A LATENT PROFILE ANALYSIS OF PARENTAL PRACTICES DURING AN INFORMAL MATH ACTIVITY

by

Yuchen Song

(Under the direction of Michael Barger)

ABSTRACT

Parents' praise, autonomy-support, value communication, and positive affect are beneficial to children's math adjustment, whereas criticism, control, and negative affect undermine children's success in math. Synthesizing parenting behaviors that have been examined separately in prior research, the present observational study sought to reveal combinations of parental practices during dyadic math interactions using a person-centered approach. In addition, accounting for psychological and socioeconomic factors that can shape parental practices, the present study also investigated how parents' child- and math-specific beliefs and family SES are associated with different combinations of parenting behaviors. Latent profile analysis yielded three distinct profiles that described 359 parents of children 7 to 8 years old: Moderately-motivating parents (75.49%), value-promoting parents (9.19%), and negative/controlling parents (15.32%). Parental beliefs were largely unrelated to combinations/profiles of parenting behaviors with the exception of parents' growth mindset, which had a *negative* association with the behavioral profile characterized by parents' frequent use of constructive behaviors. For family SES variables, parents' educational attainment was a robust predictor of profiles of parenting behaviors, whereas household income did not predict parenting behaviors. Characteristics of the

resulting profiles identified in the present study highlighted the practical importance of studying multiple parenting behaviors in tandem in the study of parents' academic socialization. Findings on parental beliefs challenged the theoretical assumption that parents' beliefs about their children and mathematics can naturally translate into their instructional behaviors. The robust relation between parental education and profiles of parenting behaviors contributed to the literature of SES disparities in parental practices, emphasizing that investigating the SES and cultural specificity of parenting behaviors is a necessary next step in the research of parents' educational involvement.
INDEX WORDS: parental involvement, parental beliefs, parenting behaviors, math learning, growth mindset, SES disparities

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CHAPTER 1

THEORETICAL FRAMEWORK

Not only does early mathematical skill predict children's later academic success (Aunola et al., 2006, Duncan et al., 2007; Watts et al., 2014), but it has also been found to contribute to skills in demand in modern workforce, such as computational thinking, quantitative reasoning, and problem-solving (Kaup et al., 2023; Wong, 2018). However, children's motivation in learning math tends to decline throughout elementary school years, as does their achievement (Frederick & Eccles, 2002; Gottfried, 2007). To help children sustain math motivation, it is important to understand the source of motivation for children of this age range. Over the past three decades, psychologists have invested substantial research effort to investigate the environmental factors that support early math motivation, interest, and achievement. Among the many factors contributing to children's early math development, parents have been recognized to have untapped potentials (Harackiewicz et al., 2012), especially considering the high frequency at which parents are involved in their children's math learning (Brown et al., 2024). However, parental involvement in children's math learning has been linked with negative emotions and less constructive behaviors (e.g., Maloney et al., 2015; Wu et al., 2022), making it a valuable context to study the process of socializing adaptive and maladaptive math motivation in children.

Prior works based on different theoretical traditions have shown a wide array of parental practices (e.g., feedback, autonomy-support, control, value communication, and affect) that differentially influence children's math motivation and achievement (e.g., Grolnick & Pomerantz, 2022; Gundeson et al., 2018; Harackiewicz et al., 2012), but what has been understudied is the extent to which parents' constructive and unconstructive behaviors co-occur when they engage in math learning with their children. A holistic investigation of multiple parenting behaviors around math is warranted because different forms of parenting behaviors rarely appear as isolated occurrence during dyadic math interaction. A holistic examination can therefore provide a more accurate representation of what actually happens during parents' math learning involvement that supports or hinders children's math motivation. Also relevant to this point, although prior research has linked individual motivational beliefs (e.g., mindset beliefs, value beliefs, perceived competence, and math anxiety) to specific parenting behaviors, it is less clear how parents' beliefs about math and their children give rise to different *patterns* in parenting behaviors. As such, the lack of attention to patterns in parenting behaviors may help explain the inconsistent findings on the intergenerational transmission of motivational beliefs, since parent's implicit beliefs may not be manifested in the form of singular behavior, but a collection of behaviors, from which children's own motivational beliefs are instilled. Lastly, prior research has identified a SES disparity in the quality of parental math involvement (see Elliot & Bachman, 2018a for review), specifically in terms of creating optimal home math environment and initiating math-related conversations. The present study aims to complement existing work by uncovering these structural barriers to parenting behaviors that are *motivationally* relevant to children's math development.

To these ends, drawing from an integrative theoretical perspective, the present study sought to address four research questions in regard to parental involvement in children's early math learning: 1) What are the prevalent *patterns* of practices parents engage in during their involvement in children's math learning? 2) To what extent can parents' beliefs about math and their children predict parents' behavioral patterns? 3) To what extent can parent's education and family income predict parents' behavioral patterns? 4) Can parents' behavioral patterns predict children's math learning outcomes above and beyond parents' education and income?

Theoretical Frameworks on Parents' Academic Socialization

The study of parents' academic socialization has a long history within the field of education and psychology that has resulted in multiple theories over time. Notably, the socialization model derived from the Situated Expectancy-Value Theory (SEVT, Eccles & Wigfield, 2020) has guided a large body of research on how parents socialize motivational beliefs in their children. According to SEVT, competence beliefs (i.e., Can I do this?) and value beliefs (i.e., Do I want to do this?) are central to children's academic motivation. Value beliefs can be further understood as a collection of children's beliefs about the usefulness (i.e., utility value), enjoyment (i.e., intrinsic value), importance (i.e., attainment value), and relative cost of engaging in any academic task (Eccles & Wigfield, 2020). To explain where and how these beliefs emerge, SEVT posits that parents can influence their children's motivation both implicitly via their own beliefs, or explicitly through their behaviors during educational co-activity (Frederick & Eccles, 2005; Simpkins et al., 2010; Simpkins et al., 2015a). Specifically, parents' beliefs about their children or about a subject area (e.g., perception of children's math competence or perception of math value) can permeate into their educational involvement in the form of different parental practices (e.g., role modeling, encouragement, or emotional tone) (Silinskas et al., 2015; Simpkins et al., 2012; Zucker et al., 2021), which may carry either motivating or demotivating messages. Children would then interpret these messages to internalize them as their own motivational beliefs (Simpkins et al., 2015b). Finally, as the result of children's academic motivation and performance, parents would then adjust their child-specific beliefs and behaviors, creating an evolving, bidirectional cycle of motivation development in children (Davison et al., 2003; Simpkins et al., 2010).

Similar to the socialization model outlined in SEVT, Social Cognitive theorists (SCT, Schunk & DiBenedetto, 2020) suggest a system of triadic reciprocality when describing the interactive dynamic among personal processes (i.e., motivational beliefs), behaviors, and environmental factors (i.e., feedback, instruction, or social models). SCT argues that each of these components affects the other two and is affected by the other two components, as in a self-contained, multi-directional triangular loop. Since the central premise of SCT is that individuals strive to achieve control over their lives (i.e., sense of agency), self-efficacy, defined as one's beliefs about their capability to manage and execute a prospective task (Bandura, 1997), becomes the focal motivational construct examined in SCT-based research. Based on the triadic reciprocality model, children's self-efficacy is informed by both behavioral processes (i.e., previous mastery experience) and environmental factors (i.e., parents' socialization). As such, children acquire self-assessment of their capability from parents' feedback (Lam & Chan, 2016; Schunck & DiBenedetto, 2016; Schunck & Usher, 2019), which in turn guides their future goal-oriented behaviors.

The third theory widely referred to in parents' socialization literature is the Self-Determination Theory (SDT, Ryan & Deci, 2000). In essence, SDT emphasizes that motivation is driven by the intent to meet three basic psychological needs: the need for autonomy, the need for competence, and the need for relatedness (Ryan et al., 2019). Fulfillment of these needs would support motivation, whereas hinderance of these needs are considered damaging to motivation. Depending on the extent to which basic psychological needs are met, children develop motivation on a spectrum ranging from amotivation, to extrinsic motivation, to intrinsic motivation. On one end of this spectrum, amotivation is characterized by a complete lack of perceived competence and relevance in the task. On the opposite end of the spectrum, intrinsic motivation is characterized by engagement in a task out of inherent enjoyment, whereas extrinsic motivation can be fueled by external factors such as values or affirmation from other people (Ryan & Deci, 2000). In relation to parents' socialization, SDT provides core tenets for supporting motivation in children, such that parents need to create a learning environment that induces a sense of autonomy, maintains interpersonal trust, and sets clear expectation and structures (Grolnick & Pomerantz, 2009; 2022). In order to achieve these parenting goals, parents need to encourage children's initiation, offer choices, and express warmth and empathy in dyadic interactions. Parenting behaviors on those lines would signal to the children that parents have confidence in children's capability to accomplish academic tasks (i.e., need for competence), and that parents allow children to take control of their own learning (i.e., need for autonomy). As such, children would be more likely to develop more autonomous forms of motivation (i.e., intrinsic motivation), leading to optimal engagement and learning (Ryan & Deci, 2020).

In summary, theories from educational, developmental, and social psychology have attempted to explain the role that parents play in fostering motivational beliefs in children. Even though these theories come from different ideological traditions, they overlap in their emphasis on the importance of competence-related beliefs and value to children's academic success. In other words, for children to perform well academically and stay motivated, they need to believe that they have the capability to plan, manage, and execute academic tasks, as well as to perceive either external or internal values in those tasks. In terms of how parents socialize these beliefs in their children, different theories agree that children receive motivational messages from parental practices, and internalize those messages as their own beliefs. Parenting behaviors motivating to children should be the ones that support children's sense of agency, build perceived values and competence beliefs, and are warm and positive in nature. Conversely, parenting behaviors that intrude on children's thoughts and behaviors, or those that devalue effort and accomplishment, are demotivating to children. A visual representation of parents' academic socialization model is presented in Figure 1.

CHAPTER 2

LITERATURE REVIEW

Which Parenting Behaviors Predict Children's Math Motivation and Achievement?

Drawn from aforementioned theoretical frameworks, both cross-sectional and longitudinal studies have documented that children across school ages can acquire competence beliefs about mathematics based on parents' perception of children's competence (Frome & Eccles, 1998; Gladstone et al., 2018; Simpkins et al., 2015a). To unveil the mechanisms through which such transmission of competence beliefs occurs, prior works have investigated a variety of parental practices. For example, parents can directly convey information that boosts or impairs children's sense of competence through their praise, encouragement, or criticism and rejection. Lam and colleagues (2016) tested the effect of positive feedback and negative feedback on middle school age children's academic self-efficacy and found that children reported significantly higher self-efficacy when they received positive feedback from their parents than when they received negative feedback. In a broader study, Ahn and colleagues (2015) compared the predictive power of different source of social persuasion (teachers, parents, and peers) on adolescents' self-efficacy beliefs across three countries (Korea, U.S, and Philippines). They found that encouragement from parents was the only source that significantly predicted adolescents' math self-efficacy in all three countries. More recent studies have even further differentiated types of positive feedback, suggesting that feedback worded to praise children's innate ability (i.e., person praise) can actually elicit *maladaptive* beliefs about intellectual ability and math in children as young as 7 years old (Barger et al., 2022; Gunderson et al., 2013;

Pomerantz & Kempner, 2013), whereas only feedback worded to praise children's hard work and strategy (i.e., process praise) is effective at fostering growth-oriented beliefs and supporting math achievement (Gunderson et al., 2013; Gunderson et al., 2018).

Unlike parents' praise and encouragement, parents' criticism and rejection can harm children's motivation and achievement (see Xie et al., 2022 for review). Although when compared to a complete lack of feedback, negative feedback can be effective in promoting children's math skills due to its corrective nature (Fyfe et al., 2022), excessive use of negative feedback can undermine self-efficacy and induce anxiety in elementary school aged children (Merrick & Fyfe, 2023; Wang et al., 2023). This is because feedback can direct children's attention in unintended ways, such that if parents constantly display coldness or disapproval, children may attribute failure experience to their inherent abilities (Kluger & DeNisi, 1996). The self-directed attention would prevent children from allocating sufficient cognitive resources (i.e., attention and working memory) to the target task. Performance on math tasks would therefore suffer as a result of the disruption in attention and working memory (Ashcraft & Kirk, 2001; Beal et al., 2005; Park et al., 2014). This lowered achievement would be further internalized by children as (non)mastery experience, which would in turn lower children's self-efficacy (Arens et al., 2020). In short, parents' overuse of criticism opens a stream of suboptimal effects on children's motivational and performance outcomes by interfering with children's cognitive and affective processes.

In addition to providing feedback, parents can also influence children's math motivation and achievement through their controlling and autonomy-supportive behaviors. Research stemming from SDT has shown that parental control predicted lower perceived competence in children 6 to 15 years old, regardless of whether parental control was reported by the parent or the child (Silinskas & Kikas, 2019; Wong et al., 2018). These findings aligned with the theorization that controlling parenting impairs children's psychological need for autonomy, thus shifting children from being intrinsically motivated to amotivated. In fact, the effect of parental control on children's motivational and achievement outcomes follows a similar pattern as parents' criticism. Oh and colleagues (2022) found that parents tend to be especially controlling toward children who have lower prior math achievement. The controlling parenting style would undermine children's achievement even further, and thus create an unhealthy cycle for children's math learning. On the other hand, autonomy-supportive parenting behaviors are theorized to fulfill the need for autonomy and therefore lead to more autonomous forms of motivation that are marked by stronger beliefs in self-competence (Grolnick & Ryan, 1989). Consistent with theoretical assumption, several studies have found that autonomy-supportive parenting offer children ranging from preschool to high school age opportunities to persist and to feel independent in face of challenging tasks in both naturalistic math learning environment and lab-based experimental setting. (Bindman et al., 2015; Meuwissen & Carlson, 2019; Silinskas & Kikas, 2019). Longitudinal studies have also contributed to this body of evidence, indicating that when children perceived more support of autonomy from their parents, their competence beliefs were less likely to decline from 7th to 12th grade (Wang et al., 2021).

