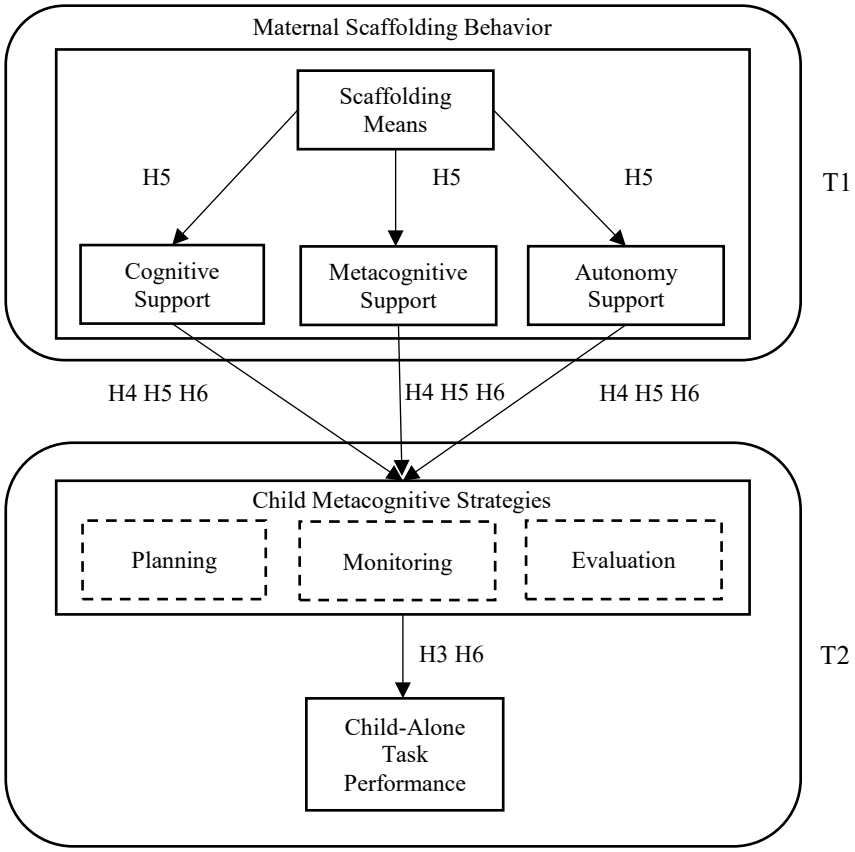


Figure 1. The hypothesis model.

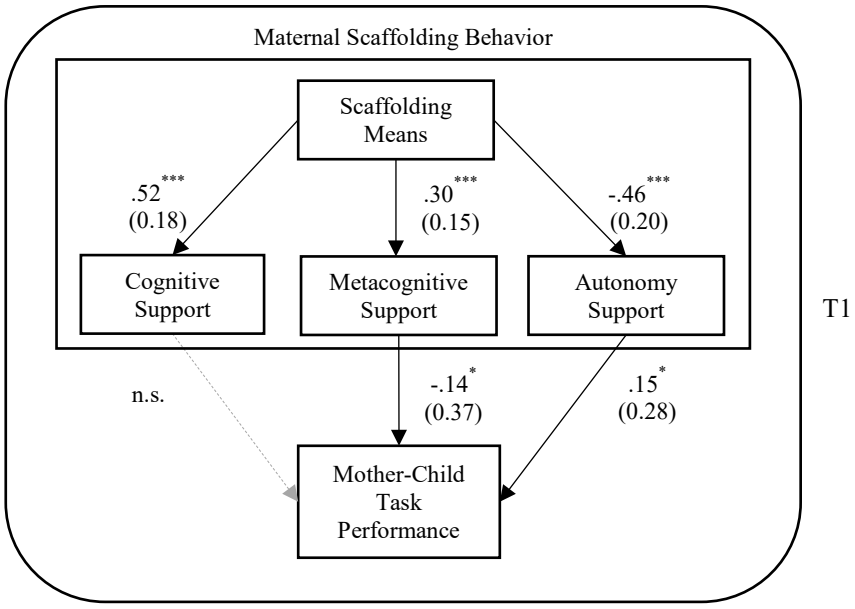


Figure 2. Path model demonstrating the associations between mothers' scaffolding and mother-child task performance. For simplicity, covariates are not shown. Child age and gender were included as covariates in all regression equations. Standardized beta coefficients are displayed with standard errors in parentheses. Dashed lines represent nonsignificant paths.
$^{*}p<.05$. $^{***}p<.001$.

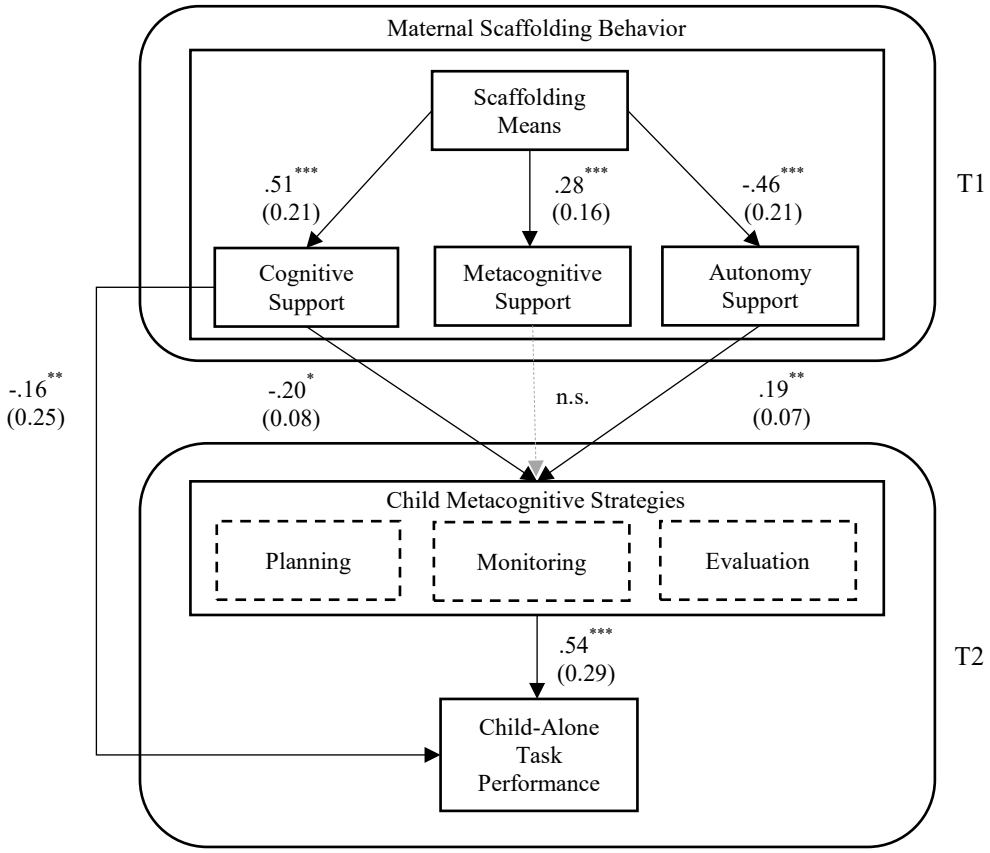


Figure 3. Path model demonstrating the associations between mothers' scaffolding, children's metacognitive strategies, and child-alone task performance. For simplicity, covariates are not shown. Child age and gender were included as covariates in all regression equations. Child-alone task performance was controlled for mother-child task performance at T1. Standardized beta coefficients are displayed with standard errors in parentheses. Dashed lines represent nonsignificant paths.

$^{*}p<.05$. $^{**}p<.01$. $^{***}p<.001$.

