Examining the Effects of Adult Scaffolding on Preschoolers' Math, Spatial, and Executive Function Skills

by

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DISSERTATION ABSTRACT

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Doctor of Philosophy in Prevention Science

Title: Examining the Effects of Adult Scaffolding on Preschoolers' Math, Spatial, and Executive Function Skills

Children's early learning experiences are a salient predictor of later academic, health, and well-being outcomes. The proximal adults that guide these early learning experiences and the effectiveness of their guidance and teaching are also key contributors to children's learning. One teaching strategy used in education is scaffolding, which is providing support to children when they are not yet able to master concepts or skills independently, with the intent to fade the support when the child is making progress toward mastery. Verbal scaffolding requires the adult to continuously evaluate children's abilities by observing their behaviors or by talking to them about their understanding and reasoning. When used effectively, scaffolding can be a low-lift teaching tool that may increase children's engagement and understanding of their learning tasks. This study examined naturally occurring verbal scaffolding by interventionists during a block play intervention, which aimed to increase preschoolers' math, spatial, and executive function skills. Transcripts and video data from a block play intervention were used to code for the type (i.e., engagement, learning, peer interaction) and complexity level (i.e., low and medium/high) of scaffolding to which the children in small block play groups were exposed during the 16-session intervention that included semi-structured and free play conditions. The sample included 112 preschool children (M_{age} = 53.39 months, SD = 6.29, 44% female). Interventionists provided significantly more total scaffolding instances in semi-structured than free play sessions, though scaffolding rates per minute did not differ between conditions. Engagement scaffolding was the

predominant scaffolding type in both conditions, and low-complexity scaffolding predominated over medium/high-complexity scaffolding in both conditions. Adjusting for child age, sex, race/ethnicity, parent education, baseline outcome scores, and receptive vocabulary, scaffolding rate did not significantly predict children's math, spatial reasoning, or executive function outcomes, and condition did not moderate this association. Similarly, the rates of engagement, learning, and peer interaction scaffolding were not differentially related to child outcomes, nor did condition moderate these associations, with the exception of a marginal trend suggesting a stronger negative association between peer scaffolding rate and inhibitory control (HTKS) scores in the semi-structured condition that did not survive correction for multiple comparisons. Finally, scaffolding complexity level did not significantly moderate the relation between scaffolding rate and child outcomes. Condition moderated this moderation, such that higher rates of low-complexity scaffolding were associated with a weaker scaffolding rate–cardinality relation in semi-structured groups compared to free play (p = .041), though this did not survive multiple comparisons correction. Findings are discussed in terms of implications for early childhood intervention design and the role of scaffolding quality in supporting school readiness.

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DEDICATION

This work is dedicated to four creative, curious, clever, cat-loving people: Dan, Alex, Jane, and Felicity. I am so thankful that we are on this adventure together.

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CHAPTER I

INTRODUCTION

Statement of Problem

School readiness predicts later academic success and long-term social, economic, and health advantages (HRSA, 2023; Peterson et al., 2018). Early childhood educators are salient contributors to children's cognitive growth through personal interactions (e.g., scaffolding; Bodrova & Leong, 2012; Mashburn et al., 2008; Nores et al., 2022) and the facilitation of other process quality factors in the classroom. Process quality factors, which are the direct experiences for children in a classroom, emphasize the quality of teacher-child interactions, classroom climate, peer-to-peer interactions, and how well learning tasks are implemented (Howes et al., 2008; Weiland, 2016). Over the past 15 years, expectations for early childhood educators in the United States (U.S.) have intensified as public and policy emphasis on kindergarten readiness and earlier academic rigor has grown (Bassok et al., 2016). Preschool teachers are often expected to teach a wide range of skills with limited training, time, resources, and support (Nagasawa & Swadener, 2020).

In the past twenty years, per-pupil spending in preschools has not increased significantly after adjusting for inflation (Friedman-Krauss et al., 2024). A lack of resources for preschool centers, coupled with increasing burnout symptoms among teachers due to job expectations and stress from working with young children (Moriarty et al., 2001; Schaack et al., 2020), makes the identification of low-cost and low-burden strategies to maximize children's learning timely and pertinent. One such strategy that has been shown to predict positive child outcomes is adult presence and scaffolding (Acar et al., 2017). This dissertation focuses on scaffolding as an aspect of process quality in preschool classrooms serving children from low-income families.

Purpose and Significance

This dissertation addresses how adults (i.e., early childhood educators) can support children's cognitive development through scaffolding within classroom constraints, such as time and teacher training. This dissertation examines naturally occurring scaffolding in a recurring, small-group, play-based intervention, which offers insight into real-world scaffolding strategies and children's responses. The purpose of this dissertation is to measure the effect of adult scaffolding frequency, type, and level on preschool children's math, spatial reasoning, and executive function (EF) outcomes post block-play intervention. Findings from this research have the potential to (1) inform preschool teachers' professional development by identifying specific scaffolding characteristics linked to child outcomes, (2) contribute to intervention design, and (3) advance theoretical frameworks on guided play and Vygotskian scaffolding.

Definition of Scaffolding

In education, scaffolding typically refers to a teaching strategy that builds on what children already know and chunks complex concepts or tasks into smaller steps (Zurek et al., 2014). This process occurs before instruction is differentiated to meet children's individual needs (Alber, 2014; Castagno-Dysart et al., 2019). In line with these shared understandings of scaffolding, characteristics of scaffolding include the adaptivity of instructional support, the transfer of responsibility (fading), and the use of diagnostic strategies (Hermkes et al., 2018; Puntambekar & Hübscher, 2005; van de Pol et al., 2010). Scaffolding is a dynamic process where a teacher, or in the context of this dissertation, an adult interventionist, is continually assessing the needs of the learner (van Geert & Steenbeek, 2005) and providing support when the child cannot yet reach the goal or work towards the goal independently (e.g., build a block

structure). Depending on the needs of the learners, the adult provides different levels of support from low to high. Though verbal scaffolding in education settings often refers to planned instructional strategies such as breaking learning into smaller tasks, this dissertation quantifies scaffolding instances as verbal utterances in which the adult (i.e., interventionist in the originating study) intervenes to support children's engagement, learning, and positive peer interactions.

Theoretical Framework

Guiding this dissertation is the sociocultural theory, created by Russian-Soviet psychologist, Lev Vygotsky. The sociocultural theory posits that social interaction and the scaffolding of learning by a more knowledgeable person are essential to children's learning and mastering a skill or concept. Scaffolding by an adult occurs when the adult intervenes to help the child when a child is not yet able to achieve a goal independently (Wood et al., 1976; Vygotsky, 1978). The more knowledgeable person adjusts their support to fit the student's learning needs. Scaffolding is based on Vygotsky's theory of the Zone of Proximal Development, which can be visualized as three concentric circles. The inner-most circle is the focal child. The circle around that is the zone of proximal development, where children can achieve mastery with intervention from a more expert peer or adult. The third circle surrounding that represents areas that the child cannot yet master, even with intervention. In 1976, Dr. Jerome Bruner, an American cognitive psychologist, coined the term *scaffolding* and connected it to Vygotsky's sociocultural theory and theory of the zone of proximal development (Wood et al., 1976).

The Importance of High-Quality Early Childhood Education

Early childhood education is predictive of long-term indicators of well-being such as academic achievement, educational attainment, and income (Gray-Lobe et al., 2023; Solang et al., 2024). Research on the benefits of high-quality early childhood education dates back to the 1960s, with the launch of the Perry Preschool Project and the Chicago Child-Parent Centers (CPC). Since then, several landmark longitudinal studies, each with distinct program features, have shaped our understanding of early learning experiences. Across the decades and contexts of these programs, children have shown short-term academic (i.e., literacy, math, language) gains at kindergarten entry. Some programs (i.e., Perry Preschool Project, Abecedarian, CPC) have also been effective long-term for participants. For example, by age 28, participants in the CPC were 20% more likely to graduate high school and more likely to sustain full-time work (Reynolds et al., 2018). Further, by age 35, participants who were in a CPC setting for four to six years had a 48% higher rate of completing an associate's degree or higher compared to participants who had fewer years in a CPC setting (Reynolds et al., 2018). Similarly, meta-analyses on Head Start effect sizes found lasting benefits in health, high school completion, and reduced grade retention (Bauer & Schanzenbach, 2016; Puma et al., 2012).

Several factors contribute to differences in children's short- and long-term outcomes in addition to enrollment in a preschool program, such as socioeconomic status (Isaacs & Magnuson, 2011; Zhao et al., 2025), familial characteristics (e.g., stress, home learning environment; Pace et al., 2017; Yoshikawa et al., 2012), structural, and process quality factors of the preschool classroom (Office of Head Start, 2024; Weiland, 2016). Structural quality factors, which are observable indicators, include class size, teacher-student ratios, teacher credentials, health supports, and curriculum adoption, among others. The "ten benchmarks of high-quality

pre-k" are a set of minimum policies to be in place to support meaningful, persistent gains in learning and development set by the National Institute for Early Education Research (NIEER). They reflect structural quality factors, including bachelor's degrees for lead teachers, CDA or equivalent training for assistants, ongoing professional development, class sizes of no more than 20, and student-teacher ratios of 1:10 or less (NIEER, 2019).

Process quality factors, as stated previously, are the direct experiences for children in the classroom (e.g., quality of interactions, quality of teaching strategies; Howes et al., 2008; Weiland, 2016). The structural features are *mediators* of the effects of process quality on children's outcomes. For example, lower ratios make it more likely that teachers can interact with all children in the classroom in positive and productive ways. Though the evidence is mixed, process quality factors have predicted children's learning in previous studies (Hamre, 2014; Hamre et al., 2014; Markowitz et al., 2017; Zaslow et al., 2016). However, other syntheses present cautionary results. A systematic review of the Classroom Assessment Scoring System (CLASS), which is a common measure of process quality, found only very modest correlations (e.g., ~.06–.09) between teacher-child interaction quality and child outcomes (Perlman et al., 2016). In addition, meta-analyses report heterogeneity, non-significant associations, and generally small effect sizes (Perlman et al., 2016; von Suchodoletz et al., 2023). Recent research suggests that in contexts where structural quality standards are already high (and therefore variation is low), the expected process-outcome links are weaker or non-significant (Kelly et al., 2025). Given these inconsistencies and the broad nature of the CLASS measurement, new research may benefit from exploring specific components of process quality, like scaffolding.

Early Childhood Educators' Role in Child Development and Learning

Early childhood educators (ECEs) are major contributors to children's school readiness, especially in children's content knowledge acquisition (Williford et al., 2013), cognitive stimulation (Rakesh et al., 2024), and EF (Vandenbroucke et al., 2018; Williford et al., 2013). In addition, the quality of children's preschool experience hinges on the educator's capacity to encourage children's engagement in the learning process and provide a stimulating classroom environment through teacher-student and peer interactions (Hamre et al., 2014; Markowitz et al., 2017; Williford et al., 2013; Zaslow et al., 2016). Williford and colleagues (2013) found that in a sample of 605 preschool children with a high proportion of children from low-income families, the quality of teacher-child interactions was related to receptive vocabulary, print knowledge, and two EFs, working memory and inhibitory control. It is also possible that these interactions relate to other domain-specific skills. Below, I describe the outcomes of interest of this dissertation and discuss the potential links between adult support in the form of scaffolding and children's development in math skills, spatial skills, and EF.

Domain-Specific Skills

Math Skills. Math skills in preschool include three key domains of numeracy: numbering, numerical relations, and arithmetic operations (Jordan et al., 2007). Numbering is understanding number order, counting, recognizing quantities within a set (cardinality), identifying numerals, and applying one-to-one correspondence. Numerical relations are comparing numbers and quantities (e.g., determining which is more or less) and understanding sequences or ordinality. Arithmetic operations refer to manipulating quantities, recognizing equivalence, and understanding how numbers combine to form other quantities (Purpura &

Lonigan, 2013; Raghubar & Barnes, 2017). Early childhood educators contribute to children's math understanding through daily interaction and instruction.

Research has found that the quality of teacher-child interactions predicts early math learning (Trawick-Smith et al., 2016). Trawick-Smith and colleagues categorized teacher-child interactions into two types: those that enhance play itself and those that directly promote math thinking. They found that interactions designed to support and extend play, as well as number and math communication interactions, predicted preschoolers' growth in math. In addition to the quality of teacher inputs, researchers have found that the quantity of math language teachers use also relates to students' math skills. Klibanoff et al. (2006) found significant differences in the amount of math-related talk by preschool teachers and that the amount of math-related talk predicted growth in children's math knowledge over the school year. This suggests that frequent exposure to math vocabulary and concepts in teacher speech contributes to children's math learning.