Different from the somewhat consistent findings with the intergenerational transmission of competence-related beliefs, findings regarding the socialization of value beliefs are mixed. A seminal cross-sectional study found that parents' academic values directly predicted their adolescents' perceived value in schooling broadly (Jodl et al., 2001). More recent longitudinal studies, however, have challenged this finding by showing that the transmission of value beliefs is dependent on domain areas. Specifically, Gniewosz and Noack (2012a) found that the parents' value beliefs about reading, but not math, were passed on to their 10- and 11-year-old children. Simpkins and colleagues (2015a) even found no direct longitudinal relation between academic values held by parents and their 6- to 10-year-old children, regardless of subject area. Although counterintuitive, these findings can be explained by the theorization that parents' beliefs need to be reflected in their behaviors and be filtered through children's interpretation, before they can internalize as children's own beliefs. In other words, parents may need to explicitly express value related information in order for children to receive it.

Following this reasoning, researchers have designed intervention programs that prompted parents to have conversations about the utility value of math and science domains with their high school aged children (Harackiewicz et al., 2012). In the study, researchers mailed brochures to parents that explain the real-world applications of math and science, and guide parents to have conversations with their children around math and science. Results indicated that during interviews that took place one year after the initial intervention, children whose parents were in the intervention condition reported more frequent math and science related conversations with their parents, which in turn predicted children's perception of utility value in math and science (Harackiewicz et al., 2012). Research since then has replicated and expanded these findings to highlight the importance of direct communication of value to successful transmission of value beliefs from parents to children. In particular, it has been discovered that children in this developmental stage perceived higher level of utility value in math and science when parents initiated elaborated conversation about math and science (Hyde et al., 2016), or when the parents connected learning materials of math and science to a future goal (Lazzarides et al., 2017).

Finally, in the context of parent-child math interactions, it would be both practically infeasible and conceptually unrealistic to disentangle parental practices from the emotions parents display toward their children. Specifically, prior research has established that dyadic math interaction can be an affectively charged context (e.g., Maloney et al., 2015; Wu et al., 2022). In this sense, it is likely that various forms of parental practices around math are accompanied by varying levels of emotional expression (i.e., praise may be more likely to appear jointly with warmth or joy; criticism may be more likely to appear jointly with coldness or annoyance). Recognizing that parenting is an affective experience (Dix, 1991), researchers have studied differential association between parents' affect and children's math outcomes based on the valence of emotional expression (e.g., Denham et al., 2000; Distefano et al., 2020; Silinskas et al., 2015). For instance, positive affect is often characterized by parents' expression of warmth, fun, and love during dyadic interactions, whereas negative affect is characterized by parents' expression of hostility, frustration, or irritation. Early research showed that negative affect can undercut children's motivation (Larson & Gillman, 1999; Nolen-Hoeksema et al., 1995). Later longitudinal studies extended this finding by showing that the more negatively affective parents were when they assisted their elementary aged children with homework, the poorer children's later motivation, engagement, and achievement became (Pomerantz & Lin, 2014; Tian & Chen, 2019; Wu et al., 2022).

Fortunately, in homework help situations, mothers also try to maintain a supportive and warm environment, and those who do so find it to be a rewarding experience that connects themselves with their children (Levine et al., 1997). Indeed, parents' positive and negative affect have been recognized as separate experiences that act on children's motivational and achievement outcomes in distinct ways (Kenny-Benson & Pomerantz, 2005), such that mothers' positive affect can moderate the damaging effect of negative affect on children's autonomous motivation during homework assistance (Pomerantz et al., 2005). Corroborating these findings, several studies have found a positive association between parental warmth and math self-efficacy, engagement, and achievement for children in middle childhood through late adolescence (e.g., Hsu et al., 2019: Kara & Sumer, 2022; Sun et al., 2020; Tian & Chen, 2019). Sun and colleagues (2020) further found that parental warmth supports children's math engagement through fulfillment of children's psychological need for autonomy, competence, and relatedness, in line with the view of self-determination theory.

Which Psychological and Contextual Factors Predict Parenting Behaviors?

Given the cascade effect parenting behaviors have on children's math motivation and achievement outcomes, it is important to understand what psychological factors give rise to those behaviors. This line of inquiry would not only inform parents of optimal forms of practices around math, but also aid researchers to design targeted intervention programs to promote specific positive motivational beliefs that set the seeds for motivating parental practices. One recent experimental study has actually shown that parents' beliefs are malleable, although changes in belief may not be accompanied by a concurrent change in behaviors (e.g., MacDonald et al., 2024). In fact, a close examination of the existing correlational research also revealed a somewhat inconsistent trend in the association between parents' beliefs and behaviors.

First, parents' math anxiety can shape parental involvement in children's math learning in a variety of ways. On a general level, highly math anxious parents avoid engaging in math-related tasks with their children (Berkowitz et al., 2019; Elliott et al., 2019). This lack of co-activity would in turn limit children's opportunities to acquire math skills, therefore hindering children's math development over time (Kiss & Vukovic, 2021). Unfortunately, when math anxious parents do engage in their children's math learning, the quality of dyadic interaction can be suboptimal. It has been found that children developed greater math anxiety when highly math anxious parents were frequently involved in children's math homework (Maloney et al., 2015). Later research identified that when working with their children on math tasks, math anxious parents tended to display more parental control, negative affect, and less autonomy-supportive behaviors (DiStefano et al., 2020; Oh et al., 2022; Retanal et al., 2021), all of which have been found damaging to children's early math motivation and achievement.

In terms of perception of children's competence and beliefs about math value, however, parents may not spontaneously act in ways that fully reflect their beliefs. Prior longitudinal studies have revealed that parents' perception of their children's math competence and their own value beliefs had little to no effect on their modeling and encouragement behaviors (Simpkins et al., 2015a). There is also evidence that parents' perception of children's competence and value was unpredictive of their controlling, autonomy-supportive, and value-communication behaviors (Falanga et al., 2022; Gneiwosz & Noack, 2012a; Lazarides et al., 2017). Hyde and colleagues (2016) found that even when prompted to discuss the utility value of math and science with their children, more than half of the participating parents had less than two conversations of this type in the span of one academic year. At first glance, these findings seemed to suggest that parents' motivational beliefs are a poor indicator of what they do during parent-child math co-activity.

However, such speculation is insufficient to explain studies that did find significant associations between parent's beliefs and behaviors (e.g., Muenks et al., 2015; Silinskas et al., 2015; Zucker et al., 2021) To reconcile the discrepancy, one competing hypothesis is that parents do display behaviors consistent with their beliefs, but the salience of those behaviors depends on the informants. Indeed, a closer examination of literature showed that when parents reported on their own behaviors, their beliefs and behaviors are often related in expected directions (i.e., more adaptive beliefs predicted more supportive behaviors). Several studies have found that when parents believe that math ability is malleable, or that math ability can change over time (i.e., growth mindset), they tend to report themselves using more behaviors that support children's psychological need for autonomy and competence (Muenks et al., 2015; Sheffler & Cheung, 2022). On the other side, when parents endorsed more fixed beliefs about math ability, they always reported themselves engaging in more controlling forms of parenting (Li et al., 2023; Matthes & Stoeger, 2018). Similar findings have been replicated when children reported on their perception of parents' beliefs and behaviors. For example, one study found that children in middle school were more likely to report parental control if they perceived their parents to view failure as debilitating rather than a venue for further improvement (i.e., failure mindset, Chin et al., 2023). Two studies focusing on the transmission of academic value attested this pattern, indicating that when adolescents perceived parents to engage in more value-promoting behaviors, they tended to infer that their parents believed in the value in math learning, which in turn predicted children's own perceived value in math learning (Gneiwosz & Noack, 2012b; Lazarides et al., 2017). Taken together, these findings suggest that when reported by the same informant, the link between parents' beliefs and behaviors was more easily discernable.

The last possible explanation for the parents' beliefs-behaviors disconnection is whether the examined motivational belief is domain-focused (i.e., perception of value in mathematics or mindset beliefs about math abilities) or child-specific (i.e., perception of child's competence). Compared to value beliefs, competence related beliefs may be more transmissible, because information about children's competence, such as academic performance, is more visible to parents than information about math value. In situations like homework assistance, parents constantly receive information about how well children perform and can provide instant positive and negative feedback in response to children's success or failure. Successful communication of math values, on the other hand, requires parents to frequently elaborate on the practical application of math concepts (Hyde et al., 2016), which assumes that parents have the necessary expertise to carry out such behaviors. This would create barriers for parents with lower educational attainment to communicate value beliefs, even when they perceive math to be useful.

Supporting this speculation, prior studies have documented a SES disparity in parental practices around math, although no study has focused specifically on value communication or feedback. For example, parents' number talk, a practice found to facilitate children's understanding in cardinality (Gunderson & Levine, 2011), is positively associated with both educational attainment and income (Levine et al., 2010). Similarly, Vandermaas-Peeler et al. (2009) found that parents with higher income tended to initiate numeracy conversation more frequently during an informal math task. On a broader scale, parents from higher SES backgrounds are also more likely to create a home math environment conducive to children's early math development. Although early studies found no significant difference between low- and high- SES families in the frequency of home math activities (Tudge & Doucet, 2004; Saxe et al., 1987), one later study discovered that middle-class parents more frequently incorporated math into daily routines (i.e., cooking or grocery shopping) and more frequently engaged in informal math games in comparison to working-class parents (Deflorio & Beliakoff, 2015). This finding suggested that it is not so much the quantity of parental involvement as the *composition* of involvement that contributes to children's early math learning. For instance, discussing math as part of daily routine would enable parents to draw connection between math concept and daily life more naturally without sounding didactic or controlling. Likewise, not engaging in as many high-stake, formal math activities gives room for constructive parenting behaviors like autonomy-supportive behaviors and positive affect from parents (Eason & Ramini, 2020; Wu et al., 2022).

Together, although parents from lower and higher SES backgrounds may be equally actively involved in children's math learning, the constructiveness of parental involvement in children's math education can be limited by social, financial, and time resources that low SES families have access to. Because of such SES disparity, any investigation of parental practices that omits this structural barrier to constructive parenting would offer only a fragmented view into parents' academic socialization. One last note about SES is that it may be necessary to operationalize parents' educational attainment and household income as separate indicators of family SES, as each can impact parental practices through distinct mechanisms (Elliot & Bachman, 2018a). Parents' education can shape their math- and child- specific beliefs, which could in turn drive their behaviors during dyadic interaction on math activities. Household income, on the other hand, can either strengthen or constrain parents' financial ability to create home math environment optimal for children's early math development. For these reasons, the current study treats SES not as a unitary construct, but separate constructs comprised of parents' education and household income.

Person-Centered Approach to Studying Parenting Behaviors

Even though prior works have provided valuable information on ways parents contribute to children's math motivation and achievement through their instructional practices, very little research has taken an integrative view to investigate the co-occurrence of various forms of parenting behaviors in math learning involvement. This is understandable because empirical studies have relied on various theoretical frameworks, each of which offers its own explanation for the mechanisms of parents' socialization. In reality, however, parent-child interaction is a dynamic process that involves a rich repertoire of behaviors and utterances. As a result, studying parenting behaviors in isolation may end up providing an incomplete picture of what parents actually do when they are involved in children's math learning. On a conceptual level, it should also not be assumed that the use of unconstructive parenting behaviors is synonymous with the absence of constructive parenting behaviors (Barber et al., 2005). Supporting this view, Shi and Tan (2021) found that 20% of children in their sample reported high levels of both perceived parental autonomy-support and control when asked about behaviors they saw their parents engaging in regularly. In the same vein, Pomerantz and colleagues (2005) found through daily interview that mothers' positive and negative affect was orthogonal to each other in homework assistance contexts. Findings as such imply that it is very likely that parents would display constructive and unconstructive behavior equally frequently when multiple parenting behaviors are examined in tandem. This independent nature of parenting behaviors warrants an integration of multiple theories and a holistic depiction of parenting behaviors during dyadic math interactions, with the potential of allowing for a more accurate representation of parents' engagement in children's math learning.

Aligned with this goal, person-centered approach examines the heterogeneity across individuals in the sample based on a set of indicators (Lanza & Cooper, 2016). Applying this concept to the context of the current study, person-centered analysis can classify parents into subgroups (i.e., profiles) based on different combinations of parenting behaviors they exhibit during dyadic math interaction. The resulting profiles are mutually exclusive and assume homogeneity within each profile (Laursen & Hoff, 2006). Simply put, unlike the more traditional variable-centered approach that assumes the sample is drawn from a singular population, person-centered approach relaxes this assumption by considering the possibility that the sample represents multiple subpopulations that cannot be estimated by one single parameter (Meyer & Morin, 2016). Following the same rationale, person-centered approach makes it possible to compare the relative supportiveness of profiles of parenting behaviors between each other, instead of arbitrarily mapping individual parenting behaviors on a spectrum from constructive to unconstructive. Additionally, person-centered analysis allows for the direct inclusion of predictors (i.e., covariates) in the model. This would enable researchers to examine whether parents' behavioral profiles are dependent on any psychological or contextual factors discussed above. Finally, compared to conducting logistical regression based on the resulting profiles/classes, including covariates directly in person-centered analysis has been shown to reduce bias when estimating the relation between covariates and latent profiles/classes (Lubke & Muthen, 2007).