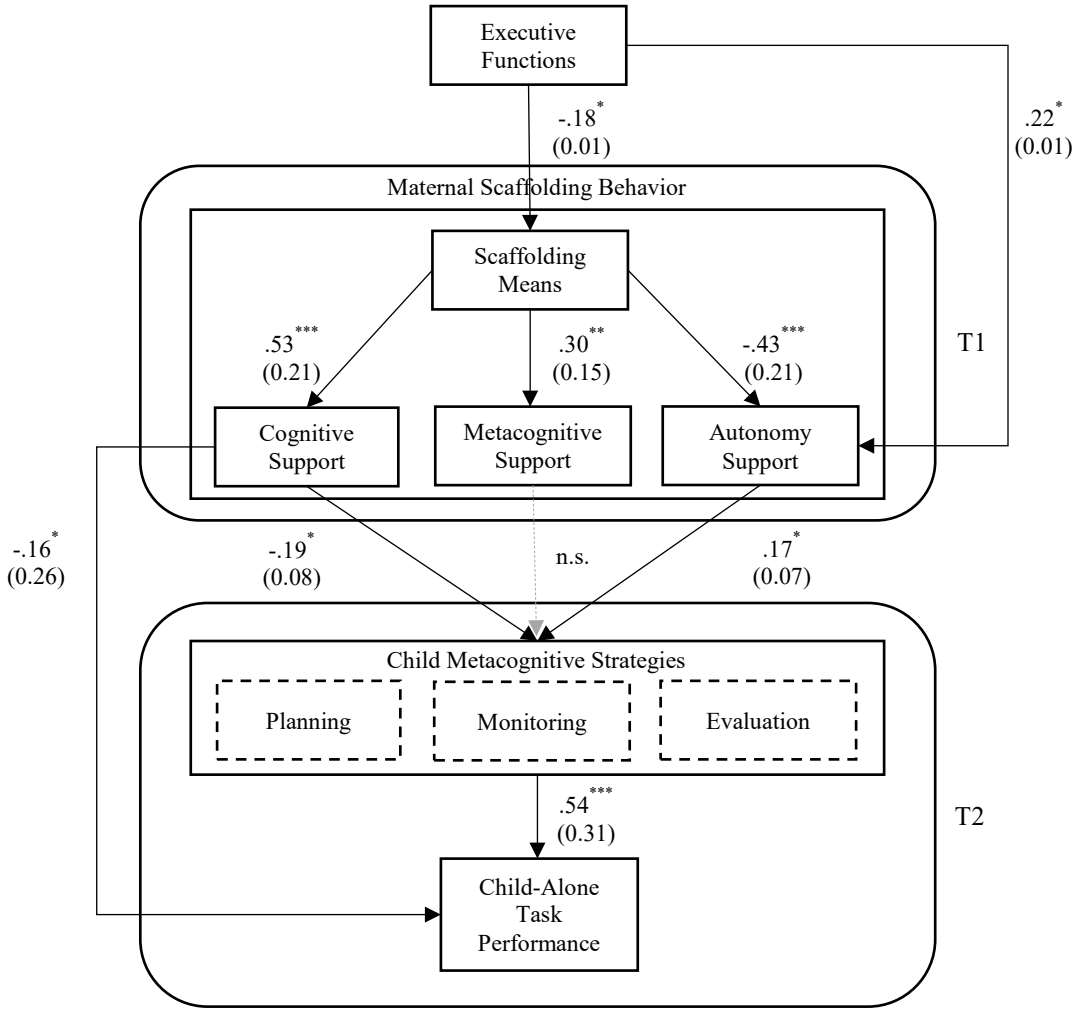
Supplementary Material

Supplementary Table 1

Bivariate Pearson-Correlations Between Scaffolding Means and Scaffolding Intentions (Following the Framework for Analysis of Scaffolding Strategies by van de Pol et al., 2010)

		Scaffolding intentions									
		Support of children's cognitive activities		Support of children's metacognitive activities		Support of children's autonomy					
		Cognitive structuring	Reduction of degrees of freedom	Strategy use and planning	Monitoring and evaluation	Lets child decide how to proceed	Picks up on child's ideas and actions	Actively engages child in the task	Encourages to work independently	Gives options to identify errors	Gives options to correct errors
Means	Questions	.32**	.26**	.16	.26**	-.21*	-.01	.19*	-.15	-.15	-.08
	Hints	.44**	.40**	.27**	.29**	-.37**	-.03	.14	-.26**	-.32**	-.18*
	Instructions	.37**	.28**	.08	.06	-.65**	-.36**	-.18*	-.58**	-.59**	-.51**
	Feedback	.26**	.21*	-.08	.00	-.42**	-.17	-.04	-.42**	-.50**	-.38**
	Explanations	.17*	.18*	.12	.10	-.17	-.04	.02	-.14	-.11	-.03
	Transfer	.34**	.31**	.31**	.36**	-.26**	.01	.26**	-.19*	-.21*	-.13

Note. *p<.05. **p<.01.



Supplementary Figure 1. Path model demonstrating the associations between mothers' scaffolding, children's metacognitive strategies, and child-alone task performance with children's executive functions as an indicator of children' self-regulatory abilities. For simplicity, covariates are not shown. Child age and gender were included as covariates in all regression equations. Child-alone task performance was controlled for mother-child task performance at T1. Standardized beta coefficients are displayed with standard errors in parentheses. Dashed lines represent nonsignificant paths.

$^{*}p<.05$. $^{**}p<.01$. $^{***}p<.001$.

Appendix C – Paper 3

This is the submitted version of the following article:

Stern, M., Erdmann, K.A., & Hertel. S. (2022). Effects of maternal mindsets on parenting behaviors and self-regulatory strategies in four- and five-year-olds. *Developmental Psychology.* (Submitted)

Effects of Maternal Mindsets on Parenting Behaviors and Self-Regulatory Strategies in Four- and Five-Year-Olds

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Abstract

Mindset theory states that growth mindsets are relevant antecedents of learning- and performance-related behavior. The present experiment used and adapted the paradigm by Moorman and Pomerantz (2010) by examining the role of mothers' intelligence mindsets in parenting behaviors. Extending the paradigm, we explored the effects of two further mindset domains: self-regulation and failure. The study had a one-factor between-subject design with six conditions (three domains: intelligence, failure, self-regulation; each comprising two forms: malleable/enhancing vs. stable/debilitating). Participants were mothers (N = 177, mean age = 38.34 years) and their preschool child (51% girls, mean age = 4.80 years). First, mothers were randomly assigned to the mindset conditions. Mothers' mindsets were experimentally manipulated using cover stories. Second, mother-child dyads worked on several problem-solving tasks for 10 min. Then, the children solved the same tasks without their mothers for 5 min. Parenting behaviors (i.e., autonomy support, intrusiveness, scaffolding means) were coded during joint problem-solving, and children's self-regulatory strategies (i.e., cognitive, metacognitive, motivational) were observed in child-alone problem-solving. Results of planned contrasts reveal that autonomy support was more frequent in mothers in the intelligence-is-stable (vs. intelligence-is-malleable) mindset condition. Less autonomy support and more scaffolding means were observed in mothers in the failure-is-debilitating (vs. failure-is-enhancing) mindset condition. Mothers' failure-is-debilitating mindset was indirectly linked to children's lower motivational strategies in child-alone problem-solving – fully mediated by mothers' scaffolding means. The findings suggest that mindsets of different domains may foster different parenting behaviors and have indirect effects on child self-regulation.

Keywords: mindset, parenting behavior, self-regulation, failure, motivation, preschoolers

The development of self-regulation is one of the hallmarks in early childhood and describes "the internally-directed capacity to regulate affect, attention, and behavior to respond effectively to both internal and environmental demands "(Raffaelli et al., 2005, p. 54). Parents play a fundamental role in this development by providing learning strategies and building a 'scaffold' for the child (e.g., drawing attention to relevant aspects; Mermelshtine, 2017). As the child progresses, parents gradually transfer responsibility so that the child becomes an independent learner. However, since parents differ in the quantity and quality of how they support their child (Carr & Pike, 2012), determinants of parents' supportive behavior are of great interest. Increasing research indicates that mindsets about the malleability of abilities are powerful predictors of behavior, motivation, cognition, and emotion (e.g., Burnette et al., 2013). While ability mindsets of students and their effects on learning and performance are well studied (e.g., Blackwell et al., 2007; Hertel & Karlen, 2021), parents' mindsets and their effects on their learning-related behavior are relatively poorly understood (Haimovitz & Dweck, 2016; Matthes & Stoeger, 2018; Moorman & Pomerantz, 2010). Initial results indicate that parents who view their children's abilities as stable (vs. malleable) are more likely to show performance-oriented and negative parenting behaviors (Moorman & Pomerantz, 2010). The present study aims to extant research in this field by examining more closely how parents' mindsets affect their learning-related parenting behavior.

Ability mindsets – also known as implicit theories – are beliefs that build a cognitive framework for individuals' interpretation of experiences (Dweck & Leggett, 1988). According to Dweck and colleagues, two types of ability mindsets are distinguished: growth mindsets and fixed mindsets. Individuals with *growth mindsets* believe that certain abilities (e.g., intelligence) are malleable and improvable by effort. Therefore, individuals with growth mindsets see challenges as an opportunity for development and learning, are more persistent in the face of failure, and show more mastery-oriented learning strategies (e.g., Blackwell et al., 2007; Burnette et al., 2013). In contrast, individuals with *fixed mindsets* think that certain abilities are fixed and cannot be changed. In the face of challenges, individuals with fixed mindsets view failure as a permanent deficit, resulting in more helpless-oriented strategies, negative emotions, and poor performance (Blackwell et al., 2007; Burnette et al., 2013). Ability mindsets are often understood on a bipolar continuum, ranging from stable to malleable, describing the malleability of abilities (e.g., Blackwell et al., 2007; Dweck, 2000).

Ability mindsets are increasingly investigated as influencing factors of parents' behavior (Bubić & Tošić, 2016; Haimovitz & Dweck, 2016; Matthes & Stoeger, 2018; Moorman & Pomerantz, 2010). Moorman and Pomerantz (2010) were one of the first to

examine mothers' ability mindsets as a predictor of mothers' involvement in children's learning. In this study, mothers' intelligence mindsets were experimentally manipulated, and the quality of their interactions with their early elementary school children during a puzzle task was observed. Mothers who were induced to hold a fixed mindset showed more unconstructive involvement (i.e., performance-oriented teaching, control, and negative affect) than mothers who were induced to hold a growth mindset. In addition, mothers with a fixed (vs. growth) mindset also responded to children's helplessness more unconstructive. Moorman and Pomerantz (2010) found no significant effects on mothers' constructive involvement. However, their findings imply that mothers with growth mindsets are more likely to stay calm because, in contrast to mothers with fixed mindsets, children's performance is not viewed as a permanent deficit in children's competence but as reflecting children's learning. These findings are supported by a recent study showing that parents' growth mindsets are positively associated with parental learning-related behaviors (i.e., less homework-related conflict and less controlling behavior), which in turn are related to children's better grades (Matthes & Stoeger, 2018).