Spatial Skills. The term spatial skills is used as an umbrella term for a constellation of related cognitive abilities that center on the mental manipulation of information about objects in the environment and the spaces we inhabit (Uttal et al., 2013). These skills include functions such as spatial visualization, form perception, visual-spatial working memory, and mental rotation (Casey et al., 2008; Mix et al., 2016; Newcombe, 2010; Uttal et al., 2013). Spatial visualization is the multi-step processing of spatial information and the ability to generate images of different shapes and mentally synthesize them into a new design (e.g., using pattern blocks or puzzles). Form perception is the ability to recognize, distinguish, and copy shapes, symbols, or objects based on their inherent properties and features. It focuses on identifying and matching forms that are not changing. Visual-spatial working memory is the cognitive system responsible

for the temporary storage and mental manipulation of visual and spatial information (McAfoose & Baune, 2009). Mental rotation is the ability to mentally transform an object or picture by visualizing its appearance after rotation in two- or three-dimensional space.

To my knowledge, only one correlational study has been done to examine how the quality of teacher-child interactions or naturally occurring interactions outside of whole- or small-group instruction relate to children's spatial skill development (Schmitt et al., 2024). Schmitt and colleagues explored preschooler's knowledge of stability with building blocks and spatial language in addition to math language, interest in block play, and self-concept. They found that teacher's scaffolding during small group block play (e.g., encouraging further thinking, modeling) was positively correlated with children's stability knowledge ($r = .16$, $p < .01$). Given that spatial skills are essential for navigating different environments (Vasilyeva & Lourenco, 2010) and understanding the world (Verdine et al., 2017), and that spatial skills co-develop with math skills (Cheng & Mix, 2014; Geer et al., 2019), it is important to explore possible predictors of spatial skill development.

Executive Function. EF consists of a core set of effortful cognitive skills, including working memory, inhibitory control, cognitive flexibility, and planning that support goal-directed behavior (Allain et al., 2002; Carlson et al., 2013; Diamond, 2013; Welsh et al., 1991; Welsh et al., 2010). Working memory as the ability to mentally hold information and manipulate it (e.g., look at a picture of a wooden block structure and recreate it with your own blocks). Inhibitory control is managing one's thoughts, behavior, and attention to do what is more appropriate despite external factors (e.g., staying engaged in a learning task while peers are off task). Cognitive flexibility manifests in several ways. It is used to shift from one task/priority to another or to shift one's perspective or point of view (e.g., "my friend must have felt sad when

his block tower toppled down"; Diamond, 2013). Planning is a higher-order EF and is defined as organizing one's thoughts and behaviors into a sequence of steps to achieve a goal (Allain et al., 2005; Jones et al., 2016; Luria, 1978; Ponitz et al., 2009).

A large body of research provides evidence of the importance of EF across development (Ahmed et al., 2021; McClelland & Tominey, 2014; Morgan et al., 2019; Schmitt et al., 2017; Schmitt et al., 2023). For instance, early EF skills are associated with academic achievement in preschool, elementary school, and higher education (McClelland & Tominey, 2014; Morgan et al., 2019; Schmitt et al., 2017), and they predict later socioeconomic outcomes in adulthood (e.g., educational attainment and income; Ahmed et al., 2021; Schmitt et al., 2023).

Teacher-child interactions are also important for young children's EF development (Sankalaite et al., 2021). Specifically, classrooms with supportive teacher-child relationships and responsive interactions provide a safe space in which children practice regulating attention, behavior, and emotions with adult guidance (Blair, 2016; Hamre & Pianta, 2007). Researchers have also found that high-quality emotional and instructional support from teachers is related to stronger EF skills in young children, as these environments foster children's ability to manage impulses, sustain attention, and flexibly adapt to classroom demands (Bierman et al., 2008; McClelland & Cameron, 2011). One way that teachers promote EF is through co-regulation strategies that model planning and problem solving (Diamond, 2013; Rimm-Kaufman et al., 2009). Teachers who structure classrooms with predictable routines and expectations support children's growth in EF (Blair & Raver, 2015; Williford et al., 2013). In addition, teachers' emotional and instructional support helps children to manage impulses, maintain attention, and adjust to classroom demands (Bierman et al., 2008; Blair & Raver, 2015; McClelland & Cameron, 2011; Williford et al., 2013). Overall, evidence suggests that positive teacher-child

interactions, particularly those emphasizing warmth, responsiveness, and instructional scaffolding, contribute to the development of EF in early childhood (Cadima et al., 2016; Hamre et al., 2014; Ursache et al., 2012).

Scaffolding as a Mechanism

Scaffolding has been found to support a wide range of developmental outcomes in early childhood (e.g., Fox et al., 2024; Rimm-Kaufman et al., 2009). In preschool classrooms, teachers provide scaffolding by modeling problem-solving, offering prompts or cues, asking guiding questions, and structuring tasks to support children's emerging skills (Diamond, 2013; Rimm-Kaufman et al., 2009). These strategies help children reach goals that are just beyond their independent ability, and they enable children to internalize skills. In math learning, teachers have used scaffolding to guide children to notice key problem features, explain their thinking, and apply concepts to new situations (Nair et al., 2024; Trawick-Smith et al., 2016). Though research on teacher scaffolding for spatial skills development in young children is limited (Berson et al., 2023; Schmitt et al., 2024), other researchers have found that parent scaffolding also promotes spatial skills by modeling spatial language use and helping children visualize and mentally manipulate objects (Foster & Hund, 2012; Fox et al., 2024). For example, Foster and Hund (2012) found that parent scaffolding with spatial language was positively related to preschool children's use of spatial language (i.e., using "between" and "middle"; Foster & Hund, 2012).

Scaffolding is also important for the development of EF. For example, when teachers encourage children to verbalize their thinking, predict outcomes, or evaluate strategies, they strengthen cognitive flexibility and working memory processes (Curby et al., 2015; Morrison et al., 2010; Rimm-Kaufman et al., 2009). Over time, children internalize these skills and use them independently (Cadima et al., 2016; Hamre et al., 2014; Ursache et al., 2012). Scaffolding within

classrooms can occur during any type of learning arrangement (e.g., whole group, small group, independent work). Guided play, in particular, provides natural contexts for teachers to observe children and intervene in response to their needs.

Guided play balances adult-directed goals for the play session with child agency in how they play (Hirsh-Pasek et al., 2009; Weisberg et al., 2013). Teachers facilitate learning without overtly managing children's play behavior with scaffolding strategies like prompting and asking questions (Cekaite & Simonsson, 2025). Guided play has been found to support young children's learning outcomes, including math, spatial, and EF skills (Fisher et al., 2013; Schmitt et al., 2025). Thus, the present dissertation builds on this research by examining scaffolding within a play-based block intervention while focusing specifically on the frequency, type, and level of scaffolding behaviors as predictors of children's outcomes.

Block Play Context

Blocks have been a popular educational and play tool since at least 1693 when John Locke, an English philosopher, wrote about wooden alphabet blocks used in educational contexts (Locke, 1693). Blocks of different materials (e.g., wood, cardboard, plastic) are common in preschool classrooms (Hirsch, 1974; Yelland, 2011) and have been well researched in relation to children's math (Ramani et al., 2014; Schmitt et al., 2018, 2025; Trawick-Smith et al., 2016; Verdine et al., 2014), spatial (Caldera et al., 1999; Casey et al., 2008; Cohen & Emmons, 2016; Gold et al., 2021), EF (Schmitt et al., 2018, 2025), social skills (Yelland, 2011), and creativity (Aksoy & Aksoy, 2023). Though past research is mixed on the effectiveness of explicit block play as a way to bolster children's academic skills (e.g., Ramani et al., 2014; Schmitt et al., 2025), blocks are prevalent for learning and constructive play (Tian et al., 2020). Block play in preschool classrooms happens in several ways. The teacher may use unit blocks or building

blocks during instruction, may assign children to a block center for a play rotation, or children may freely choose block play.

Block Play Intervention

Children from the originating study in which the data were generated for this dissertation participated in a block play intervention, and therefore, did not freely choose to play with blocks. Rather, children in the originating study were randomly assigned to one of the experimental conditions (i.e., semi-structured or free play) or the business-as-usual (BAU) condition. The two experimental block play groups are the focus of the dissertation. Children in the semi-structured and free play groups completed 16 sessions of group block play, two sessions each week for eight weeks, for an average of 15 minutes each session (range = 2–18 minutes). The semi-structured block play groups received a prompt of what to build each session. The prompts increased in complexity each session. Examples of the semi-structured prompts are "*Today, your job is to build a house together. I can't wait to see what your house looks like!* (Session 1)" and "*Today, I am going to show you a picture with a structure that I built on it. Your job is to work together to build the same structure you see in this picture (show picture)* (Session 16)." Free play block play was open-ended, child-directed play in which children were encouraged to build collaboratively but were not given a specific goal. The free play block play groups received the same prompt each session, which was "*Today your job is to build together. I can't wait to see what you build*."

Each semi-structured and free play group had three children, though some groups merged on days in which there were absences for a maximum of four children within the same condition in a session. Across all preschool sites, materials (i.e., three identical sets of wooden blocks) and intervention protocols were kept constant. The interventionists were trained research assistants

who had prior experience working with young children. In general, the interventionists facilitated the same groups throughout the 16 sessions, but occasionally, other interventionists would substitute on days when another interventionist was sick. In addition, at two preschools (five total groups), the interventionist was changed due to changes in the research assistants' schedules. More information regarding the full sample of the original study, the current study sample, and data collection procedures is found in the *Methods* section.

Prior research has found that structured play tasks that include clear goals or constraints elicit more adult guidance (Weisberg et al., 2013). Scaffolding in semi-structured groups may (a) occur more often because adults need to keep children oriented toward a specific outcome; (b) be more cognitively focused (e.g., supports targeted math, spatial, or structural reasoning); and (c) be more complex because successfully building a predetermined structure may require multi-step guidance. Thus, the structure of the semi-structured condition provides a context for higher rates and greater complexity of scaffolding than in free play groups. Compared to semi-structured contexts, free play contexts have greater child autonomy, though researchers have found that free play methods are not as effective at increasing preschool-aged children's cognitive skills as structured play methods (Martín-García & Rico-González, 2023). It may be possible that adults intervene during free play only when children disengaged in block play or encountered challenges in their own creations that they could not solve independently. As a result, scaffolding in free play groups may have been less frequent overall, but potentially were more individualized to children's needs for their own buildings in which they were invested. Accordingly, free play groups may have lower average scaffolding rates than semi-structured groups.

Adult Scaffolding During Block Play

In addition to setting up the block play area and delivering the session prompts, the adult interventionists were trained to allow children to self-direct their play. They were instructed to redirect children if they were disengaged from block play and to encourage them to build collaboratively. The interventionists (N = 10) were affiliated with or employed by the academic institution in which the block play intervention study originated and were not employed by the preschool centers where the block play sessions took place. Their role was to be a responsible adult who provided a structured task and supported children's engagement, learning, and peer interactions. Preschool teachers regularly facilitate these types of learning tasks, and thus, the findings from this dissertation may inform effective scaffolding strategies to support children's math, spatial, and EF skills.

Scaffolding Types. The block play intervention sessions elicited three major scaffolding responses from the interventionists: (1) engagement, (2) learning, and (3) peer interaction. Because interventionists were trained to redirect children back to block play if they were disengaged, many of their spoken phrases were for child engagement. To a lesser extent, some interventionists guided children through problem-solving if they were frustrated with building failure. In these instances, the interventionists scaffolded for children's learning about the math, spatial, or complexity components of block play. Finally, the interventionists encouraged children to build together because the intervention context was group block play. They encouraged collaboration by explicitly requesting that the children work together or by suggesting that their peers could help.

Types of scaffolding have also been defined in past research (Dominguez & Svihla, 2023; Winning et al., 2020). In a systematic review, Dominquez and Svihla (2023) categorized

scaffolding types into hard (planned supports) and soft (situation-specific supports). Winning and colleagues (2020) took an inductive approach when coding parent scaffolding and found six major types of scaffolding used in the context of family interactions in families with a youth with a chronic health condition. In line with these studies, the three types of scaffolding in the current dissertation reflect the context of the interventionist-child interactions and the functional relevance of the scaffolding strategies for teachers or other adults working with young children.

Scaffolding Complexity Levels. Differences in the complexity level of scaffolding were also apparent during the intervention sessions. Scaffolding complexity level can also be described as the strength of intervention or support the adult provides to the child (Hardy et al., 2021; Hermkes et al., 2018). For children who needed minimal support to reach their goal (e.g., simply engaging in block play, building a specific structure), interventionists provided a low-complex utterance such as "Keep building." Medium-complex scaffolding was given to children who needed additional support. For instance, if a child repeatedly tried and failed to balance narrow cylinders, the interventionist might encourage reflection and problem-solving (e.g., "I wonder if putting something underneath would help?"). These utterances help children connect cause and effect within their play. High-complex scaffolding utterances were multi-step, multi-phrase, and occurred when children needed the most support. Higher complexity level scaffolding may help children extend beyond what they can do independently by breaking down large obstacles into digestible steps.