Despite the potential person-centered approach holds for studying parental practices in children's math learning, to the author's knowledge, only one study has attempted to categorize parenting based on different combinations of math related parental practices. In the study, McGregor and colleagues (2024) classified parents into three profiles based on the frequency of different types of math talk (i.e., questions, statements, confirmation, and others) parents used during an informal math task. Cluster analysis classified 76 parents into three groups based on their math talk styles: Parents who prioritized statements and questions over confirmations (i.e., math discusser), parents who prioritized questions over statements and confirmations (i.e., math elicitors), and parents who prioritized statements over questions and confirmations (i.e., math commentators). This line of work is promising in presenting a more realistic view of patterns in parenting behaviors when they work on math tasks with their children, but more work is needed to understand patterns in parenting behaviors that are *motivationally* influential, as well as the psychological and contextual predecessors that lead up to parents' behavioral patterns. The current study aims to fulfill this goal.

Present Study

To reiterate, the present study sought to answer four related questions about parenting behaviors in the context of parent-child math co-activity. First, through latent profile analysis, I aimed to discover combinations of different forms of parenting behaviors (i.e., feedback, autonomy-support, control, value communication, and affect) that had been found to be relevant to children's motivation and achievement in math. Second, I aimed to connect parents' beliefs about math (i.e., mindset beliefs, utility value, and math anxiety) and their children (i.e., perceived competence) to the resulting profiles to pinpoint the psychological predecessors to patterns in parenting behaviors. Third, I aimed to explore the contextual barriers to constructive parenting by including parents' educational attainment and household income as covariates in the latent profile model. Lastly, I aimed to examine the predictive power of parents' behavioral patterns on children's math performance on a post-activity assessment, controlling for children's prior math knowledge and family SES as indicated by parents' education and household income.

Given that little to no research has examined parental behavioral profiles in the context of dyadic math interactions, my hypotheses to these research questions were exploratory. Considering previous variable-centered research that has identified a negative correlation between parents' constructive and unconstructive behaviors (e.g., Wang et al., 2023; Wu et al., 2022), I speculated that there would be one profile characterized by high frequency of constructive behaviors and low frequency of unconstructive behaviors, and another profile characterized by high frequency of unconstructive behaviors accompanied by low frequency of constructive behaviors. In addition, taking into account prior works that demonstrated the independence of parents' constructive and unconstructive behaviors from each other (e.g., Moroni et al., 2015; Pomerantz et al., 2005), I hypothesized that there would be a third profile in which parents displayed similar levels of constructive and unconstructive behaviors. In terms of psychological predecessors to parents' behavioral profiles, I speculated there would be a generally positive association between parents' adaptive beliefs (i.e., stronger beliefs in math value, perception of child's competence, mindset, and less math anxiety) and the most motivationally supportive behavioral profile (as indicated by higher frequency in constructive behaviors and lower frequency in unconstructive behaviors), a pattern that has been replicated in some variable-centered studies (e.g., Matthes & Stoeger, 2018; Sheffler & Cheung, 2022). However, it would also be possible that I would not find such association because of two main reasons. First, as discussed in prior sections, the link between parents' beliefs and behaviors has not been consistently established (e.g., Falanga et al., 2022; Gneiwosz & Noack, 2012b; Lazarides et al., 2017). Some beliefs seem to be more transferable than others in the form of corresponding behaviors. From a person-centered perspective, this inconsistency would make it more challenging to connect a specific parents' belief to a profile that consists of parenting behaviors that may or may not have shared variance with that specific belief. Second, unlike most prior works on similar topics that relied on self-report, the present study adopted an observational approach to operationalize parenting behaviors. This difference in measurement may yield findings underexplored in the existing literature, as parenting behaviors observed by researchers and those reported by parents themselves are only modestly related to each other (Oh et al., 2022).

For the association between family SES and parents' behavioral profiles, I hypothesized that parents with higher educational attainment would be more likely to be classified into the profile in which constructive behaviors are more prevalent, since parental education seems to be directly linked to parental practices (Elliot & Bachman, 2018b; Manrique Millones et al., 2014; Shi & Tan, 2020). On the other hand, because household income is more likely to determine the general quality of early math learning environment (i.e., provision of learning tools), rather than specific practices parents carry out (Elliot & Bachmann, 2018a), I did not have a directional hypothesis about the association between household income and parents' behavioral profiles.

For the last research question regarding the predictive power of behavioral profiles on children's performance on the post-activity assessment, I predicted that children's math learning outcome would differ as a function of the supportiveness of behavioral profile in which their parents would be classified into. I hypothesized that, after controlling for prior math knowledge, children whose parents classified into the most motivationally supportive behavioral profile would score the highest on the test, whereas children whose parents classified into the least supportive profile would score the lowest.

CHAPTER 3

METHOD

Participants

This study took place as part of a broader project that examined the longitudinal association between parents' math-specific growth mindset and their parental practices (see Oh et al., 2022 and MacDonald et al., 2024). Recruited at events at elementary schools (i.e., parent teacher conferences, open houses, family nights) in the Midwestern region of the United States, participants were 361 parents and their children (fathers = 66, mothers = 295; boys = 178, girls = 183; 2nd graders = 190, 3rd graders = 171). Among the participating parents, 69.8% identified as White; 15.2% identified as African American; 6.9% identified as Asian or Pacific Islander, 4.4% identified as Latino/Hispanic; and 3.6% identified as other ethnicities or multiracial. The sample represented a wide range of educational attainment, with 32.7% of the parents holding a bachelor's degree or equivalent; 38.5% of the parents holding an advanced degree (i.e., M.A, M.S, PhD, MD); 27.7% of the parents having below a college-level education, and 1.1% of parents not reporting on their level of education. The median range of annual households' income for participating families was between $80,000 and $99,999 as of spring 2018.

Procedures

Upon arrival at the laboratory, parents and children were led to separate rooms. Children were asked to complete a standardized achievement test on general math knowledge (Woodcock et al., 2007) and a self-developed, pre-activity test on their knowledge in probability. Meanwhile, parents completed a set of questionnaires that measured their child- and math-specific motivational beliefs. After completing the survey, parents were instructed to teach a probability concept to their children in the subsequent activity. To ensure parents' comprehension of the concept and procedures of the activities, we asked them to raise any clarification questions before they returned to the child's room. Once the parents joined their children, the activity was timed for 15 minutes and was video recorded.

During the activity, parents and children started with a game named Roll and Tally, which is designed to help children understand a basic probability concept. Specifically, the dyads started by rolling two dice and summing up the total. With each roll, they needed to add a tally mark to the sheet to indicate the number they rolled. Theoretically, as the number of rolls accumulated, they would start to notice that the probability of rolling each number falls on a normal distribution. For example, numbers that can be rolled from more possible combinations (i.e., six, seven, and eight) would be more likely to appear than numbers that can be rolled from fewer combinations (i.e., two or twelve). It is to their discretion to decide the number of rolls before transitioning to the next game. Parents were also given the latitude to explain the observed pattern however they wanted to facilitate children's understanding of probability.

After Roll and Tally, the dyads transitioned to the next game named Clear the Board, in which they were instructed to place fifteen cubes on a board marked by 11 numbers ranging from 2 through 12. Again, they dyads were allowed to place as many cubes on each number as they wanted. After the parents and children placed all fifteen cubes on the board, they would roll the dice and take a cube off from the board whenever they rolled a number which they placed a cube on. The goal is to clear the board in the fewest attempts of rolls. The dyads would continue the activity until the experimenter came in after fifteen minutes, or until they cleared the board. Parents were then ushered out of the observation room while children were asked to complete a post-activity test on their understanding of probability, one that was identical to what children took before the activity. At the end of the visit, the dyads were debriefed.

Measures

All measures were assessed on a 1-10 scale ranging from *strongly disagree* to *strongly agree,* where a higher score indicates stronger belief, unless otherwise noted (Table 1). All items were adapted from their original measures to assess the domain of mathematics.

Parents' Growth mindset. Measure of parents' growth mindset in math was adapted from Dweck's (1999) measure of growth mindset about intelligence in general. Items from this scale are designed to assess parents' beliefs about the malleability of math ability. A sample item reads, "people's math ability is something about them that can't be changed very much." Four out of the six items from the scale were worded in the opposite direction and therefore were reverse coded. Reliability for this measure was high ($\alpha = .87$).

Parents' Failure mindset. Parents' failure mindset was measured by an instrument adapted from Haimovitz & Dweck's (2016) measure of beliefs about failure in general. Adjacent to the growth mindset instrument, items from this scale assess the extent to which parents view failure in math as enhancing or debilitating. A sample item reads, "Experiencing failure in math can lead to learning and growth when it comes to math." Three out of the six items from the scale were worded in the opposite direction and therefore were reverse coded. Reliability for this measure was high ($\alpha = .86$).

Parents' Math anxiety. To measure parents' math anxiety, I adapted the abbreviated version of the Mathematics Anxiety Rating Scale developed by Alexandra and Martray (1989). This scale includes 16 items, each focusing on parents' perceived anxiety associated with performing a specific math task. A sample item from this scale reads, "opening a math book and seeing a page full of problems would make me feel anxious." Reliability for this measure was excellent (α = .96).

Parents' Value Beliefs. To measure parents' perception of math value, I adapted a 6-items scale from Harackiewicz et al. (2012). This instrument is designed to assess parents' beliefs about the importance and usefulness of developing math skills in school. A sample item from this scale reads, "math is one of the most valuable skills sets children develop in school." Reliability for this measure was high (α = .82).

Parents' Perception of Child's Competence. Parents' perception of children's math competence was measured by a 4-items scale adapted from Frome & Eccles (1998). Items from this scale ask parents to evaluate their children's math competence in comparison to both the children themselves and to others on a scale of 1 to 10, where a higher value indicates greater competence. A sample item from this scale reads, "if you were to rank all of the children in your child's class from the worst to the best in math, where would you put your child?" Reliability for this measure was excellent (α = .91).

Child math knowledge. Children's math knowledge was assessed with the Applied Problems subtest of the Woodcock–Johnson III Tests of Achievement (Woodcock et al., 2001). This test assesses children's skills in math fluency, calculations, and quantitative reasoning, and generates scores based on Rasch model. Due to its strong reliability and construct validity (Khoo et al., 2006), this test has been widely applied in psychological and educational research.

Pre- and post-activity knowledge assessment. I assessed children's understanding of the probability concept with six multiple-choice questions, four of which were near-transfer questions, and two of which were far-transfer questions. The near-transfer questions directly assessed children's understanding of the probability concept they learned from the activities, whereas the far-transfer questions assessed how well children could apply the learned probability concept to a different problem-solving situation. An example of the near-transfer question reads "when you roll two dice and add them together, what do you think is least likely for them to add up to?". An example of the far-transfer question reads "I have a special coin. One side has a 1 and the other side has a 2. Now I am going to flip two of my special coins. What is most likely to happen when I add the numbers together?"

Family SES Variables. Two indicators of family SES were assessed. First, parents reported their annual household income on a 1 to 10 scale divided by intervals of 20,000 dollars (i.e., 1 = $0 to $19,999; 10 = $180,000 or above). Second, parents reported their highest level of education received on a 1 to 3 scale, where 1 = high school or below, 2 = bachelor's degree or equivalent, and 3 = advanced degree (e.g., M.A., Ph.D., M.D.)

Coding of Parenting Behaviors

Videotapes of the parent-child interaction during the 15-minute activity were coded by teams of two undergraduate research assistants in 30-seconds intervals with eight coding categories: positive feedback, negative feedback, autonomy-support, control, utility value communication, intrinsic value communication, positive affect, and negative affect. These coding categories were designed with multiple prominent theoretical perspectives in mind to capture parents' behaviors that are most likely to occur during parents' involvement in math learning, and that are most likely to influence children's math motivation and performance based on previous literature. Specifically, coding categories of positive and negative feedback were developed based on prior works drawn from the social cognitive theory that have identified the motivational benefits of parents' praise over criticism. The categories of autonomy-support, control, positive affect, and negative affect were developed based on the self-determination theory and relevant research, which have shown that children's academic adjustment tend to suffer as a result of parental control and negative affect (Grolnick & Pomerantz, 2009; 2022). Lastly, coding categories of utility value and intrinsic value communication were derived from the situated expectancy value theory and related studies, which emphasized the role of value perception in shaping academic motivation (Eccles & Wigfield, 2020; Harackiewicz et al., 2012). I chose not to include the attainment value and cost dimensions in the coding scheme, since children are not able to differentiate these dimensions from other value beliefs until much later in life (Wigfield & Eccles, 2002).

For six of the motivationally relevant parenting behaviors (i.e., positive feedback, negative feedback, autonomy-support, control, utility value communication, and intrinsic value communication), research assistants were trained to indicate whether any of the behavioral categories was present in each segment. For affect codes, research assistants were trained to indicate the duration and intensity of parents' emotional expression on a 5-point ordinal scale. Given that positive and negative affect are distinct experiences and are distinguishable during parent-child interactions (Kenny-Benson & Pomerantz, 2005), they were coded separately. To account for chance agreement, interrater agreement for binary codes was calculated using Cohen's kappa (κ); interrater agreement for ordinal codes was calculated using gamma (ϒ). According to guidelines proposed by Landi and Koch (1977), kappa or gamma values in the range of .61 to .80 would suggest substantial agreement, and values above .81 would suggest nearly perfect agreement. Disagreements were resolved either through discussion within the coding teams, or by the sole author of this paper.