Although previous research has mainly focused on ability mindsets of intelligence (Matthes & Stoeger, 2018; Moorman & Pomerantz, 2010; Pomerantz & Dong, 2006), parental mindsets can refer to different domains or attributes (e.g., math and verbal ability Muenks et al., 2015. Researchers argue that beliefs about abilities in particular domains are better suited for predicting specific behavior than beliefs about the more general construct of intelligence (e.g., Bråten & Strømsø, 2005; Hertel & Karlen, 2021). For example, Muenks et al. (2015) have illustrated that parents' beliefs about their children's math and verbal abilities are better predictors of math- and reading-related parenting behaviors than parents' intelligence beliefs. The present study will consider two mindset domains in addition to intelligence: (1) failure and (2) self-regulation. First, Haimovitz and Dweck (2016) have introduced parental beliefs about the (de)motivating effects of failure. Their studies show that failure mindsets are more visible to children than parents' intelligence mindsets and strongly relate to parenting behavior. Failure mindsets refer to whether failure is seen as enhancing (e.g., learning from mistakes) or debilitating (e.g., negative feelings interfere with learning). Parents who were primed to hold a failure-is-enhancing (vs. failure-is-debilitating) mindset reported to respond more learning-oriented and less performance-oriented to a child-failure scenario. However, because parents' responses were assessed with self-report in a hypothetical scenario, it remains unclear how parents' failure mindsets influence parental and child behavior in real parent-child interactions. Second, Stern and Hertel (2020) argue that beliefs about the malleability of self-regulation are

important in predicting whether or how parents engage in children's self-regulated learning. Although the relevance of self-regulation for socio-emotional outcomes (Moffitt et al., 2011; Valiente et al., 2013) and school and academic success (e.g., Neuenschwander et al., 2012) is evident, less is known about what parents believe about the malleability of self-regulation. There is some evidence that mindsets about self-regulation are a promising approach for predicting self-regulatory processes (Hertel & Karlen, 2021; Stern & Hertel, 2020).

Research indicates that individuals can hold different mindsets in different domains simultaneously (Dweck et al., 1995; Haimovitz & Dweck, 2016; Muenks et al., 2015; Schroder et al., 2016; Tabernero & Wood, 1999). Using latent profile analysis, a recent study demonstrated that beliefs of different domains (intelligence and self-regulation) co-occur within parents, resulting in different belief profiles that relate differently to parents' attitudes and co-regulatory strategies (i.e., mastery- and helpless-oriented strategies) (Stern & Hertel, 2020). The current debate about the domain specificity of mindsets (see Bråten & Strømsø, 2005) highlights that depending on the context, mindsets of different domains may be important to predict parental behavior (e.g., Muenks et al., 2015; Stern & Hertel, 2020). However, since previous studies have assessed parental behavior mainly through self-reports (for an exception, see Moorman & Pomerantz, 2010), relatively little is known about how mindsets of different domains affect actual parental behavior in parent-child interactions. In addition, the existing studies have only been conducted with parents of school children (e.g., Haimovitz & Dweck, 2017; Matthes & Stoeger, 2018; Moorman & Pomerantz, 2010; for an exception, see Stern & Hertel, 2020). As parental support is particularly crucial during early childhood (e.g., Valcan et al., 2018), parents of younger children should be addressed in mindset research.

Preschool age is a period in which children acquire self-regulatory strategies in playful contexts (Zhang & Whitebread, 2017), including cognitive, metacognitive, and motivational strategies (Dermitzaki et al., 2009). Parents can enhance their children's self-regulatory abilities (Valcan et al., 2018), for example, by supporting children's cognitive processes. This support is called scaffolding and describes the interactive process by which parents "enable the child to solve a problem, carry out a task, or achieve a goal, which would be beyond his unassisted efforts" (Wood et al., 1976, p. 90). Zhang and Whitebread (2017) have shown that parental scaffolding predicts preschoolers' use of self-regulatory strategies and task performance. The literature distinguishes different scaffolding means that support learning activities, such as questions, hints, instructions, and feedback (see van de Pol et al., 2010 for a review). Research with infants and preschoolers shows that scaffolding means are relevant to describe how

scaffolding takes place and are related to cognitive and metacognitive measures of child behavior (Erdmann et al., 2019).

The Present Study

This study builds on previous studies that highlight the influence of mindsets on parenting behaviors. Prior research has primarily explored intelligence mindsets in parents of school-aged children (Matthes & Stoeger, 2018; Moorman & Pomerantz, 2010). We emphasize to focus on parents of preschoolers because parenting behaviors play a significant role already in early childhood (Valcan et al., 2018). Research indicates that individuals can hold mindsets on different domains (Hertel & Karlen, 2021; Schroder et al., 2016), and, depending on the context, mindsets of different domains are better suited to predict specific behavior (e.g., Muenks et al., 2015; Stern & Hertel, 2020). In the context of parenting behavior, mindsets about the (de)motivating effects of failure and the development of self-regulation might be relevant as parents support these aspects in children's early development (Zhang & Whitebread, 2017).

Based on these considerations, we extend Moorman and Pomerantz's paradigm and examine three domains of maternal mindsets: intelligence, failure, and self-regulation. Two main research questions guide the present study. The first research question of the study is:

(1) Do maternal mindsets influence parenting behaviors in mother-child interactions?

First, we want to know whether the effects of intelligence mindsets on parenting behaviors (constructive vs. unconstructive involvement) can be found in mothers of preschoolers as well. In addition to (un)constructive involvement, we measure mothers' use of scaffolding to better understand *how* mothers support their children's learning, describing the mother-child interactions more precisely (Erdmann et al., 2019; van de Pol et al., 2010). Consistent with earlier research (Matthes & Stoeger, 2018; Moorman & Pomerantz, 2010), we expect mothers with growth (vs. fixed) intelligence mindsets to show parenting behaviors that focus on children's learning. This results in the following hypothesis:

> *Hypothesis 1a*: Mothers induced to hold a growth intelligence mindset show more constructive involvement (autonomy support), less unconstructive involvement (intrusiveness), and use more scaffolding means than mothers induced to hold a fixed intelligence mindset.

Second, parents' failure mindsets have received increasing attention in mindset research. Up to now, the effects of failure mindsets on parenting behaviors have been studied in a hypothetical scenario using self-report measures (Haimovitz & Dweck, 2016). How failure mindsets affect directly observable parenting behaviors in mother-child interactions is unclear.

Based on the findings of Haimovitz and Dweck (2016), we expect that mothers with a failure-is-enhancing (vs. failure-is-debilitating) mindset allow children freedom to make mistakes, learn from them and thus behave less intrusive:

Hypothesis 1b$_1$: Mothers induced to hold a failure-is-enhancing mindset show more constructive involvement (autonomy support) and less unconstructive involvement (intrusiveness) than mothers induced to hold a failure-is-debilitating mindset.

With regard to the use of scaffolding means, previous findings suggest that scaffolding means can serve different intentions (Erdmann et al., 2019; van de Pol et al., 2010). When mothers view failure as debilitating, they may use more scaffolding means to avoid failure (e.g., by precisely instructing their child's actions). On the other side, when mothers view failure as enhancing, they may be more likely to draw children's attention to mistakes (e.g., by questions, hints, or feedback). The effects can therefore go in both directions. This leads to the following hypothesis:

Hypothesis 1b$_2$: Mothers differ in the use of scaffolding means in dependence of their failure mindset.

Since intelligence mindsets are related to parenting behaviors, we assume this is also true for self-regulation mindsets. Following the idea of domain specificity (Bråten & Strømsø, 2005; Hertel & Karlen, 2021), mothers' self-regulation mindsets should be relevant when predicting how parents support their children's self-regulatory processes. Thus, we propose the following hypothesis:

Hypothesis 1c: Mothers induced to hold a growth self-regulation mindset show more constructive involvement (autonomy support), less unconstructive involvement (intrusiveness), and use more scaffolding means than mothers induced to hold a fixed self-regulation mindset.

The second question of the present study addresses the research gap that the effects of parents' mindsets on child behavior have been neglected. Addressing this question helps to understand how mindsets contribute to children's socialization (Bornstein et al., 2018). The second research question is:

(2) Are mothers' mindsets related to children's self-regulatory strategies?

The three-term standard model by Bornstein et al. (2018) suggests a cascade of parents' cognitions, parenting behaviors, and child outcomes. Based on empirical findings that parents' mindsets relate to parenting behaviors (Haimovitz & Dweck, 2016; Matthes & Stoeger, 2018; Moorman & Pomerantz, 2010) and parenting behaviors relate to child self-regulation (Valcan

et al., 2018), we expect that parenting behaviors mediate the link between mothers' mindsets and child self-regulation:

Hypothesis 2: Mothers' mindsets are indirectly linked to children's self-regulatory strategies, mediated via parenting behaviors.

Method

Participants

Based on a priori power analysis using G*Power 3.1 (Faul et al., 2007), 187 mother-child dyads were assessed. Of the original sample, ten dyads were excluded because of comprehension problems or when mothers and children showed no interaction (i.e., the child works on the task all by him/herself). The final sample included 177 mothers (M = 38.34 years, SD = 4.31 years, range = 27 to 50 years) and their preschool child (51% girls, M = 4.80 years, SD = 0.56 years, range = 4.00 to 5.92 years). 81% of the children had at least one sibling (M = 1.04, SD = 0.73, range = 0 to 3). The mothers were only allowed to attend with one child. 71% of the mothers held a higher technical college qualification or university degree. Seven percent of mothers reported a monthly net income (of all household members) below 2,000€, approximately a third of mothers reported incomes between 2,000€ and 4,000€, while 23% had a net income between 4,000€ and 5,000€. Thirty-two percent reported higher incomes, and 9% of the sample did not want to answer this question. The family social class index was computed on mothers' school education, professional education, and current professional status following the procedure by Winkler and Stolzenberg (2009). With scores of three to eight indicating low, nine to 14 moderate, and 15 to 21 high socioeconomic status (SES), the sample included families primarily from a high socioeconomic background (M = 15.47, SD = 2.67, range = 6.50 to 19.50).