Scaffolding complexity may moderate how scaffolding rate relates to children's outcomes. A high rate of low-complexity scaffolding may offer little substantive support, particularly in free play contexts where children generate their own goals. In contrast, a high rate of high-complexity scaffolding may provide in-depth support for children's development. Thus,

scaffolding complexity level may moderate the relation between scaffolding rate and child outcomes, such that higher complexity level scaffolding amplifies the benefits of frequent interventionist support. To examine the dynamics between scaffolding type, complexity level, and play condition more systematically, the dissertation focuses on four aims that assess the nature of scaffolding within the block play intervention and its implications for children's math, spatial, and EF skills. These aims are outlined below:

Aim 1

The first aim of this dissertation is to describe the scaffolding occurrence frequency and rate of scaffolding per minute over the course of the 16-session intervention by experimental condition, to clarify the rates of occurrence of each scaffolding type observed across all sessions and experimental groups, and to describe the average complexity level of adult scaffolding observed during the block play intervention across sessions and group conditions. Specifically, the research questions (RQ) are as follows: (1.1) what is the scaffolding frequency across all sessions for semi-structured and free play groups?, and (1.2) do the proportions of scaffolding type and average levels differ between the semi-structured and free play groups? I hypothesize that interventionist scaffolding occurred more frequently and were at a higher average complexity level in the semi-structured groups than the free play groups because the semi-structured groups were given a specific prompt each session that increased in complexity.

Aim 2

Second, this dissertation examines the association between scaffolding frequency (i.e., rate of exposure to scaffolding) and children's math, spatial, and EF outcomes. The research questions are twofold: (2.1) are higher scaffolding rates predictive of greater gains in child outcomes?, and (2.2) do these associations differ between the semi-structured and free play groups? I hypothesize that children's exposure to higher scaffolding rates per minute will predict

greater gains in children's math, spatial, and EF outcomes and that these associations are stronger in the semi-structured condition compared to the free play condition because the rate of scaffolding may be higher in semi-structured groups.

Aim 3

Third, this dissertation examines the association between scaffolding type (i.e., engagement, learning, and peer interaction) and child outcomes. The research questions are as follows: (3.1) is the exposure to a higher rate of a particular scaffolding type (i.e., engagement, learning, peer interaction) differentially related to children's math, spatial, and EF outcomes?, and (3.2) do these associations differ between the semi-structured and free play groups? Given the limited prior research comparing the effects of different scaffolding types across play contexts, there is insufficient evidence to posit directional hypotheses. Therefore, these analyses are exploratory, and I have no a priori hypotheses regarding which scaffolding type may be most strongly associated with children's outcomes or whether these associations will differ across experimental play conditions.

Aim 4

Fourth, this dissertation tests whether scaffolding level (i.e., complexity or depth of support) moderates the relation between scaffolding rate and child outcomes. Specifically, does scaffolding complexity level moderate the relation between scaffolding rate and child outcomes (RQ 4.1), and does this moderation differ between the semi-structured and free play groups (RQ 4.2)? I hypothesize that higher levels of high scaffolding complexity will strengthen the positive relation between scaffolding rate and child outcomes. In regard to RQ 4.2, I have no a priori hypothesis on how the moderation effects will differ between the semi-structured and free play groups.

CHAPTER II

METHODS

Study Design

This dissertation is an observational, secondary data analysis using existing transcript and video data from a randomized controlled trial (RCT). The present dissertation does not manipulate any variables. Naturally occurring interventionist scaffolding that took place during the intervention for the experimental groups (semi-structured and free play) was analyzed. This design allowed for investigation of real-world scaffolding practices without altering the original intervention implementation.

Data Source

The data for this dissertation comes from the National Science Foundation (NSF) – funded randomized control trial (RCT), "Examining the Causal Connections and Mechanisms Between Block Play and Mathematics." The original RCT tested the effects of a block play intervention with two experimental conditions, semi-structured and free play, and the control condition, or BAU on preschooler's math, spatial, and EF. The primary aims of the original intervention study were to (1) investigate the causal associations between different types of block play and math and spatial skills in preschoolers, and (2) identify potential mechanisms (e.g., EF) underlying these associations in a sample of children from low-income backgrounds. Data collection took place in preschool centers in two midwestern states. This dissertation restricts the subsample to only children who were in the semi-structured or free play groups (48 total groups). The data includes direct child assessments in early math skills (i.e., numeracy, cardinality), spatial reasoning, and EF (i.e., cognitive flexibility, working memory, inhibitory control, planning) at pre- and post-intervention. In addition, transcripts and videos from each session

were used to calculate the rate of exposure of interventionist scaffolding utterances, scaffolding types, and scaffolding complexity levels for each block play group.

Sample

The interventionists for each group were trained research assistants that included undergraduate and graduate students, a postdoctoral researcher, and paid research assistants. All interventionists had prior experience working with young children. The full sample of the original block play study was 242 children. There were 143 children in the experimental conditions (semi-structured $n = 72$, free play $n = 71$). Of these 143 children, 23 children spoke primarily in Spanish and had a Spanish-speaking interventionist. Due to staffing limitations (i.e., few fluent Spanish speakers) in transcribing and coding the Spanish videos and transcripts, scaffolding data from these groups were not included in the current analysis. Analyses will be repeated with the full experimental condition sample when coding is complete.

In addition, eight of the 143 children attritted either after random assignment to conditions happened or early during the eight-week intervention. Three children moved prior to starting the intervention, one child had chronic absences from school before the intervention and did not continue with the study, three children moved during the intervention and had six or less completed intervention sessions, and one child had chronic absences during the intervention and had two completed intervention sessions.

Therefore, the final analytic sample was 112 children (semi-structured $n = 57$, free play $n = 55$) after excluding the 23 children in Spanish-speaking groups and eight attritted children. Children were randomly assigned to experimental condition and small group within class, with three children in each group. Although small groups generally remained stable, if there were absences, interventionists could blend groups at their discretion such that children would stay in

the same condition (i.e., semi-structured or free play) and play with children from other assigned groups. Because of absences, groupings ranged from one child to four children across sessions. A full description of the sample of child participants, including race/ethnicity, average age and range, and parent education level is seen in Table 1.

Data Collection

All data collection was completed in one academic year. Pretesting occurred between September and November. The eight-week intervention occurred 4-6 weeks after pretesting occurred, between January and March. Posttests began two weeks after the intervention between March and May. Therefore, the number of weeks between children's pre and posttests was 12-16 weeks. The procedures for pretest and posttest were identical. Research assistants completed direct child assessments with all children (semi-structured, free play, BAU) in quiet spaces in preschool centers. Research assistants were blind to children's intervention condition. The complete battery of assessments took an average of 90 minutes to complete, and children tested for around 20-30 minutes per testing day.

Block play intervention sessions occurred for eight consecutive weeks and also took place in a separate space from the preschool classrooms. Some preschool sites had an extra room or office available for sessions, and others had a cornered area or cafeteria available. Research assistants set up the camera and wooden blocks on the floor before bringing the children to the space. Each group played with three complete block sets (150 blocks total), including columns, pillars, arches, triangles, rectangular prisms of varying dimensions, and half circles. The session prompts were administered in either English or Spanish, according to the child's language group; English- and Spanish-speaking participants were assigned to separate groups. For eight weeks, children in the semi-structured and free play conditions participated in block play sessions twice

a week. Sessions happened with at least one day in-between the first and second session of the week.

Research assistants uploaded session videos to Box™ - a secure, cloud-based storage. The videos were initially transcribed with a web-based software, Temi™. Then, research assistants further refined the initial transcripts. A second research assistant checked each transcript for accuracy and removed all identifying information from the transcript.

Coding Procedures

This dissertation used a systematic coding approach to analyze adult scaffolding during block play sessions. First, the statistical software, R version 2024.12.0+467, was used to extract all interventionist utterances from each transcript and to create Excel sheets that included each adult utterance as defined as a new timestamp or turn-of-phrase. R extracted the school name, unique group number, unique interventionist ID, timestamp, and utterance. Second, trained coders used the lists of utterances and identified instances of scaffolding. Third, they classified their type and complexity level, using the protocol developed to align with past studies that explored adult scaffolding (creation of scaffolding types: Dominguez & Svihla, 2023; Winning et al., 2020 ; scaffolding level: Hardy et al., 2021; Hermkes et al., 2018). See Appendix A for the full coding protocol.

Coders for this dissertation include the author as master coder and a team of eight other coders, which include undergraduate and graduate research assistants and one postdoctoral researcher. Each coder completed a one-hour training with the master coder, which included guidance through the protocol, being familiarized with the coding documents and organization, and collaboratively coding three to five example utterances. Coders were given the first set of five randomly chosen transcripts used for reliability testing. Percent agreement was chosen to

quantify intercoder reliability (ICR), as opposed to Cohen's kappa, because coding included a mix of binary and categorical variables (Feng, 2015; O'Connor & Joffe, 2020). Additionally, using percent agreement for ICR ensures methodological consistency across concurrent coding efforts on this data. This will facilitate comparability of coder performance across studies. Coders had to reach at least 80% agreement with the master coder before continuing to work independently. If the coder did not reach 80% agreement, they were given the second set of five randomly chosen transcripts. Each coder met with the master coder after completing the first set of reliability transcripts for group discussions and calibration. Through this process, the protocol was refined, and modifications to the coding procedure were relayed to all coders. On average, each coder was at least in 83% agreement with the master coder. For English transcripts, the master coder double coded 33% of each coder's transcripts to ameliorate drift during the coding phase. This exceeds recommendations for 10-25% of transcripts to be double coded for ICR (O'Connor & Joffe, 2020).

Coding Protocol

Coders were trained to identify three scaffolding types and three complexity levels of utterances. They were told that scaffolding is support given to a child by a more expert person (e.g., an adult or experienced peer) when the focal child cannot achieve a goal or master concepts independently (Vygotsky,1978). Based on the context of the block play intervention, three types of scaffolding instances were coded: scaffolding for engagement, scaffolding for block-related learning, and scaffolding for peer interaction.

The interventionists used scaffolding for engagement to encourage children to continue playing in either condition or engage with the semi-structured session goal. Engagement scaffolding includes two safety-related subcodes: *Block Safety* and *Other Safety*, with the

reasoning that if the interventionist was intervening for a safety reason, the children were not working towards the goal of the session. *Block Safety* refers to guidance related to using blocks safely, such as walking around rather than on them or building on the floor instead of tables. *Other Safety* captures non-block-related safety prompts, like reminding children to keep their fingers out of doorways. Though block safety and other safety utterances were coded, they were not included in analysis for parsimony (i.e., to reduce the number of parameters in each model). Interventionists used scaffolding for learning to promote math, spatial, or building structure understanding. Lastly, interventionists used scaffolding for peer interaction to encourage child-child collaboration or to manage social conflicts.

Coders assigned each scaffolding instance a level (low, medium, or high; see more details below) that conveys the complexity of support provided to the children. All scripted intervention prompts (Prompt A and B, extensions) or prompt variations in semi-structured and free play sessions were coded as non-scaffolding. These prompts are standardized instructional components and were not considered responsive scaffolding. The workflow for coders was to first read the adult utterance from the coding excel to make an initial decision on if the phrase was scaffolding. If this was not obvious, coders consulted the transcript to read the context of child and interventionist dialogue. If the coder still could not determine if an utterance was scaffolding, they watched the 30 seconds to one minute preceding the utterance to gain more contextual clarity. Coders did not watch each video in their entirety.

Ethical Considerations

All research assistants who coded data for this dissertation were CITI Program certified in human subjects research. Excel sheets used for coding and transcripts from the originating study were de-identified of children's and adult's names and any other identifying information.

Data for the current dissertation was kept in OneDrive, which is also a cloud-based file storage service, managed by the University of Oregon. Only the master coder and the seven other coders had access to this folder. The intervention videos are available for the coders if they cannot identify scaffolding based on the transcript dialogue context. These videos were stored securely on Box™, managed by Purdue University, where the block play intervention study originated. Access to the files is restricted to authorized personnel affiliated with the research project, including scaffolding coders, and all data handling procedures complies with university and IRB-approved data security protocols.

Measures

All math and EF measures used in this dissertation have been validated in low-income samples to ensure validity beyond white, middle-class populations in which measures have historically been validated (Math: Kung et al., 2021; Schmitt et al., 2025A; Schmitt et al., 2025B; EF: Baker et al., 2021; Bryant et al., 2024; Fernandes et al., 2022; Hughes et al., 2009; McClelland et al., 2019).

Dependent Variables Math

The Preschool Early Numeracy Skills – Brief Version (PENS). The PENS assessment evaluates young children's numeracy abilities (Purpura et al., 2015). It consists of 25 items arranged from easiest to most difficult. The measure assesses several domains of early number knowledge, including set and numeral comparisons, one-to-one correspondence, number order, numeral recognition, ordinality, and basic number combinations. Administration takes about five minutes.