Positive and Negative Feedback. For each segment, coders indicated whether the parent gave positive or negative feedback to the child in response to the child's progress on the task, where 1 = *present* and 0 = not *present*. Positive feedback was signaled by the parents' positive evaluation of child’s performance or behavior (e.g., “Good job!” or “That is correct!”), whereas negative feedback was indicated by parents’ negative evaluation of the child’s performance (e.g., “No.” or “We didn’t predict well”) or behavior (e.g., “Stop touching it.”). Neutral feedback such as “keep going” or “okay” was not coded as either type. Interrater agreement was substantial for both positive feedback (k = .78) and negative feedback (k = .76).

Autonomy-Support & Control. For a behavior or a verbal cue to be coded as autonomy-support, parents needed to support child’s sense of agency by explicitly letting the child lead the game or make independent decisions (e.g. “Do you want to tally, or do you want to roll?”, or “Where do you want to place the cubes?”). In contrast, controlling behaviors were coded when parents undermined the child’s sense of agency by giving direct commands (e.g. “Put a cube on 7.”) or interrupting the child’s behaviors (e.g., grabbing the dice from the child without asking). These behavioral categories were coded on a binary scale, where 1 = *present* and 0 = not *present*. Interrater agreement was substantial for both categories (ks = .80 and .75).

Utility and Intrinsic Value Communication. Parents’ communication of utility value was coded when parents connected the ongoing task to a real-world application (e.g., “Probability can help predict the chance of rain.”). Similarly, communication of intrinsic value was coded whenever parents expressed their enjoyment of or interest in the task (e.g., “It’s gonna be fun!” or “This is interesting.”). These behavioral categories were also coded on a binary scale, where 1 = *present* and 0 = not *present*. Interrater agreement was substantial for both categories (ks = .74 and .75).

Positive and Negative Affect. Parents’ positive and negative affect during the activity were coded on a 5-point scale, where 1 = *none* and 5 = *very much*. Positive affect was operationalized as parents’ display of warmth or approval, which includes smiling, laughing, or cheerful talking. Negative affect was operationalized as parents’ display of annoyance or frustration, such as frowning or yelling at children. Interrater agreement for these categories was almost perfect (ϒs = .89 and .90).

Analytical Strategy

All analyses were conducted in SPSS version 26 or Mplus version 8. As preliminary steps, I conducted descriptive and correlational analyses to examine the basic properties of variables of interest. To ensure the distinctiveness among measures of parents' motivational beliefs, I conducted confirmatory factor analyses for parents' mindset, math anxiety, math value, perception of child's competence beliefs. To answer my first research question, which concerned prevalent patterns of parenting behaviors during dyadic math interaction, I carried out a series of latent profile analyses with observed parenting behaviors as input variables. I evaluated fit for models ranging from 2 to 5 profiles using multiple fit indices including Bayesian Information Criterion (BIC), sample-size-adjusted BIC (aBIC), Akaike information criterion (AIC), and Lo-Mendell-Rubin adjusted likelihood ratio test (LMRT). Generally, lower values of BIC, aBIC, and AIC would indicate better model fit (Celeux & Soromenho, 1996), but values of aBIC will be given greater consideration due to their strong reliability. For LMRT, a significant result would indicate that the more saturated model has a better fit than the more parsimonious model that contains one less latent profile (Nylund, Asparouhov, & Muthen, 2007). In addition to the relative fit indices, I took entropy value into account when determining the final solution. Although not considered a fit index, entropy value indicates the accuracy of profile classification, as well as the distinctiveness between resulting profiles. Models that have an entropy value greater than .70 were considered favorably (Reinecke, 2006). Aside from statistical reasons, I gave conceptual considerations in the model selection process. Specifically, models whose profiles have less than 5% of sample may not be representative of the population, and therefore would be excluded. The goal for the final model is to sufficiently explain variability in parenting behaviors in the sample without getting overly complicated.

To address the second and third research questions, which was related to the psychological and contextual predecessors of profiles of parenting behaviors, I added parents' motivational beliefs, parents' educational attainment, and household income as covariates to the model following the 3-step procedure in Mplus. Instead of treating profile membership as manifest variables, this procedure took into account the logit probability of profile classification when estimating the association between covariates and latent profiles, therefore reducing bias in estimation (Asparouhov & Muthen, 2014). Interpretation of coefficients from these analyses would be identical to that of a multinomial logistic regression analysis. To answer the fourth research question regarding the predictive power of parents' behavioral profiles on children's post-activity knowledge, I regressed children's performance on the post-activity assessment on parent's behavioral profile membership, controlling for children's prior general math knowledge, parents' education, and household income.

CHAPTER 4

RESULTS

Descriptive Statistics and Correlations

Descriptive and correlation information are reported in Table 1. In general, parents in the sample highly endorsed adaptive beliefs about math and their children (i.e., growth mindset, failure mindset, perceived math value, and perceived child math competence) (*M*s = 7.38 to 8.50 out of 10), and reported moderate levels of math anxiety (*M* = 3.64 out of 10). For observed parenting behaviors, parents used positive feedback, negative feedback, and control most frequently (*M*s = 33% to 37% out of all coding segments), followed by autonomy support (*M* = 18%). Communication of utility value and intrinsic value were rare, each appearing in only 2% of the total observed segments. On average, parents showed slightly higher levels of positive affect (*M* = 1.49 out of 5) than negative affect (*M* = 1.13 out of 5) during the math activity.

Consistent with previous studies (e.g., Gladstone et al., 2018; Haimovitz & Dweck, 2016; Simunovic et al., 2018), parents' adaptive motivational beliefs were all positively correlated with one another (rs = .11 to .40, $p < .029$), and negatively correlated with their math anxiety (rs = -.12 to -.22, $p < .024$). A similar pattern applied to observed parenting behaviors, but to a lesser extent. All forms of constructive parenting behaviors were positively correlated with each other (r = .12 to .41, $p < .024$), so were all forms of unconstructive parenting behaviors (rs = .46 to .52, p < .001).

In terms of the interrelation among constructive and unconstructive parenting behaviors, autonomy-support was negatively correlated with all forms of unconstructive parenting behaviors (rs = -.11 to -.20, $p < .034$). Positive feedback was also negatively correlated with all forms of unconstructive parenting behaviors (rs = -.10 to -.24, $p < .048$), with the only exception being that the correlation with negative feedback was non-significant ($r = .03$, $p = .526$). Communication of intrinsic value was not related to any of the unconstructive parenting behaviors, whereas communication of utility value was negatively related to negative feedback ($r = -.11$, $p = .034$). For parents' affectivity during the dyadic interaction, positive affect was positively correlated with all forms of constructive parenting behavior (rs = .21 to .41, $p < .01$) but not unconstructive behaviors. Negative affect was positively correlated with all forms of unconstructive parenting behaviors (rs = .46 to .52, $p < .01$), and negatively correlated with all forms of constructive parenting behaviors (rs = -.11 to - .24, $p < .03$). Notably, however, there was no correlation between parents' positive and negative affect.

There were also several correlations found between parents' beliefs and their behaviors. First, parents' failure mindset was positively correlated with their frequency in utility value statement ($r = .12$, $p = .021$) and negatively correlated with their controlling behaviors ($r = -.15$, $p = .004$). Second, parents' perception of child's competence was negatively correlated with their controlling behaviors ($r = -.24$, $p < .001$). Lastly, parents' math anxiety was negatively correlated with their autonomy-supportive behaviors ($r = -.14$, $p = .009$).

In relation to children's math knowledge and performance, parents' growth mindset and failure mindset were positively correlated with children's general math knowledge (rs = .12 to .20, $p < .022$), whereas parents' math anxiety showed a negative correlation ($r = -.21$, $p < .001$). Parents' perception of child's competence was positively correlated with both children's general math knowledge ($r = .54$, $p < .001$) and their performance on the post-activity assessment ($r = .12$, $p = .020$). Surprisingly, parents' perceived math value was *negatively* correlated with children's post-activity performance ($r = -.18$, $p < .001$). All forms of unconstructive parenting behaviors were negatively correlated with children's general math knowledge (*rs* = -.18 to -.32, $p < .001$), yet only parental control was correlated with children's performance on the post-activity assessment ($r = -.15$, $p = .004$) On the other hand, among all forms of constructive parenting behaviors, only parents' autonomy-support was related to children's general math knowledge ($r = .17$, $p = .002$), and none were related to children's post-activity learning outcome.

In terms of family SES variables, parental education was more closely related to observed parenting behaviors than household income. Specifically, higher level of parental education was positively correlated with all forms of constructive behaviors (*r*s = .13 to .24, $p < .014$), and negatively correlated with all forms of unconstructive behaviors (*r*s = -.16 to -.27, $p < .003$). Household income was positively correlated with parents' use of positive feedback ($r = .12$, $p = .024$) and intrinsic value communication ($r = .16$, $p = .004$), and negatively correlated with negative feedback ($r = -.16$, $p = .003$), parental control ($r = -.29$, $p < .001$), and negative affect ($r = -.15$, $p = .006$). In relation to parents' beliefs, both parental education and household income were positively correlated with parents' perception of child's competence in math (*r*s = .25 and .16 respectively, p < .003), and negatively correlated with math anxiety (*r*s = -.19 and -.17 respectively, $p < .002$). Household income was also positively correlated with failure mindset ($r = .15$, $p = .005$). Finally, both parental education and household income was positively related to children's general math knowledge (*r*s = .39 and .34 respectively, $p < .001$), but not their performance on the post-activity assessment.

Confirmatory Factor Analysis

I conducted confirmatory factor analysis to test whether items of each parental belief loaded onto their intended factors. I considered several fit indices to evaluate model fit including Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Cutoff values for CFI and TLI (> 0.90 adequate fit; > 0.95 good fit), RMSEA (< 0.08 adequate fit; < 0.06 good fit), and SRMR (< 0.10 adequate fit; < 0.08 good fit) as described in Cordon and Finney (2008) were used to indicate model fit. I also requested modification indices from Mplus to examine potential improvement for model fit. Essentially, the values of a modification index would correspond to a decrease in chi-square of equal value, resulting in a model that fits better to the data.

With all items from the original measures of parents' beliefs included, the initial five-factor model showed poor fit to the data (TLI = .759; CFI = .775; RMSEA = .100; SRMR = .074) (Table 2). This suggested that items from measures of parental beliefs may have loaded weakly onto their respective factors, or cross-loaded onto factors that represent a different type of parental belief. An examination of factor loadings and modification indices revealed that four items from the math anxiety scale showed weak loadings onto the factor that represented math anxiety. In addition, eight out of the ten largest modification indices involved items of math anxiety that could not be explained by a common factor (Table 3). These findings implied that the inadequate fit for the five-factor model may be largely driven by an unstable structure *within* the math anxiety scale, rather than cross-loadings *between* different scales of parental beliefs. Indeed, a test of one-factor model using only items from the math anxiety scale yielded poor model fit (TLI = .681; CFI = .723; RMSEA = .212; SRMR = .108), supporting that several items of math anxiety did not factor well onto the same latent construct as the rest of the items from the math anxiety scale. Therefore, I excluded all items from the math anxiety scale from subsequent factor models, and 2) included only items that loaded strongly (>.60) onto math anxiety when using the construct in subsequent modeling of latent variables.

Model fit of the 4-factor model improved from the initial 5-factor model but was still inadequate (TLI = .869; CFI = .885; RMSEA = .082; SRMR = .070). To identify source of misfit, I found that one item from the growth mindset scale cross-loaded onto two other factors that represented failure mindset and perceived math value beliefs respectively. The item was therefore removed from the final model estimation. The final four-factor model (Table 4) achieved adequate fit to the data (TLI = .900; CFI = .913; RMSEA = .072; SRMR = .066), indicating that measures of parents' growth mindset, failure mindset, perceived math value, and perception of child's competence are empirically distinct from each other for the overall sample.

Measurement Invariance

Guided by recommendations proposed by Maassen and colleagues (2023) on improving measurement practice, I conducted invariance testing to ensure discriminant validity among measures of beliefs across parents with varying levels of educational attainment due to its centrality to my research questions regarding SES. Although the present study did not involve comparing differences in parental beliefs at mean levels, testing for measurement invariance in variables of interest provides transparency in measurement practice that contributes to the overarching goal of reproducibility in psychological research (Flake & Fried, 2020; Wilkinson et al., 2016). I followed a stepwise procedure to test for invariance in parental beliefs across three levels of parental educational attainment. Achieving invariance at each step would allow for more conclusive claims to be drawn about the empirical distinction between measures of different parental beliefs. As the first step, configural invariance testing evaluated whether the overall factor structure was identical between parents with different levels of educational attainment. If configural invariance was met, metric invariance testing would evaluate whether factor loadings were identical between parents with different levels of educational attainment. If metric invariance was met, scalar invariance testing would evaluate whether the intercepts were identical between parents with different levels of educational attainment.

Results showed that the four-factor model including items from measures of parents' growth mindset, failure mindset, perceived math value, and perception of child's competence failed to achieve configural invariance (CFI = .864, TLI = .845, RMSEA = .095, SRMR = .110). This means that the underlying factor structure for these measures differed based on parental educational attainment. Since configural invariance is a prerequisite for metric and scalar invariance, I did not precede with further steps in invariance testing. Looking into factor loadings for each level of parent's education and modification indices, I did not find evidence for cross-loadings between different measures at any level of parents' education. Rather, misfit in the model was mostly caused by different strength in loadings across levels of parents' education. For example, one item respectively from the growth mindset and failure mindset and two items from the math value scale loaded weakly (loadings < .37) onto their intended factors among parents who had not received college education, but loaded more strongly among parents who had received college education or advanced degrees (loadings > .49).