Design

The study had a one-factor between-subject design with six conditions, two conditions per domain: intelligence (INT), failure (F), and self-regulation (SR). Accordingly, the mindset conditions were: 1) intelligence-is-malleable (INT+), 2) intelligence-is-stable (INT–), 3) failure-is-enhancing (F+), 4) failure-is-debilitating (F–), 5) self-regulation-is-malleable (SR+), and 6) self-regulation-is-stable (SR–) condition. Dependent variables included autonomy support, intrusiveness, and scaffolding means at the mother-level and (cognitive, metacognitive, and motivational) self-regulatory strategies at the child-level. Child vocabulary was used as a control variable.

Procedure

Mother-child dyads were recruited in the southwest of Germany through information letters, daycare centers, and gymnastic clubs. The information sheet indicated that we were interested in learning more about how children regulate their feelings and actions[6].

The experiment was conducted in a laboratory setting, and the full assessment was video-recorded. When participants arrived, the experimenter provided a brief description of the procedure verbally and written via tablet computer. After the written informed consent, the mothers read a definition of self-regulation to assure an equal understanding of the concept. The definition referred to Posner and Rothbart (2000) that self-regulation means controlling one's behavior, thoughts, and feelings to achieve a goal. Then, mothers were randomly assigned to one mindset condition and read one of six cover stories that were used for experimental inductions. The experimental inductions followed the cover stories used in Moorman and Pomerantz (2010) and are presented in Table 1. Before the mother-child interaction began, the experimenter orally repeated the content of the cover stories.

After the experimental induction, the experimenter introduced the mothers to support their children in solving the following problem-solving tasks but not solve the tasks by proxy for the children. Then, the experimenter left the room, and the mother-child dyad worked on several problem-solving tasks from the subtest Triangles from the German version of Kaufmann's Assessment Battery for Children II (Melchers & Melchers, 2015) for the next ten minutes. In these problems, children had to re-create two-dimensional patterns using foam triangles that are blue on one side and yellow on the other. The tasks were moderately challenging but were not intended to overburden the children. A maximum of 22 points for solved tasks could be reached. On average, nine tasks were correctly solved in the mother-child interaction (SD = 3.43, range = 0 to 15). Next, children solved the same tasks without their mothers' support in the next five minutes, followed by two tasks assessing children's vocabulary and executive functions[7]. At the same time, the mothers filled out questionnaires, including the manipulation check of mothers' mindset inductions and sociodemographic data. The manipulation check was done after the mother-child interactions not to draw mothers' attention to their mindsets. Finally, in the debriefing, the experimenter explained the actual goals of the experiment, clarified questions, and reasked mothers for their informed consent. Children were praised and were given a participation certificate and a small gift (e.g., a crayon).

[6] The Faculty Ethics Committee approved the study protocol.
[7] Because the focus of the present study is on the problem-solving tasks, children's executive functions are not reported and considered in the further analyzes.

Table 1

Mindset Inductions – Cover Stories by Mindset Conditions

Condition	Cover Story
SR+	Today, your child will be tested with the test "Triangles" from the **Self-Regulation** Assessment Battery for Children. This test assesses the **potential** of your child's self-regulatory abilities. Across over 30 studies, children's scores on this test have been shown to be quite **changeable**. In more than 95% of cases, **studying helps children do better**, such that from one assessment to the next, their score can go up as much as 20 points. Generally speaking, **the more studying children do, the more they learn**. The abilities assessed by this test are clearly something that can be **changed**.
SR–	Today, your child will be tested with the test "Triangles" from the **Self-Regulation** Assessment Battery for Children. This test assesses your child's **inborn** self-regulatory abilities. Across over 30 studies, children's scores on this test have been shown to be quite **stable**. If the child completes the test once and then does so again a year later, in more than 95% of cases, the results are within 5 points of his or her original score. This seems to be the **case regardless of how much time children spend studying** for the test. The abilities assessed by this test are clearly **nothing that can be changed**.
F+	Today, your child will be tested with the test "Triangles" from the **Learning** Assessment Battery for Children. This test is used in young children to test how to deal with failure. Across over 30 studies have shown that the failure experienced in the test **positively affects learning success**. That is, when a child experiences failure in the test, they **learn from their mistakes**. This, in turn, encourages learning new content. Generally speaking, experiencing failure **facilitates learning new content** and accelerates performance capability. Failure experiences thus **enhance** the performance capability in the long run.
F–	Today, your child will be tested with the test "Triangles" from the **Learning** Assessment Battery for Children. This test is used in young children to test how to deal with failure. Across over 30 studies have shown that the failure experienced in the test **negatively affects learning success**. That is, when a child experiences failure in the test, **more negative feelings** such as shame and sadness are experienced. This, in turn, encourages learning new content. Generally speaking, experiencing failure **makes it difficult to learn new content** and brakes performance capability. Failure experiences thus **debilitate** performance capability in the long run.
INT+	Today, your child will be tested with the test "Triangles" from the **Intelligence** Assessment Battery for Children. This test assesses the **potential** of your child's self-regulatory abilities. Across over 30 studies, children's scores on this test have been shown to be quite **changeable**. In more than 95% of cases, **studying helps children do better**, such that from one assessment to the next, their score can go up as much as 20 points. Generally speaking, **the more studying children do, the more they learn**. The abilities assessed by this test are clearly something that can be **changed**.
INT–	Today, your child will be tested with the test "Triangles" from the **Intelligence** Assessment Battery for Children. This test assesses your child's **inborn** self-regulatory abilities. Across over 30 studies, children's scores on this test have been shown to be quite **stable**. If the child completes the test once and then does so again a year later, in more than 95% of cases, the results are within 5 points of his or her original score. This seems to be the **case regardless of how much time children spend studying** for the test. The abilities assessed by this test are clearly **nothing that can be changed**.

Note. Substantial differences between cover stories are printed in bold.

Coder training

With regard to the observational measures (i.e., parenting behavior, self-regulatory strategies), we conducted extensive coder training with an experienced coder team with a

psychology degree and substantial expertise in coding parent-child interactions. Training coders to reliability comprised three phases. We began our training by giving a theoretical overview of the constructs. In the next step, the coders memorized the coding manuals that provided specific instructions, operational definitions of terms, and interpretation of the behaviors to be rated. In the third phase, test codings with data from a pilot study were performed, and results were discussed in weekly meetings reviewed by a moderator. The training ended when the coders achieved an intra-class correlation (ICC) of at least 70%. The coders double-coded 20 randomly selected videos of each observational measure, and interrater reliability for each scale was computed using ICC. The coders were blind to the mindset conditions.

Measures

Maternal mindsets

In order to test whether the experimental manipulation was successfully implemented, we measured mothers' mindsets of 1) intelligence, 2) failure, and 3) self-regulation.

We assessed mothers' *growth intelligence mindset* using a modified questionnaire (SE-SÜBELLKO-ST, Spinath & Schöne, 2003; Stern & Hertel, 2020). The scale covered mothers' mindset about the malleability of their child's intelligence by three items, using a five-point-scale adapted to the item content; e.g., "My child possesses a certain amount of intelligence and this ... cannot be changed/can be changed". Higher values indicated more agreement of a growth mindset. The scale showed good internal consistency (Cronbach's $\alpha = 0.80$).

Mothers' *failure mindset* was assessed using the German version of Haimovitz and Dweck's (2016) failure belief scale (Stern & Hertel, 2020). Mothers rated their agreement (1 = *extremely untrue*; 5 = *extremely true*) to six statements, three statements describing a failure-is-enhancing mindset; e.g., "Experiencing failure facilitates my child's learning and growth," and three statements describing a failure-is-debilitating mindset; e.g., "Experiencing failure debilitates my child's learning and growth." Statements of the failure-is-debilitating mindset were reverse-scored and averaged with all statements to a composite score. Thus, higher numbers indicated a more enhancing view of failure. The scale showed good internal consistency (Cronbach's $\alpha = 0.88$).

We assessed mothers' *growth self-regulation mindset* using Stern and Hertel's (2020) Parents' Implicit Theories of Self-Regulation (PITSR) scale. The scale covered mothers' mindset about the malleability of their child's self-regulation by three items, using a five-point-scale adapted to the item content; e.g., "My child has a certain ability to self-regulate and this

... cannot be changed/can be changed". Higher values indicated more agreement of a growth mindset. The scale showed good internal consistency (Cronbach's α = 0.80).