For the first item, children are asked to count aloud as far as they can starting from one; responses are scored on a 0–5 scale, with a score of 5 representing the ability to count to five or

higher. For the remaining 24 items, children view pictures and either point to or verbally indicate their answer. Each correct response earns one point, and the assessment is discontinued after three consecutive incorrect answers. The total score now includes the counting item, resulting in a possible range of 0–29 (earlier versions excluded this item from the total score; see PENS-B documentation for details). Previous studies have demonstrated strong internal consistency for the measure (Purpura & Reid, 2016). Cronbach's alpha for pretest was .88, and posttest was .91.

Child Math Assessment (CMA). The CMA measures young children's understanding of shapes and geometric reasoning (Klein & Starkey, 2004). The assessment includes seven items divided into two subtests, shape identification (four items) and geometric reasoning (three items), and typically takes about 10 minutes to complete. Each correct response earns one point.

In the shape identification subtest, children view a page containing various shapes and are asked to indicate all examples of a specific shape (e.g., "Point to all of the squares and let me know when you're done"). Each of the four items is scored as correct (1) or incorrect (0). If a child incorrectly points to all shapes on the page on two consecutive items (an exhaustive pointing strategy), the subtest is discontinued, and the assessor proceeds to the next section.

During the geometric reasoning subtest, children are shown two triangles, one in front of them and one held by the assessor and are asked to identify corresponding sides between the two (e.g., "Point to the side of your triangle that matches this one"). The child's triangle remains in a fixed position, while the assessor's triangle is rotated or flipped on the second and third items, respectively. Each of the three items is scored 1 for a correct response and 0 for an incorrect response.

This subtest includes both a training rule and a stop rule specific to the first item. For training, if the child touches the assessor's triangle instead of their own, the assessor repeats the

prompt up to three times (once per side). If the child continues to touch the wrong triangle, the task is ended. For the stop rule, if the child fails to touch at least two of the three sides on the first problem (regardless of correctness), the task is also discontinued.

A total is the sum of correct responses across both subtests. Prior research indicates that the CMA demonstrates good validity and is a strong predictor of children's later academic achievement (Klein & Starkey, 2004). Cronbach's alpha in this sample was .78 for pretest and .67 for posttest.

Preschool Mathematical Language Assessment (PALM). The PALM assesses children's understanding of mathematical and spatial language in two domains: comparative language (e.g., combine, more, less, take away) and spatial language (e.g., near, far, before; Purpura & Logan, 2015; Purpura & Reid, 2016). There are 19 items. For each item, children are shown a picture and asked to point to the image that matches the target word or phrase. Children receive one point per correct response; thus, scores range from 0 to 19. Prior studies have found the PALM to exhibit strong internal consistency (Purpura & Logan, 2015). Cronbach's alpha for pretest was .90, and posttest was .90.

Numeral Identification Task. The Numeral Identification (NUMID) task measures children's ability to recognize and name written numerals (Purpura & Lonigan, 2015). Children are shown nine number flashcards, one at a time, and asked to identify each numeral (e.g., "What number is this?"). Administration typically takes about five minutes. Each correctly identified numeral receives one point, for a total possible score ranging from 0 to 9. Cronbach's alpha for pretest was .87, and posttest was .88.

Cardinality Task. The Cardinality (CRDN) task assesses children's quantity knowledge and their counting skills (Purpura & Lonigan, 2015). Children are asked to give a smaller set of

blocks to the assessor from a pile of 10 (e.g., “Can you give me four blocks?”). They are also asked to present amounts of 3, 4, and 6 from this group. Next, they are given 10 more blocks (20 total) and asked to count out sets of 16, 8, and 11. The assessment takes approximately five minutes to administer. Children earn one point for each correctly counted subset with a possible score range of 0–6. Cronbach’s alpha for pretest was .81, and posttest was .80.

Dependent Variable Spatial Reasoning

Test of Spatial Assembly (TOSA). The TOSA assesses children’s spatial assembly and visualization skills by testing their ability to construct two- and three-dimensional structures based on visual models (Verdine et al., 2014a; Verdine et al., 2014b; Verdine et al., 2017). During the task, children recreate models shown to them, first in two dimensions and then in three dimensions. The two-dimension portion of the assessment includes seven items (one practice and six scored). For each item, children are shown an image of a two-dimensional model composed of two to four uniquely shaped pieces and are asked to arrange their pieces to match the model. Scoring is based on three components: accuracy of adjacent piece placement, horizontal and vertical alignment, and relative position. Depending on model complexity, each item is scored from 0 to 10, yielding a total possible score of 35.

The three-dimension portion also includes seven items (one practice and six scored). Children are provided with LEGO® bricks and asked to reproduce a three-dimensional model that varies in complexity (two to four pieces). Scoring for each model is based on three aspects of spatial accuracy: vertical placement, rotation, and translation. For more complex models containing three or more pieces, subset scores are also calculated using the same criteria. Item scores range from 0 to 8, subset scores from 0 to 3, and total scores from 0 to 46. Detailed

administration and scoring guidelines are available in the TOSA manual (Verdine & Golinkoff, 2018). Cronbach's alpha at pretest was .83 and was .80 at posttest.

Dependent Variable EF

Day-Night Stroop Task (DNS). The DNS assesses children's inhibitory control that involves focusing attention and suppressing automatic responses (Gerstadt et al., 1994). In this task, children are shown picture cards depicting either the sun or the moon and are instructed to say the opposite word, responding "night" for the sun card and "day" for the moon card.

The task begins with three practice trial sets, each consisting of two items. To proceed to the main testing phase, children must respond correctly to both items within a trial. If they make an error during the first trial, the assessor provides a reminder, and the child attempts the second trial; the same procedure applies if errors occur again during the second trial. After the third trial, children advance to the test phase regardless of performance, with the highest combined score from any of the three trial sets included in their final score.

During the testing phase, responses are scored as follows: 2 points for a correct answer, 1 point for a self-corrected or near-correct response, and 0 points for an incorrect or missing response. Total possible scores range from 0 to 32. Cronbach's alpha at pretest was .89 and was .92 at posttest.

Dimensional Change Card Sort (DCCS). The DCCS task assesses cognitive flexibility, which is a child's ability to shift attention and adapt to changing rules or task demands (Zelazo, 2006). The task begins with two practice trials, during which children receive positive feedback for correct responses and reminders of the sorting rules for incorrect ones. In the testing phase, children are asked to sort cards into boxes according to varying rules across three sections—first by shape, then by color, and finally by size. In the final section, an additional challenge is

introduced: children must remember and apply two sorting rules depending on whether the cards have a border (e.g., "If the card has a border, sort by color; if it does not, sort by shape").

The assessment includes 24 test items in total, with one point awarded for each correct response. Testing is discontinued after the third section (prior to the border condition) if the child makes more than one error within that section. Total scores range from 0 to 24. Cronbach's alpha at pretest was .93 and was .94 at posttest.

Tower of Hanoi Task (TOH). The TOH task assesses complex planning skills (ability to plan and execute a sequence of steps to achieve a goal; Carlson et al., 2004). Children are told they will play a game using wooden disks that represent monkeys—the smallest disk is the "baby monkey," the medium disk is the "little monkey," and the largest disk is the "big monkey." The three pegs used to move the disks are described as "trees." Both the researcher and child have identical sets of materials, allowing the child to view the researcher's configuration as a model to replicate.

The task includes six trials, with increasing difficulty across trials. Each trial allows for two attempts: if a child fails to complete a configuration on the first try, the researcher repeats the trial once more. The stop rule is enacted if the child fails the same trial twice. The beginning of the assessment requires simpler planning (e.g., two disks requiring a single move), and later trials require more complex planning (e.g., three disks and four moves). Scores represent the total number of successfully completed trials, ranging from 0 to 6. Cronbach's alpha at pretest was .68 and was .64 at posttest.

Head-Toes-Knees-Shoulders Task. The Head-Toes-Knees-Shoulders direct assessment (HTKS; McClelland & Cameron, 2011) assesses children's working memory, cognitive flexibility, and inhibitory control in overt behavior through a game where they are asked to

respond oppositely to directions such as “touch your head” and “touch your toes.” The HTKS has three testing sections, each becoming increasingly complex, and begins with a set of practice items. Children must score four or more out of 10 items in each testing section to proceed to the next section. Each item is scored as 0 (incorrect), 1 (self-corrected), or 2 (correct). The scores used for analysis include the practice items and test items to increase variability in this sample of children facing sociodemographic risk (Ponitz et al., 2009). Scores can range from 0 to 94. Cronbach’s alpha at pretest was .97 and was .98 at posttest.

Independent Variables

Scaffolding Frequency. Scaffolding frequency is children’s rate of exposure to scaffolding instances over the course of the 16-session intervention. This variable is continuous. The total count of scaffolding utterances was divided by the total number of minutes each child participated in intervention sessions over 16 sessions.

Scaffolding Type. The three types of scaffolding in this dissertation include (1) engagement, (2) block-related learning, and (3) peer interaction. Scaffolding for engagement included instances in which the interventionist intervened on children’s behavior to redirect them back to block play or the specific goal of the session. Interventionists used scaffolding for block-related learning to help children understand the properties of the blocks (e.g., 3-D shape names, functions of the shapes), building construction and complexity (e.g., balancing blocks, building structures in the physical space), and math and spatial skills (e.g., counting blocks, recognizing orientation of blocks). Scaffolding for peer interaction happened when the interventionist intervened to stop negative peer interactions, facilitate positive peer interactions, or to encourage collaborative block-building. This type of scaffolding in the present dissertation includes block-

related peer interaction and non-block-related peer interactions, such as speaking kindly or being considerate of others.

Each scaffolding utterance was coded as one or more types. Scaffolding types were not mutually exclusive, and it was possible for an utterance to be categorized as two or three types. For example, “We're just helping each other build. What block do you wanna add to the giant robot?” is coded as scaffolding for engagement and for peer interaction. Each scaffolding type was made into a dichotomous variable (0 = not present; 1 = present). Scaffolding rates by types (i.e., engagement, learning, peer interaction) were created across the intervention for each block play group. For example, *Rate of Engagement Scaffolding = Total Engagement Scaffolding Exposure Count/Child’s Total Dosage (minutes)*. Calculating rates per minute allowed each type of scaffolding to be an independent predictor, though a scaffolding utterance could be coded as more than one type.

Scaffolding Complexity Level. Scaffolding complexity level was coded as low, medium, or high (coded as 1, 2, 3, respectively). Complexity levels medium and high were collapsed into one grouping due to low counts of high-level scaffolding instances. Thus, scaffolding complexity level is a dichotomous variable which represents low and medium/high levels.

Low complexity level scaffolding is characterized as being a simple prompt with minimal guidance from the interventionist (e.g., “Remember, we don’t knock down our friend’s buildings”). High complexity level scaffolding is characterized as guided prompts that require children to make connections between their current activity and the goal of the session (e.g., “What are you gonna add next?”). Many times, interventionists asked questions to provide medium complexity level scaffolding such as “Does your structure look like the flat rocket in the

picture?" In addition, high complexity level scaffolding is characterized as using complex prompts, which involve multi-step problem solving. Interventionists used high complexity level scaffolding when prompting children to connect their structure with the goal and to extend support for other building challenges children could not solve alone (e.g., "Okay. Back to work. What are we building today, guys? Come take a seat by our blocks... What else are you gonna build? Okay, take a seat."). High complexity level scaffolding is used when children need the most support.

Covariates

Covariates were selected based on prior research linking child, family, and contextual factors to early cognitive outcomes and adult-child interactions. All models adjusted for child age at pretest (Zelazo et al., 2008), child sex, race/ethnicity, parent education level (Levine et al., 2010; Noble et al., 2007), corresponding baseline outcome scores (e.g., adjust for PENS at pretest for the PENS outcome; Duncan et al., 2007), and pretest receptive vocabulary skills with the National Institutes of Health (NIH) Toolbox Picture Vocabulary Test (PVT; Weintraub et al., 2013). These variables are associated with children's math, spatial, and EF and responsiveness to scaffolding (Blair & Raver, 2015; Hoff, 2013). The NIH PVT provides a direct assessment of children's receptive vocabulary (Weintraub et al., 2013). The task presents a spoken word while displaying four corresponding images depicting objects, actions, or concepts on a touchscreen device. Children are asked to select the image that best matches the word they hear. Each assessment item depended on children's response on the previous item (i.e., Computer Adaptive Testing). Thus, theta scores calculated through the NIH PVT application were used. The PVT has demonstrated strong discriminant and convergent validity among children ages 3 to 15 and is widely used as a reliable indicator of receptive language ability (Weintraub et al., 2013).