When it came to re-specifying a non-invariant model, I took a number of statistical and practical concerns into account. First, there are unfortunately no guidelines for cutoff values when determining whether or to what extent a non-invariant model is practically meaningful (Maassen et al., 2023). Although some techniques have been employed to detect the magnitude of invariance in relation to expected effect size in experimental design (Nye et al., 2018), such techniques may not be applicable to non-comparative research scenarios. Additionally, re-specifying items from established measures by allowing them to load onto factors in an exploratory fashion runs the risk of losing the original meaning of the constructs. This in turn may contradict, rather than contribute to, the very goal of conducting invariance testing in the first place by making it more difficult to compare findings across studies that use the same measures. Moreover, as alluded to earlier, it is especially important to achieve measurement invariance when the goal of the research is to compare mean-level difference in outcome variables at varying levels of the predictor (e.g., time points, experimental conditions, grade levels), because in comparative studies, researchers need to ensure that a change in the outcome variable is a result of variation in the predictor variable, rather than a shift in factor structure of the outcome variable itself. The goal of the present study, however, was not to test difference in parental beliefs at different levels of educational attainment, but to examine how parental beliefs and parents' educational attainment can each uniquely predict parenting behaviors. For these reasons, all items included in the four-factor model were retained for subsequent analyses.

Selection of Latent Profile Models

To understand parents' behavioral profiles, I estimated four latent profile models consisting of two to five profiles. As mentioned earlier, I referred to several indices to evaluate fit between non-nested models, including AIC, BIC, aBIC, LMRT, and entropy. I also considered the representativeness of each profile to the sample, as well as the practical interpretability when selecting the most fitting model. Table 5 reported model fit information for each latent profile model. Compared to the more parsimonious, two-profile model, the three-profile solution had lower values of AIC, BIC, and aBIC, indicating a better fit to the data. Results from LMRT also supported that the more saturated model significantly improved from the more parsimonious model in fit. On the other hand, even though both the four- and five-profile models had lower values of AIC, BIC, and aBIC, LMRT suggested that neither model fit the data significantly better than did the more parsimonious three-profile model. Additionally, both the four- and five-profile models contained one or more profiles represented by less than five percent of the sample. The minuscule proportion of the sample categorized into these profiles suggested that these profiles might have come as a product of the eccentricity of the sample, rather than represented patterns in parenting behaviors on a broader scale.

From an interpretability perspective, the one additional profile from the four-profile model captured seven (2% of the sample) extreme cases of an existing profile that reflected an adaptive pattern of behaviors from the three-profile model, rather than provided novel information above and beyond what the more parsimonious model has already shown. Specifically, the seven parents categorized into the fourth profile praised their children slightly more frequently and expressed their enjoyment in the activity (i.e., intrinsic value communication) more often, but used other forms of parenting behaviors in almost identical frequency as parents in the third, generally adaptive profile. Moreover, the differences in profile characteristics between the two other profiles from the four-profile model was less distinctive than their differences in the three-profile model. This lack of clear distinction between profiles can create difficulty in both interpreting profiles and drawing conclusions about the interrelation among parenting behaviors, parental beliefs, and children's math learning outcomes.

Similar to the four-profile model, the five-profile model provided an even finer distinction within the same adaptive behavioral profile. Specifically, in addition to the four existing profiles, the fifth profile characterized eight parents (2.2% of the sample) who engaged in parental control slightly more frequently and communicated intrinsic value in math learning slightly less frequently than those who were categorized into the adaptive behavioral profile. Taken together, I determined the three-profile model to be the best-fitting solution after considering multiple model fit indices, size of each resulting profile, the interpretability of profile models, and the implications for subsequent analyses.

Characteristics of the Final Latent Profile Model

Figures 2 and 3 display characteristics of observed parenting behaviors and affect in raw frequency from the selected 3-profile model. Figure 4 displays characteristics of parents' behavioral profiles in standardized frequency. When naming profiles, I considered both the raw frequency of parenting behaviors and the mean-level difference in frequency of parenting behaviors between one profile and another. The first behavioral profile (n = 271, 75.49% of the sample) was characterized by moderate frequency in positive feedback, negative feedback, autonomy-support, parental control, along with slightly elevated positive emotions. Parents from this profile very rarely communicated the utility or intrinsic value of math learning to their children. When compared to the other two profiles, the frequency of almost all observed parenting behaviors in this profile ranked second among the three identified profiles. I therefore labeled the first profile *moderately-motivating parents* to reflect both the moderate raw and relative frequency of observed parenting behaviors from this profile.

The second behavioral profile (n = 33, 9.19% of the sample) was characterized by the highest frequency in the communication of utility and intrinsic value during the math activity. Relative to parents categorized into the other two profiles, parents from this profile on average commented on the personal relevance of math (i.e., utility value) twice as much, and expressed interests in math (i.e., intrinsic value) ten times as much. In addition, parents from the second profile praised their children more frequently than parents from the other two profiles, using positive feedback in almost half of the total observational segments. The frequent use of value-promoting statements and positive feedback also concurred with the highest level of positive affect expressed by parents categorized into the second profile. I therefore labeled the second profile *value-promoting parents* to reflect the most distinguishing feature in this pattern of parenting behaviors.

The third behavioral profile (*n* = 55, 15.32% of the sample) was characterized by the highest frequency in negative feedback and parental control, with each appearing in approximately half of the total observational segments. In the same vein, parents from this profile showed the strongest level of negative affect. Compared to value-promoting parents and moderately-motivating parents, parents categorized into the third profile also used positive feedback and autonomy-support least frequently. I labeled the third profile *negative/controlling parents* to reflect this combination of frequent use of unconstructive behaviors and rarer use of constructive behaviors.

Overall, results from LPA indicated that only a small proportion of parents spontaneously communicated math value to their children during the math activity. In contrast, parental feedback and control were relatively common across all behavioral profiles. Autonomy-support was also present in all profiles but was less frequently used than parental feedback and control. Most parents were positively affective during the math activity, except for parents categorized into the negative/controlling profile, who expressed similar levels of positive and negative affect.

Differences in SES between Behavioral Profile Memberships

To test whether parents' behavioral profile membership differed based on family SES, I used the R3STEP function in Mplus to include parental education and household income as separate covariates in the latent profile model. Pairwise comparison showed that parental education predicted profile membership such that parents with higher levels of education were more likely to be categorized as value-promoting (*B* = 1.07, *p* = .004) and moderately motivating (*B* = 0.62, *p* = .007) than negative/controlling. However, there was no difference in parental education between value-promoting parents and moderately motivating parents (*B* = 0.46, *p* = .166). Household income was not predictive of behavioral profile membership (*B* = -0.17 to 0.11, *p* = .180 - .506). Because of the significant association between parental education and behavioral profiles, I controlled for parental education in all subsequent analyses where behavioral profile membership was included in the model.

Differences in Parental Beliefs between Behavioral Profile Memberships

Next, I examined the association between parents' motivational beliefs and their behavioral profile membership. Due to their clear empirical distinction, parents' growth mindset, failure mindset, perceived math value, and perception of child's competence were entered into a single block as covariates in the latent profile model along with parental education. Math anxiety, because of its misfit with measures of other types of parental beliefs, was entered into a separate model to predict parents' behavioral profiles. Results (Table 7) indicated that parents' growth mindset significantly predicted behavioral profiles: Parents who reported more growth mindset were more likely to be categorized as *negative/controlling* than moderately motivating (*B* = -0.34, *p* = .036). There was no difference in growth mindset between negative/controlling parents and value-promoting parents (*B* = -0.01, *p* = .963), nor between moderately motivating and value-promoting parents (*B* = 0.35, *p* = .211). Parents' failure mindset, perceived math value, perception of child's competence, and math anxiety were all found to be unpredictive of parents' behavioral profile membership (*B* = 0.004 to .13, *p* = .234 - .979).

The Association between Parents' Behavioral Profiles and Children's Math Performance

Since the pre- and post-activity assessment (Table 6) was not designed to capture an overarching latent construct of children's knowledge in probability, but a test of how well children could apply the knowledge in different problem-solving scenarios (i.e., formative scale, Meuleman et al., 2023), each of six questions from the assessment was scored as binary outcome based on whether children responded with the correct answer. As an initial step of testing how children's math performance differed based on parents' behavioral profile, I conducted repeated measures ANOVA to identify questions that children improved on in the post-activity assessment from the baseline measure. Results indicated that children improved on one of the near-transfer questions ("When you roll two dice and add them together, what do you think is most likely for them to add up to?") ($F(1) = 39.41$, $p < .001$) and one of the far-transfer questions ("I have a special coin. One side has a 1 and the other side has a 2. Now I am going to flip two of my special coins. What is most likely to happen when I add the numbers together?") ($F(1) = 4.81$, $p = .029$) significantly better in the post-activity assessment compared to baseline. These two items were therefore included in the predictive models testing the association between parents' behavioral profile membership and children's math performance.

To test the association between parents' behavioral profile and children's accuracy on the two retained items in the post-activity knowledge assessment, I conducted binary logistic regression (Tables 8 & 9). I first used value-promoting profile as the reference group and regressed the accuracy of children's response on parents' behavioral profile membership while controlling for children's prior math knowledge and parental education. Pairwise comparison showed that children were more likely to answer the near-transfer item correctly if their parents belonged in value-promoting profile, this relation became non-significant for both the near- (B = -0.12 to -0.41, p = .412 - .751) and far-transfer (B = -0.49 to -0.75, p = .148 - .211) items once children's prior math knowledge and parental education were entered into the model. I then used negative/controlling profile as the reference group to perform the same analysis. Again, no difference was found in children's accuracy on neither the near- nor the far-transfer item between the negative/controlling and moderately-motivating profile (*B* = 0.26 to 0.28, *p* = .424 - .502).

CHAPTER 5

DISCUSSION

Given the critical role of parental involvement in children's math adjustment, prior research has identified a number of behaviors parents may engage in during dyadic interactions that can be either conducive or detrimental to children's math motivation and achievement. However, very rarely has prior research examined multiple forms of parenting behaviors as patterns, although parenting behaviors may not always appear in isolation during dyadic math interaction. Using an analytical approach that categorizes parents based on *patterns* in their behaviors, the present study extended the existing literature by offering a more realistic depiction of the how frequently parents use each form of parenting behavior relative to another when engaging in math activities with their children.

What Patterns of Behaviors Did Parents Engage in During Dyadic Math Interaction?

Central to my research question in regard to common patterns in parenting behaviors (i.e., profiles), I found three profiles characterized by different combinations of parents' positive feedback, negative feedback, autonomy-support, parental control, utility value communication, intrinsic value communication, positive affect, and negative affect. During the math activity in which parenting behaviors were observed and coded, over 75% of parents in the sample displayed a moderately constructive pattern of behaviors. Parents from this profile typically displayed all forms of parenting behaviors in moderate frequency, each appearing in 20% to 30% out of total observational segments. This finding suggested that the majority of participating parents were neither overly critical of their children, nor were they especially encouraging. The extremely low frequency in utility and intrinsic value communication also suggested that most parents were not naturally inclined to talk to their children about ways in which math can be enjoyable or applicable to real world problems.

Another 9.19% of parents were categorized into what would be considered the most adaptive behavioral pattern, characterized by moderate to high frequency in positive feedback (49%) and autonomy-support (22%), coupled with similar levels in negative feedback and parental control as parents from the moderately-motivating profile (around 30%). This pattern suggested that compared to parents in the moderately-motivating and negative/controlling profiles, parents in the value-promoting profile were more disposed to affirm their children's behaviors, provide encouragement, or allow their children to be in charge of the flow of the activity. It is notable, however, that even parents from what would theoretically be considered the most adaptive profile engaged in some level of negative feedback and parental control. This finding implies that parents who frequently use constructive behaviors may also engage in corrective behaviors which, when studied in isolation, can be detrimental to children's math motivation and performance.

The second profile of parents also communicated utility value (4%) and intrinsic value (10%) substantially more frequently than other parents in the sample, but this finding at the same time alarmingly suggested that even among the most value-promoting parents in the sample, value-communication was still a rare occurrence compared to other forms of parenting behaviors. Overall, the low frequency of value communication was largely in line with prior work focusing on older children, which identified that over half of the participating parents discussed the usefulness of math classes with their high-school-aged children less than twice a year (Hyde et al., 2016). Further implications of this finding are discussed in a separate section below.

The third profile, consisting of 15.32% of the sample, reflects what would be considered a less adaptive behavioral pattern. Parents from this profile issued negative feedback (48%) and parental control (51%) most frequently and expressed more negative emotions during the math activity than parents categorized into the other two profiles. However, considering the positive correlation between children's general math knowledge and the unconstructive parenting behaviors prominently represented in this profile, it is likely that the third behavioral at least partially captured parents' response to children's prior math achievement. That is, parents whose children were less achieved in math tended to be more corrective and controlling probably as a way to ensure better performance in the activity as a team. Indeed, previous studies using variable-centered analyses have shown that parenting behaviors can vary as a function of children's prior achievement. Parents tend to show more negativity in their behaviors toward children who have poorer prior achievement (e.g., Oh et al., 2022; Wu et al., 2022), but more constructive toward children who are more highly achieved (e.g., Jhang, 2019; Xu et al., 2018).

Which Contextual and Psychological Factors Predicted Patterns of Parenting Behaviors?