Rating of parenting behaviors

Parenting behaviors during the 10-min interaction were coded by a high-inference rating scheme (Erdmann et al., 2019). Three aspects were rated: autonomy support as an indicator of constructive involvement, intrusiveness as an indicator of unconstructive involvement, and scaffolding means as an indicator of how scaffolding takes place. All items were rated on a 5-point scale, ranging from 1=*not at all* to 5=*very often,* and then averaged into a mean score for each scale. *Autonomy support* included three items, e.g., "The mother let the child decide how they want to work on the task" and "The mother gives the child the opportunity to detect mistakes independently." *Intrusiveness* was a newly developed scale, comprising verbal (e.g., many commands, little dialogue, speaking more to the child than with the child, frequent repetition of the same instruction) and physical intrusiveness (e.g., placing triangles herself, taking away triangles without an agreement, holding triangles that child wants to take away). The use of *scaffolding means* was measured by six items referring to how often mothers asked questions, gave hints, instructions, feedback, explanations, and transfer[8]. Interrater reliability was excellent (Koo & Li, 2016) for the scales 1) autonomy support (ICC=.99), 2) intrusiveness (ICC=1.00), and 3) scaffolding means (ICC=.99).

Rating of children's self-regulatory strategies

Children's self-regulatory strategies were coded during the 5-min sole problem-solving task. The Strategic Behavior Observation Scale (SBOS; Dermitzaki et al., 2009) was used to code children's cognitive, metacognitive, and motivational strategies. Small adaptations of the scale were made to apply the current problem-solving task. Twelve strategic behaviors were coded and rated on a 4-point Likert scale (1 = *rare or absence of the behavior*; 4 = *full employment of the behavior*) and then averaged into a mean score for each scale. *Cognitive self-regulatory strategies* included three strategic behaviors: choosing between main and trivial (select the substantial elements); analyzing and combining activities (use the previous solution as a basis for the next task); effective use of models (use the pattern template). *Metacognitive self-regulatory strategies* comprised three strategic behaviors: planning (work with a clear plan); monitoring (examine the solution process); awareness of errors (detect errors and try to

[8] Mothers' use of *explanations* and *transfer* were observed very occasionally (explanations: *M*=1.19, *SD*=0.39; transfer: *M*=1.54, *SD*=0.52), and, therefore, not considered for the scale *scaffolding means*.

fix them). *Motivational self-regulatory strategies* contained six strategic behaviors: concentration (maintain attention on task); persistence (stay on task despite difficulties); working autonomously (need no intervention by the experimenter or mother); maintaining motivation (retain interest in the task); frustration (get angry or annoyed); giving up (cancel the task). Interrater reliability was good (Koo & Li, 2016) for the scales 1) cognitive (ICC=.99), 2) metacognitive (ICC=.90), and 3) motivational self-regulatory strategies (ICC=.97).

Control variables

As there are positive associations between language and self-regulation skills (e.g., Vallotton & Ayoub, 2011), *child vocabulary* was assessed as a potential covariate using the subtest Expressive Vocabulary from the German version of Kaufmann's Assessment Battery for Children II (Melchers & Melchers, 2015). In this test, children provide the name of pictured objects (e.g., drum).

During the data collection, the Corona pandemic came up, which is associated with increased stress on parents and children (e.g., Schmidt et al., 2021). Therefore, we recorded whether the assessment took place during the pandemic (yes vs. no).

Statistical analyses

To test whether the experimental manipulation was successfully implemented, the effect of conditions on mothers' self-reported mindsets was analyzed in independent sample *t*-tests. For this purpose, we examined whether mothers reported a mindset consistent with the experimental manipulation (manipulation check).

Before testing the hypotheses of the study, we analyzed whether the participants differed between mindset conditions with regard to demographic attributes of mother and child. We calculated multiple univariate ANOVAs with mindset condition as independent variable and demographic attributes (child age, child vocabulary, siblings, maternal age, socioeconomic status (SES)) as dependent variables. Chi-square difference tests were computed for categorical demographic attributes (child gender, assessment during Corona pandemic). There were no significant differences between mindset conditions, except for child vocabulary ($p < .20$, see Table 2). Therefore, we included child vocabulary as a covariate in further analyses.

Table 2

Demographic Attributes of Mother and Child by Mindset Condition

	Mindset Condition						
	INT+ (*n*=30)	INT– (*n*=31)	F+ (*n*=30)	F– (*n*=28)	SR+ (*n*=29)	SR– (*n*=29)	
Attribute	*M* or % (*SD*)	*M* or % (*SD*)	*M* or % (*SD*)	*M* or % (*SD*)	*M* or % (*SD*)	*M* or % (*SD*)	*p*
Child age [years]	4.81 (0.61)	4.92 (0.56)	4.79 (0.51)	4.76 (0.59)	4.80 (0.60)	4.73 (0.55)	.869
Child gender [female]	56.7%	41.9%	53.3%	60.7%	44.8%	51.7%	.705
Child vocabulary	17.93 (3.93)	19.67 (3.77)	17.41 (3.82)	17.32 (3.45)	17.46 (3.74)	17.03 (3.39)	.073
Siblings	0.97 (0.78)	1.26 (0.77)	1.03 (0.67)	0.86 (0.76)	1.14 (0.69)	0.97 (0.68)	.340
Maternal age	38.47 (5.02)	37.61 (5.08)	38.80 (3.12)	38.86 (3.77)	37.48 (4.57)	38.86 (4.01)	.670
Family SES	15.18 (2.76)	14.79 (3.21)	16.07 (2.14)	15.63 (2.50)	15.74 (2.77)	15.43 (2.49)	.516
Assessment during pandemic	33.3%	29.0%	30.0%	21.4%	27.6%	24.1%	.933

Note. Chi-square difference tests were computed for results reported as percentages, *F*-tests were computed for all others; two-tailed testing.

To test the effects of mindset induction on parenting behaviors (Research Question 1), we conducted covariate analyses of variances, controlling for child vocabulary. We applied multiple one-way ANCOVAs with (1) mothers' autonomy support, (2) intrusiveness, and (3) scaffolding means as dependent variables and mindset condition as independent variable. Since we were interested in the comparisons within the domains, we calculated three planned contrasts (INT+ vs. INT–, F+ vs. F–, SR+ vs. SR–) for each dependent variable.

To examine indirect effects of mindset induction on child self-regulatory strategies (Research Question 2), we calculated a mediation analysis. In a first step, we explored whether children's self-regulatory strategies differed by mindset conditions. A one-way MANCOVA, with mindset condition as between-subject factor, was conducted. The rating of children's cognitive, metacognitive, and motivational self-regulatory strategies served as dependent variables. Correlations between dependent variables were low ($r = .27$, $p < .01$) to strong ($r = .61$, $p < .01$), but $r < .90$ (see Table 3 for bivariate Pearson-correlations of all study variables), speaking against multicollinearity (Tabachnick & Fidell, 2012, p. 89). Since we were again

interested in the comparisons within the domains, we calculated three planned contrasts (INT+ vs. INT–, F+ vs. F–, SR+ vs. SR–) for each dependent variable. If the planned contrasts were significant, we tested whether parenting behaviors mediated the effect of mothers' mindset on children's self-regulatory strategies. We used a bootstrapping procedure (Preacher & Hayes, 2008) with 5,000 bootstrap samples and bias-corrected (BC) 95% confidence intervals (CIs).

All descriptives, correlations, and analyses of variances were computed using SPSS (Version 28). The mediation analysis was conducted using lavaan in R (Rosseel, 2012).

Table 3

Pearson-Correlations of all Study Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Child age	-											
2. Child gender	-.04	-										
3. Child vocabulary	.40**	-.02	-									
4. Maternal age	.86**	-.01	.38**	-								
5. Growth INT mindset	.07	.02	.01	.14	-							
6. Failure-is-enhancing mindset	.01	.02	-.02	-.01	.13	-						
7. Growth SR mindset	-.05	-.01	.07	-.02	.18*	.09	-					
8. Autonomy support	.18*	.04	.23**	.14	-.09	.04	.09	-				
9. Intrusiveness	-.05	-.08	-.22**	-.02	.10	-.05	-.07	-.64**	-			
10. Scaffolding means	-.26**	-.13	-.27**	-.24**	.09	-.08	-.09	-.57**	.42**	-		
11. Cognitive SR strategies	.42**	.03	.21**	.36**	.10	.01	.06	.22**	-.02	-.22**	-	
12. Metacognitive SR strategies	.40**	.07	.20**	.33**	.07	.02	.13	.29**	-.15*	-.25**	.61**	-
13. Motivational SR strategies	.38**	.02	.14	.30**	.01	.05	.05	.21**	-.20**	-.29**	.27**	.40**

Note. INT = intelligence; SR = self-regulation/ self-regulatory; two-tailed testing. $^{*}p < .05$. $^{**}p < .01$.

Results

Manipulation Check

Table 4 shows all means and standard deviations of mothers' self-reported mindsets (growth intelligence mindset, failure mindset, growth self-regulation mindset) as a function of mindset conditions. Mothers in the INT+ condition reported a higher growth intelligence mindset than mothers in the INT– condition, $t(59) = 2.93$, $p = .005$, $d = 1.02$. Mothers in the F+ condition reported a higher failure-is-enhancing mindset than mothers in the F– condition, $t(56) = 3.89$, $p < .001$, $d = 0.82$. Mothers in the SR+ condition reported a higher growth self-regulation mindset than mothers in the SR– condition, $t(56) = 3.86$, $p < .001$, $d = 0.53$. Thus, mothers reported a mindset consistent with the experimental induction, indicating that the manipulation was successful. Mindset conditions also differed to some extent in mindset domains that were not intentionally induced via cover stories ($p < .20$, see Table 4).