Analytic Strategy by Specific Aim

Assessment of Levels and Data

Intraclass correlation coefficients (ICCs) and design effects (DEs) were calculated for all outcome measures (Math: PENS, CMA, PALM, CRDN, NUMID; Spatial: TOSA; EF: DNS, DCCS, TOH, HTKS) to assess the extent to which variance in the outcomes is due to clustering in block play groups (Level 2) and classrooms (Level 3) in R version 2024.12.0+467. First, I fit unconditional (outcome only) three-level models, which automatically assessed two-level models as well. Second, I calculated ICCs to assess the proportion of total variance at each level. As a guideline, ICCs over .05 and DEs over 2 were interpreted as having meaningful clustering at that level. If an ICC was under .05 and the DE is under 2, models were to be conducted as single-level linear models with multiply imputed data (Lai & Kwok, 2015). To account for negligible clustering by classroom or block play group, standard robust errors were used. Linear regression assumptions were checked using the following tests: diagnostic plots (linearity), Shapiro-Wilk normality test (normality of residuals), Breusch-Pagan test (homoscedasticity), Variance Inflation Factor test (VIF; no evidence of multicollinearity), and Cook's Distance test (no influential outliers).

Scaffolding predictor variables were coded at the group level. If all children in a group were present for all sessions, their exposure to scaffolding would be equal. In this sample, absences were common due to COVID-19-related illnesses, typically occurring absences, or children's refusal to participate in a session. Similarly, in some sessions, children opted to leave the block play session before the end of the session. Thus, dosage was measured at the child level, with minutes being measured from the moment the interventionist finished giving the prompt to the end of the play session for each session.

Analyses for each aim were preregistered on Open Science Framework as separate regression models for each outcome variable. Prior to analysis, I also examined intercorrelations among math measures and among the EF measures to assess whether measures within the math domain and EF domain were sufficiently related to justify composite variables. These are reported in a supplemental analysis, as written in the preregistration. The domain of spatial reasoning has one assessment; therefore, a composite variable was not applicable.

Aim 1

To address Aim 1 (*To describe the frequency and complexity level of adult scaffolding observed during the block play intervention*), descriptive statistics were calculated to summarize scaffolding frequency across the full sample and by play condition (semi-structured vs. free play), including mean, standard deviations, range (minimum and maximum), and frequencies of scaffolding instances. The independent sample t-test equivalent Wilcoxon test (i.e., Mann-Whitney U) was used to verify if scaffolding conditions differed by intervention condition.

Aim 2

To address Aim 2 (*To examine the association between scaffolding frequency and children's math, spatial reasoning, and EF outcomes*), scaffolding frequency was operationalized as the total number of adult scaffolding instances observed during a child's total sessions, divided by the total number of minutes the child participated (i.e., scaffolding rate per minute). This rate served as the primary predictor. Child outcomes included all math, spatial reasoning, and EF measures assessed at post-intervention. All continuous predictor variables were grand-mean centered, including scaffolding rate per minute, child age, pretest scores, and pretest vocabulary, to make regression coefficients interpretable at the average level of all predictors across the full sample.

For RQ 2.1, each child outcome measure was regressed onto the rate of scaffolding per minute (i.e., 10 models). Covariates included in these models were age at pretest, child sex, race/ethnicity, parent education level, corresponding pretest outcome scores, and pretest vocabulary skills. For RQ 2.2, models included an interaction term between scaffolding rate per minute and experimental condition (semi-structured vs. free play) to test whether the strength of associations differs by group. To control the false discovery rate across multiple simultaneous hypothesis tests, the Benjamini–Hochberg procedure was applied to *p*-values within each research question for aims 2, 3, and 4 (Benjamini & Hochberg, 1995).

Aim 3

To address Aim 3 (*To examine the association between scaffolding type and children's math, spatial, and EF outcomes*), each child outcome measure was regressed onto the child's rate (the group rate) of each type (i.e., engagement, learning, peer interaction) of scaffolding, adjusting for all covariates (RQ 3.1). All continuous predictor variables were grand-mean centered. For RQ 3.2, interaction terms of the rate of a type times the group condition were included in each model. To avoid multicollinearity and over-fitting models due to multiple interaction terms, moderation models were separated by scaffolding type. In other words, three models (one for each scaffolding type and corresponding interaction term) for each outcome were tested. The rates were grand-mean centered so that the main effects may be interpreted at average rates for RQ 3.2. Significant interactions and interactions with unadjusted *p*-values at or below .10 were probed using simple slopes analysis. The regression equation was as follows for RQ 3.2:

$$\widehat{Outcome}_{ij} = \beta_0 + \beta_1 RateType_{ij} + \beta_2 SemiStructured_{ij} + \beta_3 \text{Age}_{ij} + \beta_4 Sex_{ij} + \beta_5 Race_{ij} + \beta_6 ParentEd_{ij} + \beta_7 PretestOutcome_{ij} + \beta_8 PretestVocab_{ij} + \beta_9 RateEngagement_{ij} * SemiStructured_{ij}$$

Aim 4

To address Aim 4 (*To test whether scaffolding complexity level moderates the relation between scaffolding rate and children's math, spatial, and EF outcomes*), scaffolding complexity levels (low and medium/high) counts were used to create rates per minute. For RQ 4.1, each child outcome measure was regressed twice (with either low or medium/high scaffolding complexity rates) onto scaffolding rate, complexity level rate, and their interaction terms (scaffolding rate × level 1 or scaffolding rate × level 2), adjusting for all covariates. Significant interactions would indicate that the association between scaffolding frequency and outcomes depends on the complexity level of scaffolding provided. The regression equations were as follows with race dummy-coded with the largest grouping, White, as the reference group:

$$\widehat{Outcome}_{ij} = \beta_0 + \beta_1 ScafRate_{ij} + \beta_2 LevelLow + \beta_3 SemiStructured_{ij} + \beta_4 \text{Age}_{ij} + \beta_5 Sex_{ij} + \beta_6 Race_{ij} + \beta_7 ParentEd_{ij} + \beta_8 PretestOutcome_{ij} + \beta_9 PretestVocab_{ij} + \beta_{10} ScafRate_{ij} * LevelLow_{ij}$$

$$\widehat{Outcome}_{ij} = \beta_0 + \beta_1 ScafRate_{ij} + \beta_2 LevelHigh + \beta_3 SemiStructured_{ij} + \beta_4 \text{Age}_{ij} + \beta_5 Sex_{ij} + \beta_6 Race_{ij} + \beta_7 ParentEd_{ij} + \beta_8 PretestOutcome_{ij} + \beta_9 PretestVocab_{ij} + \beta_{10} ScafRate_{ij} * LevelHigh_{ij}$$

For RQ 4.2, to test whether this moderation effect differs by experimental condition (i.e., a moderated moderation or cascaded moderator analysis; Hair et al., 2021; Henseler & Fassott, 2010), a three-way interaction was included in each model (scaffolding rate × level rate × condition). Significant and marginal three-way interactions with unadjusted *p*-values were

probed using simple slopes to interpret how the moderation of scaffolding frequency by complexity level differs between conditions. For each outcome, two models were created: one that included the rate of low level scaffolding complexity and one that included the rate of medium/high level scaffolding complexity. The regression equations were as follows with race dummy-coded with the largest grouping, White, as the reference group:

$$\widehat{Outcome}_{ij} = \beta_0 + \beta_1 ScafRate_{ij} + \beta_2 LevelLow + \beta_3 SemiStructured_{ij} + \beta_4 Age_{ij} + \beta_5 Sex_{if} + \beta_6 \text{Race}_{ij} + \beta_7 ParentEd_{ij} + \beta_8 PretestOutcome_{ij} + \beta_9 PretestVocab_{ij} + \beta_{10} ScafRate_{ij} * LevelLow_{ij} + \beta_{11} ScafRate_{ij} * SemiStructured_{ij} + \beta_{12} LevelLow_{ij} * SemiStructured_{ij} + \beta_{13} ScafRate * LevelLow_{ij} * SemiStructured_{ij}$$

$$\widehat{Outcome}_{ij} = \beta_0 + \beta_1 ScafRate_{ij} + \beta_2 LevelHigh + \beta_3 SemiStructured + \beta_4 Age_{ij} + \beta_5 Sex_{ij} + \beta_6 \text{Race}_{if} + \beta_7 ParentEd_{ij} + \beta_8 PretestOutcome_{ij} + \beta_9 PretestVocab_{ij} + \beta_{10} ScafRate_{ij} * LevelHigh_{ij} + \beta_{11} ScafRate_{ij} * SemiStructured_{ij} + \beta_{12} LevelHigh_{ij} * SemiStructured_{ij} + \beta_{13} ScafRate * LevelHigh_{ij} * SemiStructured_{ij}$$

Because 10 child outcomes were tested, multiple comparisons were accounted for using the Benjamini-Hochberg procedure to minimize Type I error (the false discovery rate at 5% across each set of related analyses). All continuous predictor variables, including scaffolding rate, were grand-mean centered to aid the interpretability of main effects and interactions.

Missing Data Handling

Missing data was addressed using multiple imputation (MI) under the assumption that data were missing at random (MAR; Little & Rubin, 2020). MI was performed using the mice package in R (van Buuren & Groothuis-Oudshoorn, 2011), generating 20 imputed datasets with

predictive mean matching (PMM). Imputation models included all analytic variables, including outcomes, predictors, and covariates. Results were pooled across imputed datasets using Rubin's rules, which were automatically calculated by using the pool command in the mice package. This approach retains sample size and provides less biased estimates than listwise deletion (when MAR is identified).

Statistical Power

A sensitivity power analysis using G*Power (Faul et al., 2007) was conducted to determine the adequacy of the sample size to detect meaningful effect sizes given the number of predictors of the most complex models (i.e., research question 4.2 with a three-way interaction and all two-way interaction combinations). At $\alpha = .05$ and power = .80, and with a sample size of $n = 112$, this dissertation has adequate power to detect small-to-medium effects ($f^2 = 0.072$).

CHAPTER III

RESULTS

Sample Descriptives

The analytic sample included 112 preschool children (M_{age} = 53.39 months, *SD* = 6.29, 44% female). Parent-reported race and ethnicity of their children indicated that 40% were White, 19% identified as Hispanic/Latino, 16% were Asian, 16% were multiracial or other, and 8.6% were Black or African American. Highest level of parent education was normally distributed. See Table 1 for full demographic characteristics.

Table 1

Demographic Characteristics

	N	Missing	% / Mean (SD)	Min	Max
Child Characteristics					
Age at preschool entry (months)	112		53.39 (6.29)	36.94	63.39
Female	111	1	44%		
Race/Ethnicity	105	7			
Asian	17		16.19%		
Black/African American	9		8.57%		
Hispanic/Latino	20		19.05%		
Multiracial/Other	17		16.19%		
White	42		40.00%		
Family Characteristics					
Parental education	103	9			
8th grade/less	5		4.46%		
Some High school	13		11.61%%		
GED	8		7.14%		
High school diploma	27		24.11%		
Some college	19		16.96%		
Associates degree	8		7.14%		
Bachelor's degree	18		16.07%		
Master's degree	4		3.57%		
Doctoral/Postgraduate degree	1		0.89%		

Note. GED = General Educational Development.

Preliminary Results

Little's MCAR test indicated that missing data was MCAR ($\chi^2(133) = 130.73$, $p = .539$), and multiple imputation was used, given the small sample size of the dissertation. Data for child outcome variables at pre and posttest ranged from .89% to 8.93% missing (see Table 2). Scaffolding predictor variables, including scaffolding rate, rates of scaffolding types and levels, did not have missing data (see Table 3). Semi-structured and free play groups were largely equivalent in baseline outcome scores, though two sample t-tests identified two measures in which the free play condition scored higher. Children in the free play condition scored marginally higher on the CMA pretest ($t(109.96) = 1.95$, $p = .054$) and significantly higher on the CRDN task pretest ($t(109.35) = 2.74$, $p = .043$) than children in the semi-structured condition. All regression estimates from the 20 multiply imputed datasets were pooled using Rubin's Rules.

Evaluation of the multilevel structure of the data showed that some variance of the CMA (math) outcome was due to small group clustering (ICC = .100, DE = 1.17), and some variance in the DCCS (EF) outcome was due to clustering by classroom (ICC = .096, DE = 1.435). DEs for both outcomes were less than two, so multilevel modeling was not necessary (Lai & Kwok, 2015). Instead, regression models were conducted using the linear model function with cluster-robust standard errors (CR2; Pustejovsky & Tipton, 2018) to account for modest clustering and violations of regression assumptions. CR2 standard errors do not require homoskedasticity or normality of residuals, and they derive estimates based on the actual pattern of residuals in the data. Regression assumption tests confirmed that the multiply imputed math outcomes of PENS, CMA, and CRDN met all assumptions. The PALM, NUMID, DCCS, and TOH outcomes violated the normality assumption, and the DNS, HTKS, and TOSA violated both the normality

and homoskedasticity assumptions. Four out of 10 intercorrelations of the math outcomes were greater or equal to 0.6 and significant at $p < .05$. The other five significant math intercorrelations were moderate (range = .29-.59). One math intercorrelation was not significant — CMA and NUMID, though it was marginal ($r = .19$, $p = .051$). Intercorrelations of the four EF outcomes were moderate and ranged from $r = .25$-.57. Therefore, a math composite score was created with PENS, PALM, NUMID, and CRDN and used in models for research questions 2.1, 2.2., 3.1, 3.2, 4.1, and 4.2. These math composite models were analyzed using the same multiple imputation and CR2 cluster-robust standard errors as the primary models. Results are found in Appendix B.