In addition to revealing patterns of behaviors parents engaged in during dyadic math interactions, the present study also shed light on the SES disparities in constructive parenting. Specifically, parents who received college education or above were more likely to be categorized into more adaptive behavioral profiles than parents who did not. However, parents who had a college degree and parents who had a more advanced degree did not differ in their behavioral patterns. Household income, despite its positive correlation with parental education, was not predictive of any of the behavioral profiles. Overall, aligned with existing literature on SES disparities in cognitive-focused parental math practice (i.e., number talk, Levine et al., 2010; Vandermaas-Peeler et al., 2009), the present study extended the findings to include *motivationally* relevant parenting behaviors. “Leveling the playing field” by assigning dyads in a lab-based activity, these findings also highlighted that constructive parenting behaviors are not tied to the financial resources a family possesses, consistent with prior studies focusing on parental involvement in home math-learning environments (e.g., Elliot & Bachman, 2018a).

In terms of the association between parents’ domain- and child-specific beliefs and their behavioral patterns, the only significant association was for parents’ growth mindset. Counterintuitively, however, I found that parents who reported more growth mindset were *more* likely to be categorized into the negative/controlling profile. In other words, parents in the sample who believed that math ability can grow over time issued more negative feedback and parental control, expressed more negative emotions, and rarely communicated math value to their children. This finding stood in contrast to not only theories of parent’s academic socialization, but also prior studies using variable-centered approaches that have consistently found the opposite association: Parents were more likely to use controlling behaviors when they endorsed a more *fixed* belief about math abilities (Matthes & Stoeger, 2018; Muenks et al., 2015), or were more likely to support children’s autonomy if they endorsed more growth mindset belief about math abilities (Sheffler & Cheung, 2022). I return to this point later when I discuss difference in measuring parental beliefs across studies.

Were Patterns of Parenting Behaviors Related to Children’s Math Learning Outcomes?

Children showed improvement on two out of the six assessment items (one near-transfer and one far-transfer item) designed to test what they learned from the dyadic math activity. Children’s post-activity comprehension on the near-transfer item was linked to parents’ behavioral profiles: Children were more likely to answer the near-transfer item correctly if their parents were categorized into the value-promoting profile. However, this association was overshadowed by children's prior knowledge and parental education, meaning that parenting behaviors were not able to contribute to children's immediate math learning outcome above and beyond pre-existing individual differences in knowledge resources. Children's comprehension on the far-transfer item, on the other hand, was not related to children's prior knowledge, parental education, and parents' behavioral profile.

Implications

The "Undervaluing" of Value Communication

Children's value beliefs about mathematics lay the foundation for successful acquisition of math-related, applicable skills beneficial to their future academic and career development (Duncan et al., 2007; Watts et al., 2014). Both the centrality of value beliefs and the crucial role of parents' socialization in fostering those beliefs have been specified in theories across different schools of thoughts. Based on findings from the present study, however, parents as the key socializers in early math learning do not often communicate why math-learning can be useful or enjoyable on a level comparable to its practical significance suggested by theories. Put my findings in perspective, only 9.19% of the participating parents belonged in the behavioral profile characterized by at least some usage of value communication (i.e., value-promoting profile) accompanied by frequent usage of other forms of constructive behaviors. Specifically, parents from the value-promoting profile on average expressed their enjoyment towards the math activity once every 5 minutes (i.e., communication of intrinsic value). To an even less extent, parents from the value-promoting profile discussed how the concept of probability can be useful outside of the ongoing activity on average only once during the entire interaction (i.e., communication of utility value). Taken together, these findings indicated that although some parents spontaneously used language that can promote intrinsic and utility value, most parents were not using these potentially supportive behaviors at all during their interaction with children on math activities.

Due to its focus and correlational nature, the present study differed from previous works in that it did not prompt parents to engage in any particular practice during their interactions with their children. It is therefore not surprising that communication of both types of value beliefs was relatively sporadic in the sample. Even so, according to my observation of dyadic interactions, some parents did use value-promoting statements naturally and even elaboratively in the absence of any experimental manipulation. For example, when explaining the concept of probability, several parents talked about how the concept can be applied to various real-life scenarios such the chance of raining and snowing or the chance of winning in a casino. As another example, one father likened the ongoing dice-rolling activity to a coin-flipping scenario, prompting his child to use what they learned about probability to reflect how many heads or tails they would get if they flipped a coin one hundred times. In contrast to the communication of utility value, which often involved some levels of elaboration, parents' communication of intrinsic value was always commentative rather than explanatory. For example, most cases of intrinsic value communication in the sample happened as parents' spontaneous reaction to rare dice combination they rolled (e.g., "Oh! That was interesting!") or as a direct comment on how they enjoyed playing the activity (e.g., "This game was fun!").

Together, these examples demonstrated that, on one hand, value communication can be so subtle and actionable that it would not require substantial effort from parents to carry out. On the other hand, these observations also showed that although expressing enjoyment or interest in math to their children was mostly a natural action, connecting the concept of probability to other applicable scenarios in an automated fashion may require some levels of content knowledge from the parents. Findings from the present study speak to this notion in many aspects. To elaborate, parents in the sample mostly viewed math as an important skill to learn (8.4 out of 10), but their strong belief in math value rarely translated into actions in the observational task. What did predict parents' behavioral profile represented by (relatively) frequent utility value communication was their educational attainment. Overall, findings on parents' value beliefs and utility-value-promoting behaviors suggested that viewing math learning as important alone might be a necessary but insufficient prerequisite of allowing parents to convey utility-value-promoting messages during dyadic math interactions.

Taking into account my findings and observations, future research should continue to explore parents' math knowledge as a missing link between their beliefs in math value and utility-value-communication behaviors. In the meantime, researchers can use information from the current study and prior intervention works to refine existing intervention programs that aim to assist parents with integrating value-promoting messages into their routine educational involvement practices. Although the impact of these practices may not be immediately visible, letting children at an early age know ways in which math knowledge can not only be applied to numerous everyday life situations, but also facilitates their future academic and career development, has the potential to fuel their math motivation in the long term.

Given that intrinsic value communication, unlike utility value, may not require parents to have substantial knowledge in the content area to initiate, I encourage future research to examine the parents' spontaneous usage of intrinsic value-affirming statement across multiple math learning contexts. The present study took place in an isolated lab setting, with the dyads performing a low-stakes, informal math learning task. Contexts as such may be more well positioned to afford parents to use intrinsic value-affirming language in the interaction than high-stakes, homework assistance situations, which are often fraught with negative emotions (e.g., Maloney et al., 2015; Wu et al., 2022). Following this reasoning, researchers should consider understanding the between-contexts variation in parents' intrinsic value communication through experimental studies, to more fully understand what a realistic goal for parents would be to work towards in terms of the intergenerational transmission of value beliefs in math.

Why Might Parents' Growth Mindset be Related to a Less Constructive Behavioral Profile?

Contrary to prior works and theoretical iterations of parents' mindset beliefs, the present study found that parents who endorsed more growth mindset beliefs were more likely to engage in pattern of behaviors characterized by frequent negative feedback and parental control. These findings, although contradictory to the existing literature at first glance, may extend the field's understanding of the link between growth mindset and parenting behaviors in two meaningful ways. First, since parents' growth mindset was assessed through the most widely implemented survey in the existing literature (Dweck, 1999), it became almost unavoidable that parents' report of growth mindset was inflated in the sample (i.e., false growth mindset, Barger et al., 2022b). Essentially, parents would over-report on the growth mindset scale because items from that scale express a general positivity that aligns with American cultural norm (Schuetze, 2022). Growth mindset, ever since its initial conceptualization 30 years ago, has been a far cry from a generalized optimistic view about math ability, but a system of beliefs that reflect individuals' views on effort, intelligence, growth, locus of attribution, and malleability of ability (for review, see Dweck & Yeager, 2019). Aiming to uncover the misalignment between adults' report on the growth mindset scales and their actual beliefs, recent studies have developed alternative methods to gauge a wider range of beliefs that are conceptualized in theoretical iterations of growth mindset (Barger et al., 2022b; Lou et al., 2017).

In one study, Lou and colleagues (2017) found only weak correlation between scores on the traditional growth mindset scale and an alternative scale that assesses beliefs about effort-based attribution of change in ability, indicating that adults can view growth as a result of innate ability, rather than effort, even though they may highly agree with items from the traditional growth mindset scale, which purports to capture peoples' latent, incremental theories about ability. A more recent study further corroborated this misalignment through a cluster analysis of adults' response from three independently developed growth mindset instruments (Barger et al., 2022b). Across three studies, it was established that approximately 12% to 23% of American adults reported strong endorsement with the traditional growth mindset scale but not the two alternative measures, implying that a nonnegligible proportion of parents may hold a false growth mindset in the U.S.

The false representation of parents' growth mindset can pose difficulties in interpreting findings on the association between parental beliefs and their behaviors found in the current study. Given the mounting evidence that pointed to the prevalence of false growth mindset among the U.S population, it is very likely that some parents in the sample who reported strong endorsement with items from the growth mindset scale did not fully embrace the craft, effort, and attributional strategy in parenting required to bring out positive changes in children's academic outcomes. As a result, among parents who reported strong growth mindset belief, some may in reality act in a fixedness-oriented way, thus skewing the relation between mindset belief and parents' behavioral profile.

For this reason, the counterintuitive finding from my study should not be taken as definitive evidence against fostering a growth mindset culture in home learning environments. Instead, to combat the misrepresentation of mindset beliefs in the study of parental involvement, future research should adopt a multi-method approach in order to acquire a complete view of parents' belief system about growth, effort, ability, and attribution. These research practices would in turn allow researchers to treat parental beliefs as a system through person-centered approaches, which will not only provide novel insights into how parents' beliefs are linked to children's academic outcomes, but also aligns more rigorously with the growth mindset as the way it has been conceptualized in theories.

The second, more methodology-focused reason that might explain why the direction of association between parents' growth mindset and their behaviors differed from prior studies concerns with the modality through which parents' belief and behavioral data were collected. Specifically, most prior studies assessed parenting behaviors using self-reported surveys. When parents reported both their mindset beliefs and behaviors, the direction of their report tended to be aligned. For example, when parents reported more fixed mindset, they were also more likely to report more frequent usage of controlling behaviors during dyadic interactions (Matthes & Stoeger, 2018; Muenks & Miele, 2015). When parents reported more growth mindset, they were more likely to report using positive feedback or autonomy-supportive behaviors during dyadic interactions (Li et al., 2023). This overreliance on measuring parenting behaviors through self-report may inadvertently create a delusion of association, such that parents who found the growth mindset scale agreeable would also be more prone to report socially desirable behaviors. It is also possible that parents reported their behaviors based on the way they *perceived* their own behaviors, even children's interpretation of their parents' behaviors was not always consistent with parents' report (e.g., Rubach & Bonanati, 2021). Simply put, the association between parents' growth mindset and their constructive behaviors may be biased toward parents' own construction of motivating behaviors, rather than an authentic translation from mindset beliefs to growth-oriented behaviors.

To obtain a more accurate understanding of the link between parents' mindset beliefs, parenting behaviors, and children's academic outcomes, I recommend researchers to be proactive about getting both the parent and the child involved in future data collection. Beyond the statistical benefit of overcoming systematic measurement errors associated with mono-informant bias, such research practice would also allow researchers to address underexplored questions that would advance the field. For example, by assessing both parents' reports of their behaviors and children's *perception* of parenting behavior, researcher will be able to not only further test the consistency in parenting behaviors reported by different informants, but also examine the extent to which parents' reports and children's perception of parenting behaviors uniquely or additively relate to children's math motivation and achievement.

Structural Barriers to Constructive Parenting

Aside from shedding light on new perspectives to the link between parental beliefs and behaviors, findings from the present study also contributed to the discussion on structural barriers to constructive parenting. Most importantly, I found parents' educational attainment, but not household income, to be a robust predictor of their behavioral profile. Additionally, although not central to the research hypotheses, measurement invariance testing revealed that items from instruments of parental beliefs behaved differently for parents with different levels of educational attainment. Namely, there were fundamental differences in ways that parents from various educational backgrounds perceive growth, failure, competence, and values in math learning.

Contextualized within the broader literature of SES disparities in parenting, these findings are consistent with Hardin's family-process model (2015), which posits that as parents receive additional years of education, they accumulate knowledge, networking connections, and more highly-achieved career role models, which in turn jointly influence their system of beliefs.

The variations in parenting behaviors by parental education also implied that what has been considered "optimal" parenting might be biased toward certain populations that have been more frequently examined in prior research (i.e., middle- to upper-class, well-educated, American sample). Parents' educational attainment sometimes intersects with their racial identities (Assari et al., 2019), which are linked to cultural norms and social class. Adopting this rationale, some scholars have argued that parents at different socioeconomic strata behave differently as a result of responses to circumstances that they constantly interact with (e.g., Hoff & Laursen, 2019). As such, SES difference in parenting might be as practically meaningful as cultural difference, to the extent where theories of parents' socialization need to be recentered among parents with identities that have been historically less represented in the study of parental educational involvement. Emerging research has contributed to this body of literature by investigating ways in which parents support children's math motivation and learning unique to Black, Latine, and Asian parents from low SES background (e.g., Lu et al., 2025; Starr et al., 2025; Tulagan & Eccles, 2023). Future research should continue this effort to achieve the eventual goal of reimaging existing theories in a way that does not perpetuate a deficit-view on SES disparities in parenting.