Table 4

Descriptives and T-Tests of Mothers' Mindsets as a Function of Mindset Condition

	Mindset Condition								
	INT+ (*n*=30)	INT– (*n*=31)		F+ (*n*=30)	F– (*n*=28)		SR+ (*n*=29)	SR– (*n*=29)	
Mindset	*M* (*SD*)	*M* (*SD*)	*p*	*M* (*SD*)	*M* (*SD*)	*p*	*M* (*SD*)	*M* (*SD*)	*p*
Growth intelligence mindset	4.06 (0.88)	3.29 (1.14)	**.005**	3.97 (0.95)	3.74 (1.09)	.398	4.06 (0.98)	3.64 (1.26)	.169
Failure-is-enhancing mindset	3.54 (0.84)	3.59 (0.79)	.802	3.77 (0.85)	2.93 (0.80)	**<.001**	3.68 (0.71)	3.35 (0.78)	.100
Growth self-regulation mindset	4.56 (0.46)	4.32 (0.53)	.073	4.40 (0.40)	4.56 (0.46)	.163	4.67 (0.45)	4.13 (0.60)	**<.001**

Note. Significance tests for group differences are based on independent samples *t*-tests; two-tailed testing. Statistically significant values are printed in bold.

RQ1: Do Maternal Mindsets Influence Parenting Behaviors in Mother-Child-Interaction?

Table 5 displays the effects of mindset induction on parenting behaviors, including the *F*-values and effect sizes (partial η^2) of overall effects, descriptive statistics, and planned contrasts results.

Table 5

Parenting Behaviors as a Function of Mindset Condition

			Mindset Condition											
	Overall (n = 177)		INT+ (n=30)	INT – (n=31)			F+ (n=30)	F– (n=28)			SR+ (n=29)	SR– (n=29)		
Parenting Behaviors	F	η^2	M (SD)	M (SD)	F	η^2	M (SD)	M (SD)	F	η^2	M (SD)	M (SD)	F	η^2
Autonomy support	**3.16****	.09	3.31 (1.20)	3.97 (0.90)	**3.98***	.02	4.14 (0.89)	3.62 (1.26)	**3.52***	.02	3.89 (1.08)	4.16 (0.89)	2.08	.01
Intrusiveness	1.68	.05	1.58 (0.79)	1.32 (0.46)	1.44	.01	1.31 (0.54)	1.61 (0.93)	**3.13***	.02	1.32 (0.51)	1.28 (0.47)	0.14	.00
Scaffolding Means	**3.01***	.08	2.98 (0.41)	2.99 (0.46)	0.45	.00	2.67 (0.53)	2.99 (0.55)	**6.76***	.04	2.93 (0.45)	2.87 (0.47)	0.39	.00

Note. F-tests were computed for overall tests and planned contrasts (controlling for child vocabulary). Overall tests are two-tailed tested, planned contrasts are one-tailed tested (except for scaffolding means regarding the F+ vs. F– contrast). Statistically significant values are printed in bold.

$^{*}p < .05$. $^{**}p < .01$.

H1a: Effects of intelligence mindsets. Hypothesis 1a predicted that a growth intelligence mindset leads to higher autonomy support, less intrusiveness, and the use of more scaffolding means compared to a fixed intelligence mindset. Mothers in the INT– condition showed more autonomy support than mothers in the INT+ condition, which contrasts to Hypothesis 1a. No effects on mothers' intrusiveness and use of scaffolding means were found. Thus, Hypothesis 1a could not be supported.

H1b$_{1\&2}$: Effects of failure mindsets. Hypothesis 1b$_1$ stated that a failure-is-enhancing mindset leads to higher autonomy support and less intrusiveness compared to a failure-is-debilitating mindset. Mothers in the F+ condition showed more autonomy support than mothers in the F– condition, supporting Hypothesis 1b$_1$. With regard to mothers' intrusiveness, the overall effect was not significant, and, therefore, the significant result of the planned contrast should be interpreted with caution. However, on a descriptive level, mothers in the F– condition showed more intrusiveness than mothers in the F+ condition. In addition, we assumed that F+ and F– conditions differ in their use of scaffolding means (Hypothesis 1b$_2$). A significant difference between conditions was found, with mothers in the F– condition showing more scaffolding means than mothers in the F+ condition. Hypothesis 1b could be partially confirmed overall.

H1c: Effects of self-regulation mindsets. Hypothesis 1c predicted that a growth self-regulation mindset leads to higher autonomy support, less intrusiveness, and the use of more scaffolding means compared to a fixed self-regulation mindset. There were no significant differences between SR+ and SR– condition on parenting behaviors. Thus, Hypothesis 1c could not be supported.

RQ2: Are Mothers' Mindsets (Indirectly) Related to Children's Self-Regulatory Strategies?

H2: Indirect effects of mindsets. Hypothesis 2 stated that mothers' mindsets are indirectly linked to children's self-regulatory strategies, mediated via parenting behaviors. Results of a one-way MANCOVA revealed a main effect for mindset condition, Roy's Largest Root = 0.09, $F(5, 163) = 2.96$, $p = .014$, partial $\eta^2 = .08$. Planned contrasts indicated that differences in children's self-regulatory strategies were observed only in the failure mindset conditions: Children of mothers in the F+ condition showed more motivational strategies (M = 3.60, SD = 0.59) compared to children of mothers in the F– condition (M = 3.15, SD = 0.85), M_{Diff} = 0.45, 95%-CI [0.05, 0.85], $F(1, 163) = 4.95$, p =.027, two-tailed tested, partial $\eta^2 = .03$ (see Table 6 for all self-regulatory strategies). Therefore, a multiple mediation for the failure

conditions (n = 58) was tested with mothers' scaffolding means and autonomy support as mediators. The total effect of mothers' failure-is-debilitating mindset on children's motivational strategies – not accounting for any mediators – equaled β = -0.30, p = .023, 95% BC CI = [-0.832, -0.062]. As shown in Figure 2, this effect decreased to nonsignificance when mothers' scaffolding means and autonomy support were entered into the model, β = -0.16, p = .188, 95% BC CI = [-0.579, 0.115]. Mothers' failure-is-debilitating mindset was significantly related to more scaffolding means, β = 0.28, p = .030, 95% BC CI = [0.021, 0.576], which in turn were significantly related to lower levels of children's motivational strategies β = -0.38, p = .019, 95% BC CI = [-0.905, -0.065]. Mothers' failure-is-debilitating mindset was not significantly related to autonomy support β = -0.20, p = .138, 95% BC CI = [-1.077, 0.148], and mothers' autonomy support was not significantly related to children's motivational strategies β = 0.19, p = .289, 95% BC CI = [-0.097, 0.334]. Thus, of the two potential mediators examined, only mothers' scaffolding means qualified as a mediator in the model. Overall, the mediator model accounted for 26% of the variance in children's motivational strategies (R^2 = .26). The results indicate a full mediation of mothers' scaffolding means and thus support Hypothesis 2.

Table 6

Descriptives and Planned Contrasts of Children's Self-Regulatory Strategies as a Function of Mindset Condition

	Mindset Condition								
	INT+	INT–		F+	F–		SR+	SR–	
	(n=30)	(n=31)		(n=30)	(n=28)		(n=29)	(n=29)	
Self-regulatory strategies	*M* (*SD*)	*M* (*SD*)	*p*	*M* (*SD*)	*M* (*SD*)	*p*	*M* (*SD*)	*M* (*SD*)	*p*
Cognitive	2.83	2.92	.886	2.76	2.82	.741	2.57	2.76	.223
	(0.72)	(0.57)		(0.54)	(0.66)		(0.66)	(0.62)	
Metacognitive	2.62	2.84	.775	2.99	2.62	.077	2.88	2.74	.572
	(0.77)	(0.82)		(0.84)	(0.77)		(0.89)	(0.79)	
Motivational	3.54	3.23	.059	3.60	3.15	**.027**	3.40	3.34	.834
	(0.66)	(0.77)		(0.59)	(0.85)		(0.71)	(0.89)	

Note. *F*-tests were computed for planned contrasts within domains (while controlling for child vocabulary); two-tailed testing. Statistically significant values are printed in bold.

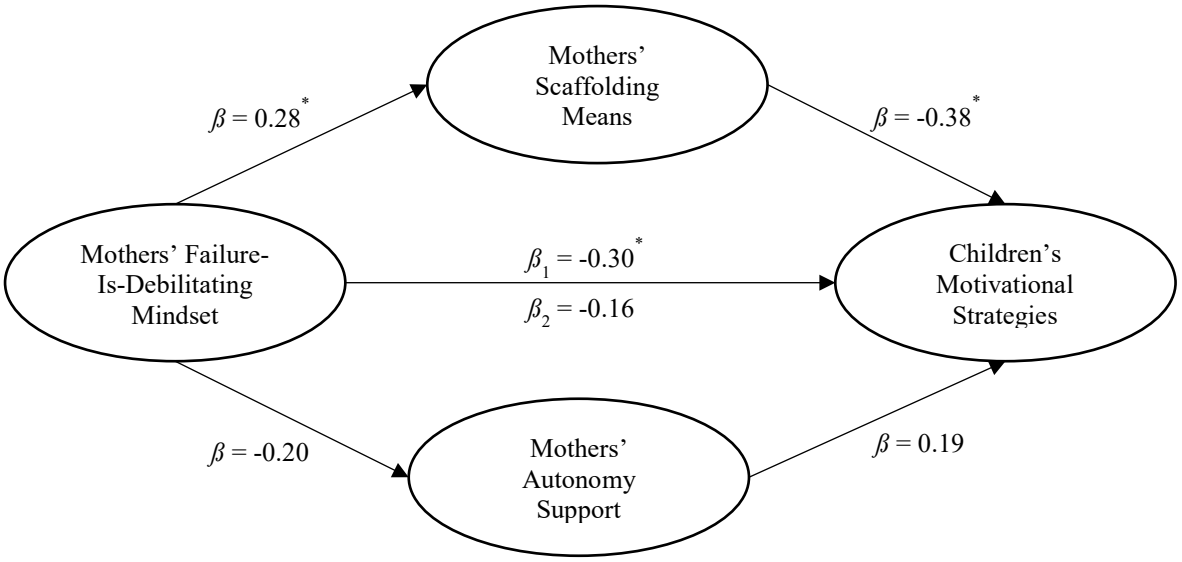

Figure 2. Mediation model: mothers' scaffolding means and autonomy support as mediators of the effect of mothers' failure mindset on children's motivational strategies, with child vocabulary as control variable. Along the bottom path, the value above the arrow indicates the effect without the mediator included in the model (β_1). The value below the arrow indicates the effect with the mediator included in the model (β_2). Asterisks indicate significant differences between conditions (* $p < .05$).