Table 2

Descriptive Statistics for Child Outcome Variables at Pretest and Posttest by Condition

	Free Play				Semi-Structured				% Missing	
	Pre (n = 55)		Post (n = 50)		Pre (n = 57)		Post (n = 55)			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	Pre	Post
Math										
PENS	12.80	6.22	15.44	6.39	11.35	6.49	14.73	7.12	0.0	6.3
CMA	4.00	2.03	4.40	1.81	3.25	2.06	3.80	1.80	0.0	6.3
PALM	9.71	3.77	10.72	3.57	8.68	4.08	10.46	3.92	0.0	7.1
NUMID	4.55	2.71	5.96	2.79	3.48	2.75	4.98	2.95	0.9	7.1
CRDN	2.55	1.83	3.10	1.83	1.61	1.76	2.62	1.93	0.0	7.1
Spatial										
TOSA	54.15	11.58	60.94	12.51	52.74	13.42	60.28	13.27	0.0	8.0
EF										
DNS	18.82	10.54	23.96	8.40	19.77	7.73	22.72	9.01	0.0	8.0
DCCS	10.89	5.92	13.56	6.66	10.11	5.88	12.80	6.32	0.0	6.3
TOH	2.13	1.96	2.82	1.93	1.91	1.50	1.91	1.53	0.0	7.1
HTKS	17.24	24.48	33.16	31.15	14.86	21.87	26.96	27.97	0.0	8.9
Covariate										
PVT	−6.17	1.70			−6.32	2.00			0.0	

Note. PENS = Preschool Early Numeracy Scale; CMA = Child Math Assessment; PALM = Preschool Mathematical Language Assessment; TOSA = Test of Spatial Assembly; DNS = Day-Night Stroop; DCCS = Dimensional Change Card Sort; TOH = Tower of Hanoi; HTKS = Head-Toes-Knees-Shoulders; PVT = Peabody Vocabulary Test (pretest only theta score). % Missing = percentage of total sample (N = 112) with missing data. Sample sizes reported reflect modal n per condition and timepoint.

Table 3

Descriptive Statistics for Scaffolding Variables by Condition

	Free Play (n = 55)					**Semi-Structured** (n = 57)				
	M	*SD*	*Med*	Skew	Kurt	*M*	*SD*	*Med*	Skew	Kurt
Scaf count	107.20	52.30	88.00	0.75	−0.03	153.56	78.63	144.00	0.78	0.09
Scaf Rate	0.60	0.36	0.55	1.15	1.54	0.73	0.46	0.69	0.33	−0.31
Scaf type										
Eng count	60.40	33.20	55.00	1.00	0.08	99.40	56.01	83.00	0.55	−0.96
Eng rate	0.35	0.25	0.29	1.59	3.00	0.47	0.34	0.38	0.58	−0.40
Learn count	14.53	18.10	10.00	2.47	6.81	21.60	22.54	17.00	1.22	0.65
Learn rate	0.08	0.11	0.05	2.76	7.69	0.11	0.12	0.08	1.11	0.23
Peer count	25.58	20.26	21.00	0.53	−0.76	36.98	24.77	37.00	0.36	−0.85
Peer rate	0.14	0.12	0.14	0.60	−0.29	0.18	0.13	0.19	0.14	−1.18
Complexity level										
Low rate	0.40	0.30	0.36	1.17	1.53	0.44	0.30	0.40	0.69	0.36
Med/High rate	0.14	0.12	0.14	0.60	−0.29	0.18	0.13	0.19	0.14	−1.18

Note. Scaf = Scaffolding. Rate = Count divided by total session length in minutes. Eng = Engagement scaffolding excluding safety-related instances. Low = Level 1 complexity scaffolding rate; Medium/High = Levels 2 and 3 combined. Med = median; Kurt = kurtosis.

Table 4

Zero-Order Correlations Among Study Variables

Panel A. *Posttest Outcomes*

	1	2	3	4	5	6	7	8	9	10
1. PENS	—									
2. CMA	.32**	—								
3. PALM	.69***	.41***	—							
4. NUMID	.63***	.19	.43**	—						
5. CRDN	.70***	.29**	.59***	.73***	—					
6. TOSA	.44***	.31	.31	.23	.25	—				
7. DNS	.36*	.30	.40*	.30	.43**	.26**	—			
8. DCCS	.52***	.39**	.56***	.40**	.56***	.29**	.44***	—		
9. TOH	.35	.34	.32	.24	.37*	.25*	.25**	.26**	—	
10. HTKS	.70***	.32	.68***	.45***	.58***	.29**	.43***	.57***	.37***	—

Panel B. *Outcomes and Scaffolding Variables*

	Scaf Rate	Eng Rate	Learn Rate	Peer Rate	Low Rate	Med/High Rate
PENS	-.09	-.15	-.15	-.01	-.15	-.01
CMA	-.12	-.19	-.02	.06	-.14	.06
PALM	-.13	-.21*	-.12	-.01	-.01	-.01
NUMID	-.12	-.17	-.13	-.17	-.08	-.17
CRDN	-.09	-.13	-.16	-.06	-.11	-.06
TOSA	-.15	-.22*	-.05	-.08	-.22*	-.08
DNS	-.01	-.11	-.01	.03	-.05	.03
DCCS	-.02	-.06	-.03	.06	-.08	.06
TOH	-.15	-.13	-.15	-.05	-.25*	-.05
HTKS	-.13	-.17	-.13	.00	-.04	.00

Panel C. *Outcomes and Covariates*

	Age	Sex	Par Ed	PVT	PENS T1	CMA T1	PALM T1	NUMID T1	CRDN T1	TOSA T1	DNS T1	DCCS T1	TOH T1	HTKS T1
PENS	.43***	-.04	.12	.49***	.72***	.45***	.62***	.55***	.60***	.57***	.45***	.52***	.44***	.53***
CMA	.34***	.22*	.07	.38***	.21*	.43***	.40***	.12	.24*	.37***	.33***	.21*	.25*	.36***
PALM	.50***	.03	.20	.69***	.64***	.52***	.80***	.43***	.59***	.47***	.47***	.51***	.38***	.55***
NUMID	.23*	-.15	.17	.39***	.61***	.40***	.38***	.80***	.67***	.35***	.36***	.41***	.39***	.33***
CRDN	.36***	-.02	.13	.46***	.65***	.49***	.46***	.70***	.66***	.43***	.46***	.52***	.38***	.46***
TOSA	.36***	-.02	.01	.21*	.31**	.14	.30**	.21*	.24*	.60***	.23*	.27**	.20*	.20*
DNS	.27**	.11	-.03	.20*	.38***	.23*	.35***	.28**	.35***	.30**	.50***	.17	.19*	.31**
DCCS	.29**	.12	.08	.51***	.49***	.32***	.50***	.40***	.52***	.35***	.54***	.56***	.29**	.54***
TOH	.15	.00	-.02	.43***	.23*	.37***	.35***	.14	.19	.38*	.09	.25*	.27**	.34
HTKS	.46***	.06	.13	.44***	.70***	.42***	.65***	.45***	.61***	.53***	.49***	.56***	.54***	.70***

Note. N ranges from 100–105 due to missing data. * $p < .05$. ** $p < .01$. *** $p < .001$. PENS = Preschool Early Numeracy Scale; CMA = Child Math Assessment; PALM = Preschool Mathematical Language Assessment; NUMID = Numeral Identification; CRDN = Cardinality; TOSA = Test of Spatial Assembly; DNS = Day-Night Stroop; DCCS = Dimensional Change Card Sort; TOH = Tower of Hanoi; HTKS = Head-Toes-Knees-Shoulders. Scaf Rate = total scaffolding rate; Eng Rate = engagement scaffolding rate (excluding safety); Par Ed = parent education; PVT = Peabody Vocabulary Test (theta score); T1 = pretest score.

Correlations between outcome variables and predictor variables including covariates were computed on available data prior to multiple imputation (Table 4). Zero-order correlations showed that the rate of engagement scaffolding was marginally correlated with the CMA outcome ($r = -.19$, $p = .051$) and also negatively correlated with PALM ($r = -.21$, $p < .05$) and TOSA ($r = -.22$, $p < .05$).

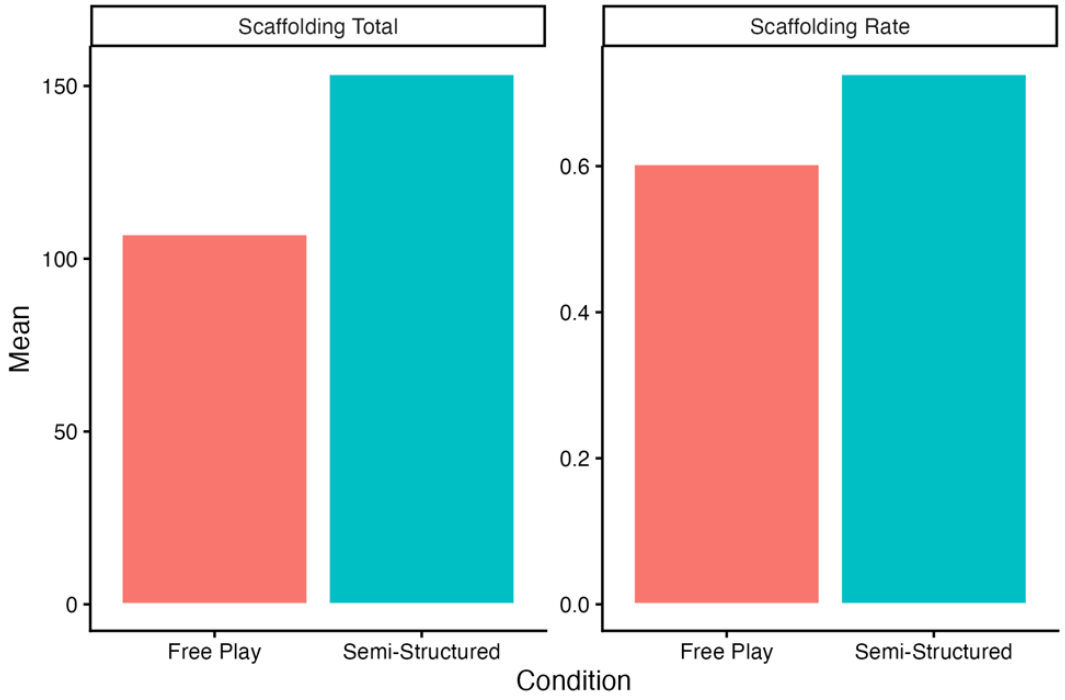
Aim 1: Description of the Frequency and Complexity Level of Scaffolding

Research Question 1.1: Scaffolding Frequency

Over the 16 block play sessions, children were exposed to an average of 131 scaffolding utterances. Across conditions, children received an average of 0.67 instances of scaffolding per minute. Scaffolding frequency was not normally distributed in either condition (Shapiro-Wilk, *ps* < .05), so a Wilcoxon rank sum test was conducted to derive effect sizes. Children in the semi-structured condition received significantly more total scaffolding instances than children in the free play condition ($W = 1005$, $p = .001$, $r = .31$; Figure 1). However, conditions did not differ significantly in scaffolding rate per minute ($W = 1281$, $p = .096$, $r = .16$).