Another implication carried by the present study concerned with measuring SES in parenting research. Adhering to recommendations by Elliot and Bachman (2018), I measured SES as a host of separate indicators including household income and parental education. Finding supported the rationale by showing that parental education was a more robust predictor of parenting behaviors than household income. This finding was in line with early studies that focused on parenting in non-academic contexts, where education has been identified as the most reliable source of effects on parental practices among other indicators of SES such as occupation and family income (e.g., Kelly et al., 1993). The robustness of predictive power of parental education can be attributed the fact that education, compared to occupation and family income, tends to remain stable over time and unaffected by temporary occupational and financial stress (i.e., unemployment, Richman et al., 1992). Taken together, the present study demonstrated that researchers need to be precise at measuring specific aspects of family SES that are theoretically and practically significant to their research questions. Treating family SES as a unitary construct, on the other hand, may veil important mechanism from which parents draw economic, human, or financial resources during their educational involvement.

Limitations

Informed by theories from various fields of education and psychology, the current study offered an integrated view on the dynamic among parental beliefs, parenting behaviors, children’s math learning, and family SES. Still, findings from the study need to be interpreted in light of several limitations. First, despite the variety of parenting behaviors examined in the study, the content of dyadic interaction was limited in an isolated, lab-based task. Given that parents’ instructional behaviors can vary across formal and informal math learning contexts (e.g., Carkoglu & Eason, 2025), it would be overgeneralizing to take profiles identified in the current study as a conclusive depiction of what parents’ math learning involvement looks like on a daily basis. Future research should consider following the rationale of revealing patterns in parenting behaviors and testing the replicability of my finding in different contexts (i.e., formal versus informal; high-stakes versus low-stakes). On a similar note, due to the breadth of parenting behaviors observed in the study, I was unable to capture nuanced distinction that existed *within* each behavioral category, which may have cognitive or motivational implications for children's math learning. A prominent example is parents' feedback orientation. Particularly, prior research has demonstrated that parents' implicit attribution of success and failure in their feedback (i.e., person and process feedback) has differential effects on children's math performance (Barger et al., 2022a; Gunderson et al., 2013). Distinction as such was challenging to discern when the goal of the study was to offer an aerial view of how different parenting behaviors combined to form into patterns.

From a methodological perspective, the person-centered analysis employed in the present study can be helpful in offering a realistic reflection of patterns of behaviors parents engage in during dyadic math activities, but it is also important to note that person-centered analysis naturally reduced variability in parents' behavioral data, which is a key assumption underlying any analysis that involves modeling of latent variables. It is likely that the prototypical parent delineated by a certain profile in fact did not represent any single parent from that profile. Additionally, person-centered analyses may be especially useful to reveal general patterns, but can be limited when it comes to explaining complex mechanistic change or interaction effect. For these reasons, I advise researchers to be considerate when evaluating whether person-centered analysis is the most appropriate for the questions they aim to address in the study. Another methodological constrain of the study has to do with measures (or lack thereof) of motivational beliefs from the children. Grounded in multiple theories of achievement motivation, the study nevertheless does not have the power to inform theories of the different impact on children's motivation development each parenting behavioral profile would bring. Using longitudinal design, future research should carry on this thread of work by testing 1) whether parenting behavioral profiles and children's math motivation transactionally predict each other across time points, and 2) whether it is possible for parents switch between behavioral profiles as a function of children's math motivation and achievement.

Finally, similar to most prior studies on parental involvement, participating parents in the study were mostly mothers. Traditionally, mothers have been considered the primary caregiver and therefore the socializer of children's education. Recent evidence, however, suggested that fathers are playing an increasing role in shaping children's academic outcomes due to a shift in cultural norms and familial structure (Sun & Rao, 2017). This increase in educational involvement from fathers has prompted researchers to study the qualitative difference in parenting behaviors between mothers and fathers. Indeed, several studies have found that father's involvement can uniquely influence children's math motivation and achievement, even after controlling for mother's involvement behaviors (Del Rio et al., 2017; Zou et al., 2017). It is possible that fathers' and mothers' involvement functions through different psychological and behavioral pathways to shape children's math adjustment (e.g., Cai et al., 2024), or that the strength of association between parental involvement and children's math adjustment depends on parent-child relationship (e.g., Ma et al., 2021). Future research can test these possibilities to provide more clarity in understanding the role of both parents in fostering early success in math learning.

Conclusion

By revealing that different forms of parenting behaviors rarely appeared as isolated cases in dyadic math interactions, the present study highlighted the importance of examining *multiple* relevant behaviors in the study of parental involvement. Expanding the notion of parents as untapped resources for children' math development (Harackiewicz et al., 2012), the study emphasized the underuse of value-communication in the context of informal dyadic math interactions, despite the centrality of value beliefs placed in many theories of educational psychology. Given that it was value-communication that distinguished the most constructive behavioral profile from the rest of the sample, future research should focus on promoting parents' use of value-affirming language in addition to giving feedback, supporting children's autonomy, and issuing command, all of which were already common practices in parents' math-learning involvement.

Additionally, the counterintuitive and null associations between parental beliefs and behavioral profiles identified in the present study demonstrated that parental beliefs may not be easily transferable into parenting behaviors as outlined in theories of parents' academic socialization. These findings thus challenged the fundamental assumption of prior studies that sought to improve parental practices through intervening on parental beliefs (e.g., MacDonald et al., 2024), since parental education might be a systemic barrier that prevents adaptive parental beliefs from transferring into constructive behaviors. As discussed earlier, parental practices are likely to be a reflection of parents' response to the environments they live in. Researchers should therefore also consider conducting exploratory studies through partnership with low-SES families to unveil parenting behaviors that are not traditionally considered constructive or motivating, but that can be helpful to math adjustment among children who have fewer access to economic, human, and social resources.

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Table 1

Descriptive and Correlation Statistics for Parents' Beliefs, Behaviors, Child Math Knowledge, and SES Variables

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
1. GM	-																
2. FM	.40**	-															
3. MV	.29**	.16**	-														
4. PCC	.11*	.22**	.16**	-													
5. Anx	-.20**	-.22**	-.12**	-.20**	-												
6. PF	.03	.09	.00	.00	-.09	-											
7. NF	.10	-.06	-.03	-.13*	.00	.03	-										
8. AS	-.03	.00	-.04	.05	-.14**	.17**	-.13**	-									
9. CB	-.03	-.15**	.01	-.24**	.00	-.10*	.52**	-.11*	-								
10. UV	.07	.12*	.06	.10	-.09	.17**	-.11*	.21**	-.10	-							
11. IV	.07	.06	.03	.06	.06	.23**	-.04	.12*	-.07	.21**	-						
12. PA	.03	.07	-.09	.01	-.10	.41**	.08	.21**	-.10	.22**	.27**	-					
13. NA	.06	-.08	.05	-.01	.02	-.24**	.46**	-.20**	.47**	-.11*	-.12*	.03	-				
14. GMK	.12*	.20**	.08	.54**	-.21**	.05	-.18**	.17**	-.32**	.04	.05	.03	-.18**	-			
15. Post-K	-.05	.07	-.18**	.12*	-.03	.00	-.04	.00	-.15**	.07	.02	.08	-.08	.26**	-		
16. Inc	.08	.15**	.05	.16**	-.17**	.12**	-.16**	.10	-.29**	.08	.16**	.11	-.15**	.34**	.09	-	
17. Pedu	.10	.06	-.06	.25**	-.19**	.23**	-.16**	.24**	-.27**	.20**	.13*	.23**	-.18**	.39**	.09	.49**	-
M	8.48	7.38	8.50	8.49	3.64	.37	.33	.18	.34	.02	.02	1.49	1.13	492.55	3.02	4.80	-
SD	1.36	1.81	1.14	1.40	2.07	.16	.14	.10	.15	.03	.03	0.30	0.15	21.99	1.28	2.46	-
Minimum	3.67	1.00	4.67	2.75	1.00	.03	.03	.00	.03	.00	.00	1.00	1.00	415.00	0.00	1	-
Maximum	10.00	10.00	10.00	10.00	10.00	.90	.77	.53	.90	.17	.17	2.37	1.88	542.00	6.00	10	-
Kurtosis	0.86	-0.08	0.19	1.83	-0.08	-0.26	-0.04	0.24	0.17	5.35	7.53	-0.45	3.56	-0.20	-0.38	.43	-
Skewness	-1.07	-0.57	-0.79	-1.32	0.76	0.35	0.35	0.48	0.57	2.13	2.56	0.52	1.76	-0.31	-0.01	-.56	-
N	358	357	357	358	358	359	359	359	359	359	359	359	359	359	359	357	355

Note. $^*p < .05$; $^{**}p < .01$. GM = growth mindset; FM = failure mindset; MV = math value; PCC = perceived child competence; Anx = math anxiety; PF = positive feedback; NF = negative feedback; AS = autonomy support; CB = controlling behaviors; UV = utility value statement; IV = intrinsic value statement; PA = positive affect; NA = negative affect; GMK = general math knowledge; Post-K = post-activity probability knowledge; Inc = annual household income; Pedu = parents' educational attainment. Descriptive statistics of annual household income are based on a 10-point Likert scale where a higher value indicates higher household income. Parental education was coded as a 3-level categorical variable, and thus not applicable for descriptive statistics.

Table 2

Items and Standardized Loadings for Parental Beliefs from the Initial Five-Factor Model

Items	Label	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
People have a certain amount of math ability, and there is really not much that can be done to change it.	GM1	.784				
People's math ability is something about them that can't be changed very much.	GM2	.788				
People can learn new things, but there is little that can be done to change their basic math ability.	GM3	.894				
No matter how good people are at math, it's always possible to change their math ability quite a bit.	GM4	.578				
People's math ability is something that can be changed a lot.	GM5	.639				
To be honest, people's math ability just can't be changed all that much.	GM6	.812				
Experiencing failure in math gets in the way of learning and growth in math.	FM1		.823			
The effects of failure in math are positive and should be utilized.	FM2		.860			
Experiencing math failure enhances later math performance and productivity.	FM3		.811			
Experiencing math failure hinders later math performance.	FM4		.664			
The effects of failure in math are negative and should be avoided.	FM5		.637			
Experiencing failure in math can lead to learning and growth when it comes to math.	FM6		.761			
It is important that my child does well in math.	MV1			.706		
If my child is to be successful later in life, he/she will need to have advanced math skills.	MV2			.641		
It is important that my child develops solid mathematical skills.	MV3			.818		
Math is one of the most valuable skill sets children develop in school.	MV4			.763		
Math skills are not that useful compared to other skills that children need to develop.	MV5			.564		
When it comes to school, I don't see math as a priority for my child.	MV6			.478		

How well has your child done on recent math work (for example, homework and tests)?	PCC1	.865	
If you were to rank all of the children in your child’s class from the worst to the best in math, where would you put your child?	PCC2	.840	
How capable is your child at math?	PCC3	.801	
How well do you expect your child to do in math this year?	PCC4	.907	
Receiving a math textbook.	Anx1		.769
Watching a teacher work on an algebra problem on the blackboard.	Anx2		.771
Signing up for a math course.	Anx3		.834
Listening to another student explain a math formula.	Anx4		.779
Studying for a math test.	Anx5		.857
Taking the math section of a standardized test, like an achievement test.	Anx6		.804
Reading a cash register receipt after you buy something.	Anx7		.352
Taking a test in a math course.	Anx8		.821
Being given a set of addition or subtraction problems to solve on paper.	Anx9		.398
Being given a set of multiplication or division problems to solve on paper.	Anx10		.506
Picking up your math textbook to begin working on a homework assignment.	Anx11		.766
Being given a homework assignment of many difficult math problems, which is due the next time the class meets.	Anx12		.806
Thinking about an upcoming math test.	Anx13		.884
Realizing that you have to take a certain number of math classes to meet the requirements for graduation.	Anx14		.863
Picking up a math textbook to begin a difficult assignment.	Anx15		.862
Opening a math or statistics book and seeing a page full of problems.	Anx16		.834

Table 3

Ten Largest Item Level Modification Indices for the Initial Five-Factor.