Discussion

This study aimed to examine the effects of mothers' mindsets in an experimental study in which three mindset domains were manipulated. Each mindset domain (intelligence, failure, and self-regulation) comprised two forms (malleable/enhancing vs. stable/debilitating), resulting in six mindset conditions to which mothers were randomly assigned. We investigated how these mindsets (1) differently affect parenting behaviors when mothers support their children in moderately challenging tasks and (2) indirectly affect children's subsequent self-regulatory strategies while working on the same tasks independently.

To answer research question 1, we examined the effects of mothers' mindsets on parenting behaviors in three mindset domains: intelligence, failure, and self-regulation. Regarding mothers' intelligence mindsets, the current research is the first study replicating the experiment by Moorman and Pomerantz (2010) with a sample of preschool children aged four and five years. The present study results revealed that mothers induced to hold a fixed intelligence mindset provided more autonomy support than those induced to hold a growth

intelligence mindset. This finding contrasts to Hypothesis 1a and previous studies that found positive (e.g., Muenks et al., 2015) or no significant (Moorman & Pomerantz, 2010) associations between growth intelligence mindsets and autonomy-supportive behaviors. The inconsistency across the studies might result from differences in methodology as parents of elementary school children were researched (Moorman & Pomerantz, 2010) or self-report measures were used (Muenks et al., 2015). Parents of school-aged children might be faced new demands that impact parents' involvement and mindsets: The transition from preschool to elementary school is associated with changes in parenting stress (Neece et al., 2012) which have been found to negative relate to growth mindsets (Lee et al., 2016). In the current study, mothers with a growth intelligence mindset intervened more (i.e., transferred less responsibility and supported less autonomy) because, with a growth mindset, there is the possibility of growth. In contrast, mothers with a fixed intelligence mindset focused more on accompanying the child (e.g., encouraging the child to use their own strategies) and were more autonomy-supportive. One reason for this finding might be the moderating role of mothers' beliefs about children's competence. The social-cognitive theory by Dweck and Leggett (1988) emphasized that individuals with fixed mindsets and high perceived present abilities displayed a mastery-oriented behavior pattern. In contrast, individuals with fixed mindsets and low perceived abilities would have a greater tendency for helplessness. In the current study, it is possible that (due to the selective, high educated sample) mothers' beliefs about child's competence were high, which resulted in mastery-oriented, autonomy-supportive parenting behavior. In a set of supplementary analyses, we preliminary tested the role of mothers' competence beliefs. The mothers rated their children's intelligence as average to slightly above average (compared to peers), but there was no significant interaction between mothers' intelligence mindsets and competence beliefs (see Supplementary Table 1). Nevertheless, the results imply that fixed mindsets can also have positive effects (i.e., in terms of autonomy-supportive behaviors).

Regarding mothers' failure mindsets, our results revealed that mothers induced to hold a failure-is-enhancing mindset showed more constructive (i.e., autonomy support) involvement in mother-child interactions than mothers who were induced to view failure as a debilitating experience. This finding confirmed Hypothesis $1b_1$ and is in line with work with school-age children. For instance, Haimovitz and Dweck (2016) indicated that a failure-is-enhancing mindset is related to more learning-oriented and less performance-oriented parental responses to child failure. Our results expand the findings by Haimovitz and Dweck (2016) because mothers' involvement was not measured in a hypothetical scenario via self-report but was rated more objectively using video analyses. In addition, we analyzed mothers' use of scaffolding

means to describe *how* mothers support their child's learning (Erdmann et al., 2019). Because scaffolding means can serve different intentions, we hypothesized that mothers differ in the use of scaffolding means in dependence of their failure mindset. The finding was that mothers induced to hold a failure-is-debilitating mindset used more scaffolding means than mothers induced to hold a failure-is-enhancing mindset. This result supports Hypothesis $1b_2$ and corresponds to the content of failure-is-debilitating mindsets: failure should be avoided; thus, more scaffolding means were applied. In order to get a deeper understanding of *which* scaffolding means are used more frequently, supplementary analyzes were conducted (see Supplementary Table 2). Results indicated that mothers in the failure-is-debilitating (vs. failure-is-enhancing) mindset condition were more instructive. However, more support is not always better (Pomerantz et al., 2007). For instance, Landry et al. (2000) observed that higher degrees of parents' directiveness (i.e., providing structured information) at three and a half years have negative effects on children's cognitive abilities at four and a half years (in contrast to the positive influence of directiveness during the toddler period). The high level of instructions of mothers in the failure-is-debilitating (vs. failure-is-enhancing) mindset condition could be an expression of increased intrusiveness. On a descriptive level, mothers induced to hold a failure-is-debilitating (vs. failure-is-enhancing) mindset showed more intrusiveness in mother-child interactions. However, this finding was not statistically significant, which might be related to the fact that the mother-child interactions have not been studied in an explicit failure scenario. As failure mindsets should be especially activated when failure is imminent (Haimovitz & Dweck, 2016), the effects may have been larger if an impending failure had been more present. Overall, the results indicate that mothers' failure-is-enhancing mindsets are associated with more learning-oriented parenting behaviors.

Regarding mothers' self-regulation mindsets, we found no significant differences in parenting behaviors which contrasts with Hypothesis 1c. One reason may be that the manipulation effect was smaller for the self-regulation domain (medium effect size) compared to the intelligence and failure domain (large effect size according to Cohen, 1992). This could be attributed to the ceiling effect for the growth self-regulation mindsets that emerged in our data. These ceiling effects also occurred in other studies examining growth self-regulation mindsets (e.g., Hertel & Karlen, 2021; Stern & Hertel, 2020). Ceiling effects are associated with restricted variance, which may explain why no significant effects were found. Overall, however, a similar behavioral pattern as in the intelligence domain emerged, which might be explained by a shared factor of both domains, namely malleability. Referring to the current debate about the domain specificity of mindsets (Bråten & Strømsø, 2005; Hertel & Karlen,

2021), we argued that mindsets about self-regulation might be essential when self-regulatory processes are aimed to be explained, which was not confirmed by our data. Although the problem-solving task of the current study required self-regulatory abilities (e.g., working with a plan, monitoring activities, maintaining motivation; Dermitzaki et al., 2009), it originated from an intelligence test (Melchers & Melchers, 2015) and mothers were instructed to support their child in solving the task. In this way, we created a mother-child interaction that was as natural and realistic as possible. However, the question arises whether more self-regulatory-type tasks or other instructions (e.g., promoting child self-regulation; support of child learning vs. performance; Grolnick et al., 2002) might be necessary for the effects of domain specificity of self-regulation to become apparent. Additional experimental studies, including multiple tasks, with different demands, are needed to test this assumption.

To answer research question 2, we examined the indirect effects of mothers' mindsets on children's self-regulatory strategies. We expected that parenting behaviors mediated the link between mothers' mindsets and children's self-regulation. In support of Hypothesis 2, an indirect effect was found: Mothers induced to hold a failure-is-debilitating mindset used more scaffolding means which in turn were related to lower motivational self-regulatory strategies in child-alone problem-solving. Motivational strategies are essential as they encompass the initiation or maintenance of actions (e.g., Zimmermann, 1999), affect the learning process (Ryan & Deci, 2000), and predict interest, choices, effort, performance, and academic achievements (e.g., Wolters, 2003). Thus, mothers' failure mindsets seem to instigate a cascade that leads to children's behavioral adjustment, as described in the three-term "standard model" by Bornstein et al. (2018). The results indicate that mothers' mindsets (indirectly) contribute to children's socialization process. The present findings go beyond Moorman and Pomerantz's (2010) findings which showed that mothers respond more unconstructively to children's helplessness: The present study suggests that mothers' failure mindset can indirectly induce a reduction in child's motivation. However, when failure is seen as enhancing, mothers seem to step back, give the child more space, and behave in a more autonomy-supportive way. Those children give up less, show more persistence, and thus seem to respond to setbacks differently. Whether these effects have a long-term impact on child development should be investigated in future longitudinal studies.