Figure 1

Average Scaffolding Counts and Rates by Condition



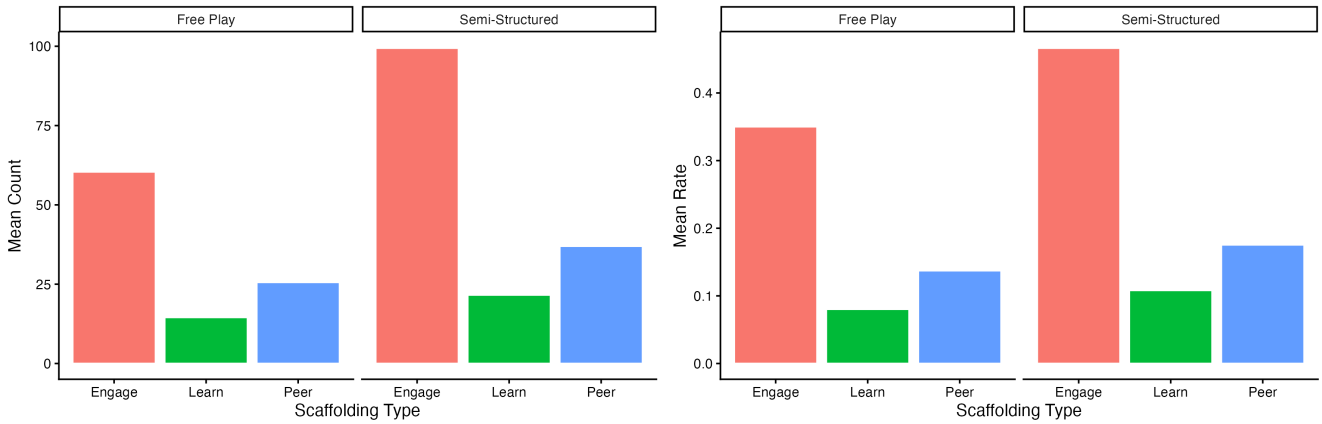
Research Question 1.2: Scaffolding Type and Complexity Levels by Condition

In both conditions, engagement scaffolding rates were significantly higher than both learning and peer interaction scaffolding rates. In the free play condition, engagement rates exceeded learning rates by an average of .27 ($t(54) = 9.13$, $p < .001$) and exceeded peer interaction rates by .21 ($t(54) = 7.49$, $p < .001$; Figure 2). The pattern was similar in the semi-structured condition, where engagement rates exceeded learning rates by .36 ($t(56) = 9.50$, $p < .001$) and peer interaction rates by .29 ($t(56) = 8.14$, $p < .001$). Interventionists provided significantly more peer interaction scaffolding instances for semi-structured groups ($M = 36.98$) than free play groups ($M = 25.58$; $t(107.15) = -2.67$, $p = .009$), though this difference became nonsignificant when peer interaction rates were calculated ($M = .18$ vs. $M = .14$; $t(109.65) = -1.67$, $p = .098$; Figure 2).

Figure 2

Mean Counts and Rates of Scaffolding Types by Condition

Panel A. *Mean Counts* **Panel B.** *Mean Rates*

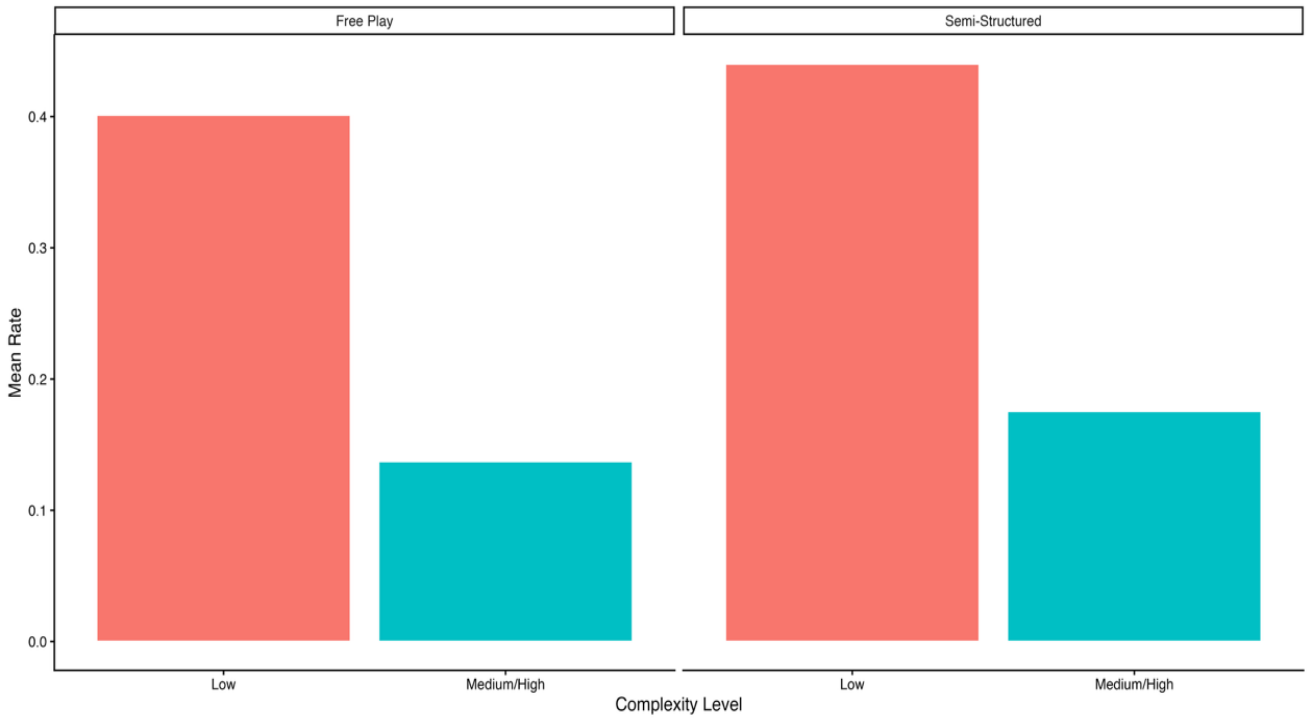


Note. Engage = Engagement scaffolding not including safety-related utterances.

Across conditions, the rate of low complexity scaffolding (M = .40 vs. M = .44; t(109.96) = −0.69, p = .493) and medium/high complexity scaffolding (M = .14 vs. M = .18; t(109.65) = −1.67, p = .098) did not significantly differ between free play and semi-structured groups (Figure 3). Both semi-structured and free play groups received significantly more low complexity scaffolding than medium/high complexity scaffolding (free play: t(54) = 7.83, p < .001; semi-structured: t(56) = 7.69, p < .001).

Figure 3

Mean Scaffolding Complexity Level Rates by Condition



Aim 2: Scaffolding Frequency and Children's Math, Spatial Reasoning, and EF

Research Question 2.1: Scaffolding Rates and Child Outcomes

Adjusting for child age at pretest, child sex, race/ethnicity, parent education, corresponding pretest outcome, and receptive vocabulary at pretest, there was no evidence that

scaffolding rate predicted child math, spatial, or EF outcomes. See Table 5 for regression estimates and *p*-values before multiple comparisons correction. Complete model output including all covariate estimates is provided in Appendix C.

Table 5

Pooled Regression Estimates for Scaffolding Rate Predicting Math, Spatial, and EF Outcomes (RQ 2.1)

	b	SE	*t*	*p*	95% CI	ΔR^2
Math						
PENS	0.34	1.52	0.22	.825	[−2.70, 3.38]	.002
CMA	−0.17	0.51	−0.34	.738	[−1.19, 0.85]	.003
PALM	−0.33	0.65	−0.50	.618	[−1.63, 0.98]	.002
NUMID	−0.85	0.63	−1.34	.184	[−2.11, 0.41]	.013
CRDN	0.23	0.48	0.49	.625	[−0.72, 1.18]	.004
Spatial						
TOSA	−4.31	3.13	−1.38	.176	[−10.63, 2.00]	.017
EF						
DNS	0.34	1.77	0.19	.848	[−3.20, 3.88]	.001
DCCS	1.18	1.50	0.79	.434	[−1.81, 4.17]	.006
TOH	−0.28	0.51	−0.55	.586	[−1.29, 0.73]	.004
HTKS	−3.01	5.58	−0.54	.591	[−14.13, 8.12]	.002

Note. EF = Executive function. PENS = Preschool Early Numeracy Scale; CMA = Child Math Assessment; PALM = Preschool Mathematical Language Assessment; NUMID = Numeral Identification; CRDN = Cardinality; TOSA = Test of Spatial Assembly; DNS = Day-Night Stroop; DCCS = Dimensional Change Card Sort; TOH = Tower of Hanoi; HTKS = Head-Toes-Knees-Shoulders. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. ΔR^2 = change in R^2 from reduced to full model. CI = confidence interval for *b*.

Research Question 2.2: Moderation by Condition

For Research Question 2.2, the scaffolding rate by condition interaction term was included in all models. Adjusting for all covariates, the interaction of scaffolding rate and condition was not a significant predictor of children's math, spatial reasoning, or EF outcomes. See Table 6 for regression estimates and *p*-values before multiple comparisons correction. Complete model output including all covariate estimates is provided in Appendix D.

Table 6

Pooled Regression Estimates for Moderation of Condition Predicting Math, Spatial, and EF Outcomes (RQ 2.2)

	Term	*b*	SE	*t*	*p*	95% CI
Math						
PENS	Scaffold rate	0.35	3.68	0.09	.925	[−7.09, 7.79]
	Rate × Semi	−0.04	3.94	−0.01	.992	[−7.98, 7.91]
CMA	Scaffold rate	−0.26	1.18	−0.22	.824	[−2.67, 2.14]
	Rate × Semi	0.25	1.28	0.19	.848	[−2.34, 2.83]
PALM	Scaffold rate	−0.86	1.82	−0.47	.642	[−4.64, 2.92]
	Rate × Semi	0.61	1.97	0.31	.760	[−3.44, 4.66]
NUMID	Scaffold rate	−1.58	1.23	−1.28	.208	[−4.07, 0.92]
	Rate × Semi	1.15	1.38	0.83	.412	[−1.65, 3.94]
CRDN	Scaffold rate	0.17	1.16	0.15	.881	[−2.19, 2.54]
	Rate × Semi	0.10	1.23	0.08	.938	[−2.40, 2.59]
Spatial						
TOSA	Scaffold rate	−4.76	6.93	−0.69	.499	[−19.09, 9.57]
	Rate × Semi	−0.05	7.36	−0.01	.995	[−15.04, 14.94]
EF						
DNS	Scaffold rate	0.35	3.43	0.10	.919	[−6.60, 7.30]
	Rate × Semi	0.46	3.71	0.12	.903	[−7.01, 7.92]
DCCS	Scaffold rate	2.26	3.03	0.75	.461	[−3.94, 8.47]
	Rate × Semi	−1.48	3.55	−0.42	.679	[−8.64, 5.69]
TOH	Scaffold rate	0.05	1.06	0.05	.961	[−2.07, 2.18]
	Rate × Semi	−0.26	1.09	−0.24	.814	[−2.44, 1.92]
HTKS	Scaffold rate	10.09	11.54	0.87	.388	[−13.37, 33.55]
	Rate × Semi	−19.25	12.38	−1.55	.128	[−44.32, 5.81]

Note. PENS = Preschool Early Numeracy Scale; CMA = Child Math Assessment; PALM = Preschool Mathematical Language Assessment; NUMID = Numeral Identification; CRDN = Cardinality; TOSA = Test of Spatial Assembly; DNS = Day-Night Stroop; DCCS = Dimensional Change Card Sort; TOH = Tower of Hanoi; HTKS = Head-Toes-Knees-Shoulders. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Rate × Semi = interaction between centered scaffolding rate and semi-structured condition (reference = free play). CI = confidence interval for *b*.

Aim 3: Scaffolding Type and Children's Math, Spatial, and EF

Research Question 3.1: Scaffolding Type and Differential Child Outcomes

Adjusting for all covariates, rates of scaffolding for engagement, learning and peer interaction were not differentially related to children's math, spatial reasoning, and EF posttest outcomes. See Table 7 for regression estimates and *p*-values before multiple comparisons correction. Complete model output including all covariate estimates is provided in Appendix E.

Table 7

Pooled Regression Estimates for Scaffolding Type Rates Predicting Math, Spatial, and EF Outcomes (RQ 3.1)

	Scaffolding Type	*b*	SE	*t*	*p*	95% CI
Math						
PENS	Engagement	0.33	2.34	0.14	.890	[−4.35, 4.99]
	Learning	−2.57	5.50	−0.47	.642	[−13.54, 8.40]
	Peer	−0.12	6.41	−0.02	.985	[−12.93, 12.70]
CMA	Engagement	−0.46	0.76	−0.60	.549	[−1.97, 1.06]
	Learning	0.53	1.42	0.37	.710	[−2.30, 3.36]
	Peer	1.14	1.73	0.66	.511	[−2.30, 4.58]
PALM	Engagement	−0.75	1.03	−0.73	.468	[−2.80, 1.30]
	Learning	−1.29	2.15	−0.60	.552	[−5.60, 3.02]
	Peer	0.31	2.89	0.11	.914	[−5.47, 6.09]
NUMID	Engagement	−1.36	0.89	−1.53	.130	[−3.12, 0.41]
	Learning	−1.69	1.67	−1.01	.317	[−5.03, 1.65]
	Peer	−2.38	2.03	−1.17	.246	[−6.43, 1.68]
CRDN	Engagement	0.33	0.71	0.46	.649	[−1.10, 1.75]
	Learning	−0.47	1.46	−0.32	.748	[−3.37, 2.43]
	Peer	0.78	1.51	0.52	.607	[−2.22, 3.77]
Spatial						
TOSA	Engagement	−5.89	5.50	−1.07	.291	[−17.02, 5.25]
	Learning	−5.77	9.16	−0.63	.531	[−24.11, 12.56]
	Peer	−15.94	10.02	−1.59	.116	[−35.96, 4.07]
EF						
DNS	Engagement	−1.95	3.10	−0.63	.531	[−8.11, 4.22]
	Learning	0.67	6.77	0.10	.921	[−12.91, 14.25]
	Peer	4.51	6.91	0.65	.517	[−9.38, 18.40]
DCCS	Engagement	1.25	2.13	0.58	.561	[−3.01, 5.50]

Table 7. (continued)

	Scaffolding Type	*b*	SE	*t*	*p*	95% CI
	Learning	2.78	5.46	0.51	.612	[−8.08, 13.64]
	Peer	3.79	4.97	0.76	.447	[−6.10, 13.68]
TOH	Engagement	−0.01	0.79	−0.01	.988	[−1.58, 1.56]
	Learning	−1.56	1.68	−0.93	.358	[−4.91, 1.79]
	Peer	−0.94	2.09	−0.45	.654	[−5.09, 3.21]
HTKS	Engagement	−5.32	7.86	−0.68	.501	[−21.04, 10.40]
	Learning	−12.09	26.21	−0.46	.646	[−64.27, 40.09]
	Peer	−8.22	20.31	−0.40	.687	[−48.78, 32.35]

Note. PENS = Preschool Early Numeracy Scale; CMA = Child Math Assessment; PALM = Preschool Mathematical Language Assessment; NUMID = Numeral Identification; CRDN = Cardinality; TOSA = Test of Spatial Assembly; DNS = Day-Night Stroop; DCCS = Dimensional Change Card Sort; TOH = Tower of Hanoi; HTKS = Head-Toes-Knees-Shoulders. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Engagement = engagement scaffolding rate (excluding safety-related instances); Learning = learning scaffolding rate; Peer = peer scaffolding rate. CI = confidence interval for *b*.