Item	Item	M.I.
Reading a cash register receipt after you buy something (Anx7).	Being given a set of addition or subtraction problems to solve on paper (Anx9).	200.38
Being given a set of multiplication or division problems to solve on paper (Anx10).	Being given a set of addition or subtraction problems to solve on paper (Anx9).	166.18
Studying for a math test (Anx5)	Taking a test in a math course (Anx8).	134.20
Being given a set of multiplication or division problems to solve on paper (Anx10).	Reading a cash register receipt after you buy something (Anx7).	98.08
People’s math ability is something that can be changed a lot (GM5).	No matter how good people are at math, it’s always possible to change their math ability quite a bit.	97.58
Opening a math or statistics book and seeing a page full of problems (Anx16).	Picking up a math textbook to begin a difficult assignment (Anx15)	95.40
Taking a test in a math course (Anx8).	Taking the math section of a standardized test, like an achievement test (Anx6).	90.15
Receiving a math textbook (Anx1).	Picking up your math textbook to begin working on a homework assignment (Anx11).	88.72
Watching a teacher work on an algebra problem on the blackboard (Anx2).	Receiving a math textbook (Anx1).	88.45
Experiencing math failure hinders later math performance (FM4).	Experiencing failure in math gets in the way of learning and growth in math (FM1).	72.81

Note. M.I. = modification indices

Table 4

Items and Standardized Loadings for Parental Beliefs from the Final Four-Factor Model

Items	Label	Factor 1	Factor 2	Factor 3	Factor 4
People have a certain amount of math ability, and there is really not much that can be done to change it.	GM1	.783			
People's math ability is something about them that can't be changed very much.	GM2	.808			
People can learn new things, but there is little that can be done to change their basic math ability.	GM3	.913			
No matter how good people are at math, it's always possible to change their math ability quite a bit.	GM4	.527			
To be honest, people's math ability just can't be changed all that much.	GM6	.790			
Experiencing failure in math gets in the way of learning and growth in math.	FM1		.522		
The effects of failure in math are positive and should be utilized.	FM2		.863		
Experiencing math failure enhances later math performance and productivity.	FM3		.812		
Experiencing math failure hinders later math performance.	FM4		.661		
The effects of failure in math are negative and should be avoided.	FM5		.635		
Experiencing failure in math can lead to learning and growth when it comes to math.	FM6		.760		
It is important that my child does well in math.	MV1			.707	
If my child is to be successful later in life, he/she will need to have advanced math skills.	MV2			.642	
It is important that my child develops solid mathematical skills.	MV3			.818	
Math is one of the most valuable skill sets children develop in school.	MV4			.763	
Math skills are not that useful compared to other skills that children need to develop.	MV5			.563	
When it comes to school, I don't see math as a priority for my child.	MV6			.477	
How well has your child done on recent math work (for example, homework and tests)?	PCC1				.867
If you were to rank all of the children in your child's class from the worst to the best in math, where would you put your child?	PCC2				.842
How capable is your child at math?	PCC3				.800
How well do you expect your child to do in math this year?	PCC4				.905

Table 5

Fit Statistics for Latent Profile Models

Model	AIC	BIC	aBIC	VLMR-LRT	Profile Proportion (% of *N* = 359)	Entropy
2-Class	-5046.05	-4948.97	-5028.28	.013	16.70, 83.30	.89
3-Class	**-5273.78**	**-5141.75**	**-5249.61**	**.003**	**9.20, 15.30, 75.50**	**.92**
4-Class	-5524.37	-5357.39	-5493.8	.252	2.00, 7.80, 19.20, 71.00	1
5-Class	-5935.63	-5733.7	-5898.67	.624	2.00, 2.20, 5.60, 19.20, 71.00	1

Note. The bolded model was selected as the best fitting solution.

Table 6

Post-Activity Assessment of Children Knowledge in Probability

Item	
NT1	I am going to roll this die 10 times. This die has six sides. Which number do you think is most likely to come up?
NT2	If I roll the die once, do I have a better chance of rolling a one, rolling a six, or are they both equal?
NT3	When you roll two dice and add them together, what do you think is most likely for them to add up to?
NT4	When you roll two dice and add them together, what do you think is least likely for them to add up to?
FT1	I have a special coin. One side has a 1 and the other side has a 2. If I flip the coin, what am I most likely to get?
FT2	Now I am going to flip two of my special coins. What is most likely to happen when I add the numbers together?

Note: NT = near transfer; FT = far transfer.

Table 7

Parents' Educational Attainment and Parental Beliefs Predicting Parents' Behavioral Profiles in Latent Profile Analysis

Model #	Reference Profile	Profile in Comparison	Predictors	B	S.E.	*p*
1	Value-Promoting	Moderately-Motivating	Parental Education	-0.61	0.32	.054
			Growth Mindset	-0.36	0.29	.211
			Failure Mindset	-0.01	0.11	.906
			Math Value	-0.04	0.16	.812
			Perceived Child Competence	0.02	0.18	.912
1	Value-Promoting	Negative/Controlling	Parental Education	-1.34	0.38	**.001**
			Growth Mindset	-0.01	0.31	.963
			Failure Mindset	-0.15	0.14	.309
			Math Value	0.09	0.20	.655
			Perceived Child Competence	0.02	0.21	.912
1	Moderately-Motivating	Negative/Controlling	Parental Education	-0.73	0.26	**.005**
			Growth Mindset	0.34	0.16	**.036**
			Failure Mindset	-0.13	0.11	.234
			Math Value	0.05	0.15	.738
			Perceived Child Competence	0.004	0.14	.979
2	Value-Promoting	Moderately-Motivating	Parental Education	-0.62	0.28	**.026**
			Math Anxiety	0.09	0.08	.265
2	Value-Promoting	Negative/Controlling	Parental Education	-1.33	0.34	**.001**
			Math Anxiety	0.01	0.10	.890
2	Moderately-Motivating	Negative/Controlling	Parental Education	-0.71	0.23	**.002**
			Math Anxiety	-0.07	0.08	.360

Table 8

Multinomial Logistic Regression Model using Profile Membership to Predict Accuracy on the Near-Transfer Item

Outcome Variable: Accuracy on the Near-Transfer Item (Binary)						
	Predictors	B	Exp (B)	S.E	Wald	*p*
	Intercept	-11.34	0.00	2.91	15.15	<.001
Reference Group: Value-Promoting	General Math Knowledge	0.02	1.02	0.006	11.03	<.001
	Parental Education	0.57	1.77	0.16	12.59	<.001
	Moderately-Motivating	-0.12	0.88	0.39	0.10	.751
	Demotivating	-0.41	0.67	0.50	0.67	.412
	Intercept	-11.74	0.00	2.97	16.75	<.001
	General Math Knowledge	0.02	1.02	0.006	11.03	<.001
Reference Group: Demotivating	Parental Education	0.57	1.77	0.16	12.59	<.001
	Moderately-Motivating	0.28	1.33	0.35	0.64	.424
	Value-Promoting	0.41	1.50	0.50	0.67	.412

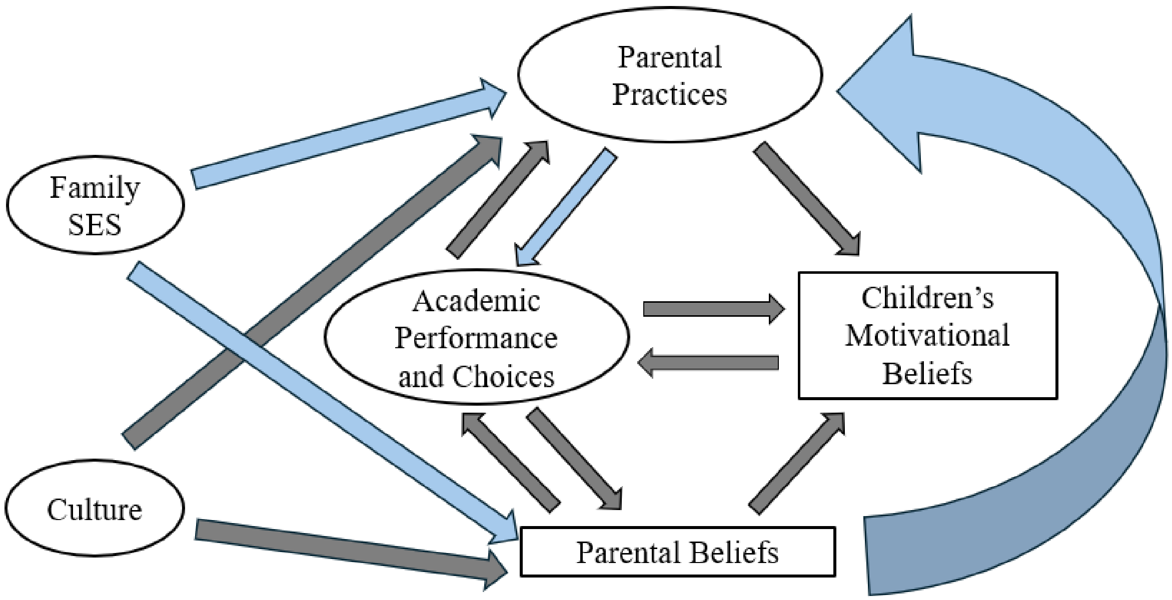
Table 9

Multinomial Logistic Regression Model using Profile Membership to Predict Accuracy on the Far-Transfer Item

Outcome Variable: Accuracy on the Far-Transfer Item (Binary)						
	Predictors	B	Exp (B)	S.E	Wald	*p*
Reference Group: Value-Promoting	Intercept	-5.06	0.006	3.03	2.79	.095
	General Math Knowledge	0.009	1.009	0.006	1.87	.171
	Parental Education	0.09	1.09	0.17	0.27	.605
	Moderately-Motivating	-0.49	0.612	0.39	1.56	.211
	Demotivating	-0.75	0.472	0.52	2.10	.148
Reference Group: Demotivating	Intercept	-5.81	0.003	2.99	3.79	.052
	General Math Knowledge	0.009	1.009	0.006	1.87	.171
	Parental Education	0.09	1.09	0.17	0.27	.605
	Moderately-Motivating	0.26	1.23	0.39	0.45	.502
	Value-Promoting	0.75	2.11	0.25	2.10	.148

Figure 1

Conceptual Model of Parents' Academic Socialization



Note. Highlighted paths were tested in the current study.

Figure 2

Characteristics of Parenting Behaviors by Latent Profile Membership (Raw Score)

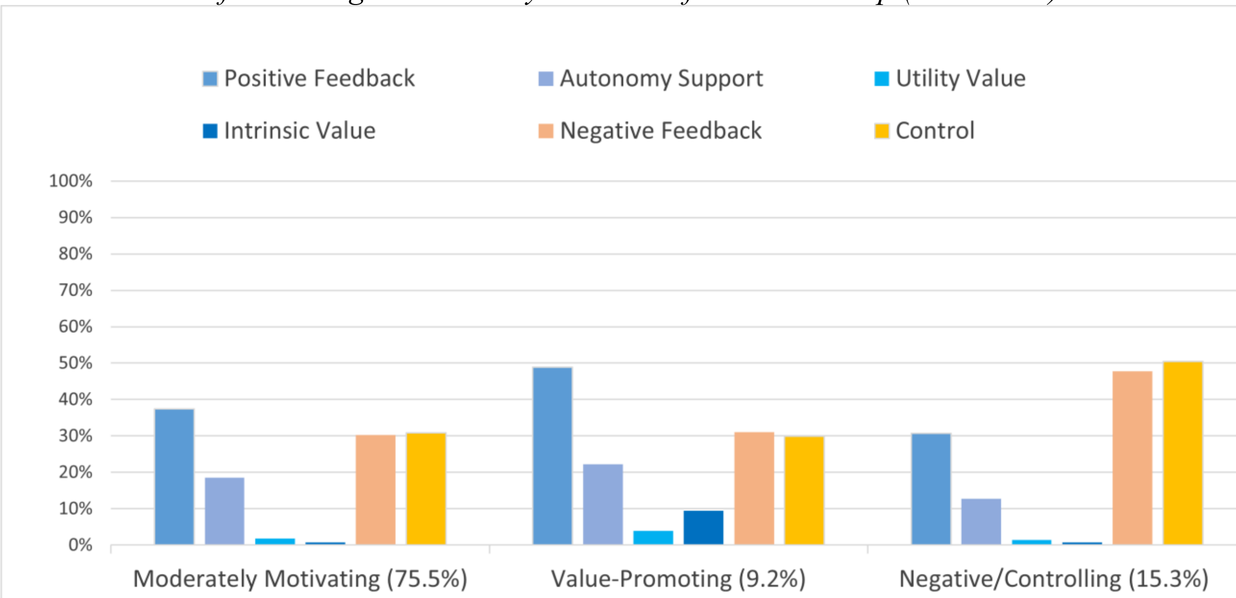


Figure 3

Characteristics of Parents' Affect by Latent Profile Membership (Raw Score)

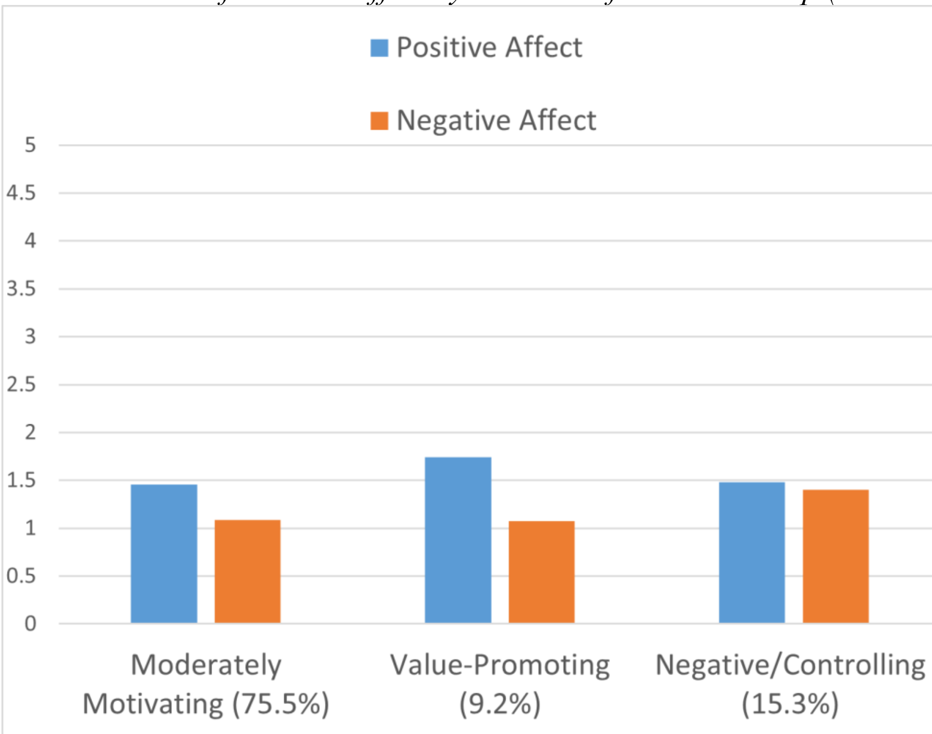


Figure 4

Characteristics of Parents' Behaviors and Affect by Latent Profile Membership (Standardized)