The current research is the first experiment that simultaneously induced mindsets of different domains (i.e., intelligence, failure, self-regulation). This allows identifying different maternal and child behavior patterns depending on mothers' induced mindsets. At the same time, researchers argue that mindsets of different domains can be activated simultaneously

(Dweck et al., 1995; Haimovitz & Dweck, 2016; Muenks et al., 2015; Tabernero & Wood, 1999). The experimental design with the manipulation of single mindsets reflects a simplification of the real world. Although the induction of mindsets via cover stories was successful, and we assume that the certain mindset was activated in the corresponding condition, we do not know whether this mindset remained activated over the entire time of mother-child interactions or, for example, whether different mindsets were activated at the same time and influenced parenting behavior. However, overall, no systematic activation patterns of other mindsets between conditions could be found (see Supplementary Table 3). To investigate this question in more detail, further experiments involving different combinations of mindsets or other approaches such as profile analyses (see also Hertel et al., 2019; Stern & Hertel, 2020) could be conducted in the future.

The presented study, however, is subject to several limitations. First, the generalization is limited due to the selective sample of high-educated mothers from southwest Germany. A selection bias cannot be excluded as the caption of the study comprised children's self-regulation, and participants were asked to come to the laboratory. This might have reduced the variability of the sample because especially mothers highly interested in self-regulatory processes participated (cf. ceiling effects of mothers' self-regulation mindsets). Second, although the experimental design offers several advantages (e.g., cause-effect relations), the laboratory context may have affected parenting behaviors in the way that mothers felt under pressure because they were video-recorded while interacting with their children. Third, we have to acknowledge that the rating of parenting behaviors captured the quantity rather than the quality of maternal involvement. Assessing the level of contingency (cf. Wood & Middleton, 1975) and children's subsequent responses in mother-child interactions (e.g., by using micro-analytical approaches; Carr & Pike, 2012) might give additional insights into mothers' and child behavior. Finally, although we assessed mothers' mindsets according to the usual practice in the literature (e.g., Hertel & Karlen, 2021; Spinath & Schöne, 2003), the scales reflect rather global measures. The next step in research might be further developing the scales, for instance, by distinguishing specific subcomponents of intelligence (e.g., numerical vs. verbal) and/or self-regulation (e.g., hot vs. cold). In addition, even though we gave a brief definition of self-regulation at the beginning of the study, we do not know mothers' detailed understanding of the introduced constructs. Future studies could qualitatively assess mothers' concepts of self-regulation or intelligence. Overall, the effect sizes of mothers' mindsets were small. Since parenting behaviors and children's self-regulatory strategies are determined by a range of

variables (e.g., SES, gender, temperament; Bornstein, 2016; Lengua et al., 2014), only small effects can be expected. Nevertheless, these can also have high practical relevance.

Despite these limitations, the present study is the first to investigate mothers' mindsets of different domains influencing parenting behaviors in mother-child interactions with their four- to five-year-old children. Mothers' mindsets about failure seemed to have the strongest effects: When mothers view failure as something that should be avoided – that is, they hold a failure-is-debilitating mindset – it leads mothers to use "too much" scaffolding means resulting in lower motivational strategies in children. Our results offer some practical implications for parents and educators. In preschool age, many abilities and competencies are growing, but children still make mistakes. Caregivers' attitudes towards failure may then become important in child socialization (Bornstein et al., 2018) and self-regulatory development. Therefore, parents and educators should be trained to view failure as enhancing and provide an autonomy-supportive environment to promote children's motivation and self-regulation.

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Supplementary Material

Supplementary Table 1

Descriptives and Planned Contrasts of Mothers' Competence Beliefs as a Function of Mindset Condition

			Mindset Condition											
	Overall[2] (n = 159)		INT+ (n=29)	INT – (n=29)			F+ (n=26)	F– (n=25)			SR+ (n=24)	SR– (n=26)		
Competence Beliefs[1]	F	η^2	M (SD)	M (SD)	F	η^2	M (SD)	M (SD)	F	η^2	M (SD)	M (SD)	F	η^2
Problem-solving abilities	1.50	.05	3.38 (0.62)	3.41 (0.83)	0.08	.00	3.46 (0.58)	3.64 (0.64)	1.05	.01	3.29 (0.62)	3.62 (0.64)	3.47	.02
Dealing failure	0.66	.02	2.93 (0.77)	2.76 (0.80)	0.26	.00	2.96 (0.58)	3.32 (0.58)	0.34	.00	3.25 (0.74)	2.85 (0.61)	1.55	.01
Self-regulatory abilities	**2.40***	.07	2.97 (0.78)	3.10 (0.86)	0.71	.01	3.08 (0.69)	3.20 (0.76)	3.12	.02	3.13 (0.85)	2.85 (0.68)	**3.93***	.03

Note. [1]Mothers rated children's competencies in problem-solving, dealing failure, and self-regulatory abilities on a 5-point rating scale (e.g., "In comparison to peers, how do you rate your child's problem-solving abilities?"; 1 = "below-average", 3 = "average", 5 = "above average. [2]Not all mothers in the sample answered these questions, resulting in a smaller overall sample size. F-tests were computed for overall tests and planned contrasts (controlling for child vocabulary); two-tailed testing. Statistically significant values are printed in bold. $^{*}p < .05$. $^{**}p < .01$.

Supplementary Table 2

Descriptives and Planned Contrasts of Mothers' Scaffolding Means as a Function of Mindset Condition

	Overall (*n*=177)		Mindset Condition											
			INT+ (*n*=30)	INT– (*n*=31)			F+ (*n*=30)	F– (*n*=28)			SR+ (*n*=29)	SR– (*n*=29)		
	F	η²	*M* (*SD*)	*M* (*SD*)	*F*	η²	*M* (*SD*)	*M* (*SD*)	*F*	η²	*M* (*SD*)	*M* (*SD*)	*F*	η²
Scaffolding Means[1]	**5.12*****	.13												
Questions	0.36	.01	2.40 (0.62)	2.48 (0.72)	0.53	.00	2.41 (0.78)	2.61 (0.88)	1.00	.01	2.43 (0.69)	2.52 (0.63)	0.16	.00
Hints	**4.19****	.11	2.70 (0.47)	2.71 (0.46)	0.13	.00	2.24 (0.58)	2.50 (0.58)	3.45	.02	2.46 (0.58)	2.38 (0.49)	0.47	.00
Instructions	**2.25***	.06	3.33 (0.80)	3.13 (0.85)	0.21	.00	2.76 (0.87)	3.29 (0.94)	**5.98***	.03	3.29 (0.81)	3.10 (0.72)	0.96	.01
Feedback	1.47	.04	3.50 (0.68)	3.65 (0.75)	1.67	.01	3.28 (0.65)	3.57 (0.74)	2.54	.02	3.54 (0.69)	3.48 (0.74)	0.69	.00

Note. A one-way MANCOVA was conducted with mindset condition as independent variable and mothers' scaffolding means (questions, hints, instructions, and feedback) as dependent variables, controlling for child vocabulary. [1]Roy's Largest Root was computed for the multivariate overall test; *F*-tests were computed for overall tests and planned contrasts; two-tailed testing. Statistically significant values are printed in bold. $^{*}p < .05$.

Supplementary Table 3

Pearson Correlations Between Mindsets as a Function of Mindset Condition

			Mindset Condition											
	Overall		INT+		INT–		F+		F–		SR+		SR–	
	(*n*=177)		(*n*=30)		(*n*=31)		(*n*=30)		(*n*=28)		(*n*=29)		(*n*=29)	
Mindset (self-report)	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1. Growth INT mindset	-		-		-		-		-		-		-	
2. Failure-is-enhancing	.13	-	-.25	-	.30	-	-.04	-	-.03	-	.24	-	**.39**	-
mindset	[.097]	-	[.186]	-	[.107]	-	[.850]	-	[.864]	-	[.218]	-	[.034]	-
3. Growth SR mindset	**.18**	.09	.30	.26	.07	-.13	**.42**	.01	-.25	.02	**.38**	**.37**	.08	.16
	[.015]	[.215]	[.104]	[.164]	[.700]	[.473]	[.023]	[.947]	[.195]	[.930]	[.041]	[.048]	[.670]	[.408]

Note. Values in square brackets indicate *p*-values for each correlation; two-tailed testing. Statistically significant values are printed in bold.

Description of Personal Contribution for the Papers of This Dissertation

Paper 1: *Profiles of parents' beliefs about their child's intelligence and self-regulation: A latent profile analysis*

Maren Stern and Silke Hertel conceptualized the study. Maren Stern collected the data, analyzed them, and wrote the manuscript. Silke Hertel commented on the analysis plan and the manuscript and supervised the project.

Paper 2: *Relationship between maternal scaffolding and preschooler's metacognitive strategies in a problem-solving situation*

Maren Stern and Silke Hertel conceptualized the study. Maren Stern collected the data, analyzed them, and wrote the manuscript. Silke Hertel commented on the analysis plan and the manuscript and supervised the project.

Paper 3: *Effects of maternal mindsets on parenting behaviors and self-regulatory strategies in four- and five-year-olds*

Maren Stern, Kim Erdmann, and Silke Hertel conceptualized the study. Maren Stern collected the data and analyzed them. Maren Stern wrote the manuscript in consultation with Kim Erdmann. Silke Hertel commented on the analysis plan and the manuscript and supervised the project.

Declaration in accordance to § 8 (1) c) and (d) of the doctoral degree regulation of the Faculty

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Erklärung gemäß § 8 (1) c) der Promotionsordnung der Universität Heidelberg für die Fakultät für Verhaltens- und Empirische Kulturwissenschaften / Declaration in accordance to § 8 (1) c) of the doctoral degree regulation of Heidelberg University, Faculty of Behavioural and Cultural Studies

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