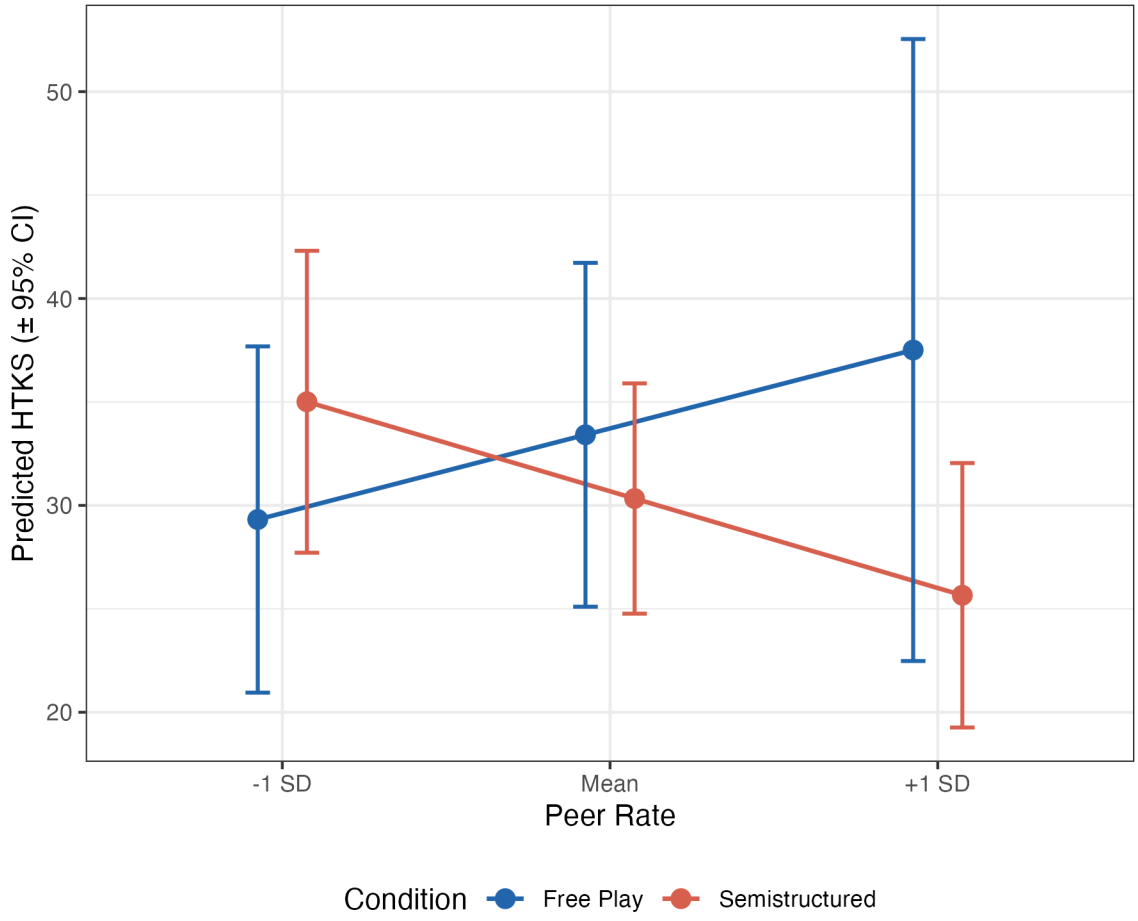
Research Question 3.2: Moderation by Condition

Adjusting for all covariates, the interactions of scaffolding type rate and condition were not significant predictors of children's math, spatial reasoning, or EF outcomes after correcting for multiple comparisons. Though, the unadjusted *p*-value of the interaction of the rate of peer interaction scaffolding and condition was marginally significant on HTKS scores ($p = .053$), with the negative association between peer scaffolding rate and HTKS scores appearing stronger in the semi-structured condition ($b = -71.14$) than in free play. The interaction was probed with simple slopes to show the descriptive trend only. Descriptively, the pattern of simple slopes suggested that the association between peer interaction scaffolding rate and HTKS scores differed by condition. Peer interaction scaffolding rate was unrelated to HTKS scores ($b = 33.50$, $SE = 36.21$, $p = .359$), but in the semi-structured condition, higher peer interaction scaffolding rates were associated with lower HTKS scores (See Figure 4; $b = -38.25$, $SE = 16.41$, $p = .023$).

This should be interpreted with caution as this interaction did not survive the Benjamini-Hochberg correction.

Figure 4

Predicted HTKS Posttest Scores by Rate of Peer Interaction Scaffolding and Condition



Note. The y-axis shows predicted values at ±1 SD of the rate of scaffolding for peer interaction. Error bars represent 95% confidence intervals around each predicted value, derived from pooled multiply-imputed estimates using Rubin's rules.

See Table 8 for regression estimates and *p*-values before multiple comparisons correction. Complete model output including all covariate estimates is provided in Appendix F.

Table 8

Pooled Regression Estimates for Scaffolding Type × Condition Interactions Predicting Math, Spatial, and EF Outcomes (RQ 3.2)

	Scaffolding Type	Term	*b*	SE	*t*	*p*	95% CI
Math							
PENS	Engagement	Main effect	0.97	5.60	0.17	.863	[−10.39, 12.33]
		× Condition	−1.02	5.96	−0.17	.866	[−13.10, 11.07]
	Learning	Main effect	0.23	9.16	0.02	.980	[−18.30, 18.76]
		× Condition	−5.26	11.50	−0.46	.649	[−28.34, 17.82]
	Peer	Main effect	0.75	10.89	0.07	.945	[−21.12, 22.62]
		× Condition	−1.79	12.34	−0.15	.885	[−26.42, 22.83]
CMA	Engagement	Main effect	−0.68	1.90	−0.36	.721	[−4.54, 3.18]
		× Condition	0.50	2.01	0.25	.806	[−3.57, 4.56]
	Learning	Main effect	1.69	2.27	0.74	.462	[−2.90, 6.27]
		× Condition	−1.66	3.06	−0.54	.590	[−7.78, 4.47]
	Peer	Main effect	1.03	3.19	0.32	.747	[−5.33, 7.39]
		× Condition	0.93	3.51	0.26	.792	[−6.07, 7.92]
PALM	Engagement	Main effect	−2.62	2.77	−0.95	.352	[−8.28, 3.05]
		× Condition	2.48	2.98	0.83	.413	[−3.63, 8.58]
	Learning	Main effect	0.51	4.86	0.10	.917	[−9.29, 10.30]
		× Condition	−3.88	5.35	−0.73	.472	[−14.65, 6.89]
	Peer	Main effect	1.22	4.95	0.25	.806	[−8.76, 11.20]
		× Condition	−2.66	5.36	−0.50	.622	[−13.41, 8.09]
NUMID	Engagement	Main effect	−1.95	1.89	−1.03	.310	[−5.81, 1.91]
		× Condition	0.92	2.14	0.43	.671	[−3.44, 5.27]

Table 8. (continued)

	Scaffolding Type	Term	*b*	SE	*t*	*p*	95% CI
	Learning	Main effect	−3.76	3.25	−1.16	.253	[−10.31, 2.78]
		× Condition	3.87	3.75	1.03	.308	[−3.69, 11.44]
	Peer	Main effect	−3.34	3.53	−0.95	.348	[−10.42, 3.74]
		× Condition	1.88	3.75	0.50	.617	[−5.61, 9.37]
CRDN	Engagement	Main effect	0.21	1.76	0.12	.906	[−3.40, 3.82]
		× Condition	0.18	1.90	0.10	.924	[−3.71, 4.08]
	Learning	Main effect	−0.12	3.35	−0.04	.971	[−6.79, 6.55]
		× Condition	−0.66	3.87	−0.17	.864	[−8.36, 7.03]
	Peer	Main effect	0.88	2.48	0.36	.723	[−4.07, 5.83]
		× Condition	−0.16	2.65	−0.06	.952	[−5.44, 5.12]
Spatial							
TOSA	Engagement	Main effect	−7.44	11.78	−0.63	.534	[−31.77, 16.89]
		× Condition	1.13	11.98	0.09	.925	[−23.21, 25.48]
	Learning	Main effect	0.63	18.13	0.03	.972	[−35.75, 37.01]
		× Condition	−13.66	19.59	−0.70	.489	[−52.92, 25.60]
	Peer	Main effect	−13.71	16.91	−0.81	.421	[−47.60, 20.19]
		× Condition	−8.82	19.98	−0.44	.660	[−48.66, 31.02]
EF							
DNS	Engagement	Main effect	−3.11	6.27	−0.50	.622	[−15.74, 9.52]
		× Condition	2.39	6.96	0.34	.733	[−11.59, 16.37]
	Learning	Main effect	4.12	10.72	0.38	.703	[−17.74, 25.98]
		× Condition	−4.53	12.08	−0.38	.709	[−28.83, 19.77]
	Peer	Main effect	13.26	11.53	1.15	.257	[−10.00, 36.52]
		× Condition	−12.45	11.90	−1.05	.300	[−36.28, 11.38]
DCCS	Engagement	Main effect	2.55	4.58	0.56	.583	[−6.95, 12.05]
		× Condition	−1.67	5.14	−0.32	.748	[−12.20, 8.87]

Table 8. (continued)

	Scaffolding Type	Term	*b*	SE	*t*	*p*	95% CI
		× Condition	−8.02	11.09	−0.72	.472	[−30.13, 14.09]
	Peer	Main effect	7.13	7.68	0.93	.357	[−8.23, 22.49]
		× Condition	−4.80	10.10	−0.48	.636	[−24.89, 15.29]
TOH	Engagement	Main effect	0.63	1.72	0.37	.716	[−2.82, 4.08]
		× Condition	−0.54	1.78	−0.31	.761	[−4.11, 3.02]
	Learning	Main effect	−0.62	2.43	−0.26	.799	[−5.54, 4.29]
		× Condition	−0.81	2.81	−0.29	.775	[−6.48, 4.87]
	Peer	Main effect	0.40	3.56	0.11	.910	[−6.71, 7.52]
		× Condition	−0.97	3.62	−0.27	.790	[−8.20, 6.26]
HTKS	Engagement	Main effect	9.08	17.45	0.52	.606	[−26.41, 44.57]
		× Condition	−20.34	18.58	−1.09	.280	[−57.90, 17.22]
	Learning	Main effect	20.48	37.44	0.55	.587	[−55.00, 95.97]
		× Condition	−55.07	40.11	−1.37	.176	[−135.71, 25.57]
	Peer	Main effect	34.55	35.99	0.96	.341	[−37.60, 106.70]
		× Condition	−71.14	36.01	−1.98	.053	[−143.20, 0.93]

Note. PENS = Preschool Early Numeracy Scale; CMA = Child Math Assessment; PALM = Preschool Mathematical Language Assessment; NUMID = Numeral Identification; CRDN = Cardinality; TOSA = Test of Spatial Assembly; DNS = Day-Night Stroop; DCCS = Dimensional Change Card Sort; TOH = Tower of Hanoi; HTKS = Head-Toes-Knees-Shoulders. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. × Condition = interaction between scaffolding type rate and condition (reference = free play). Engagement = engagement scaffolding rate (excluding safety-related instances); Learning = learning scaffolding rate; Peer = peer scaffolding rate. CI = confidence interval for *b*.

Aim 4: Scaffolding Complexity Level Moderator

Research Question 4.1: Complexity Level, Scaffolding Rate, and Child Outcomes

Adjusting for all covariates, scaffolding level did not significantly moderate the relation between scaffolding rate and child outcomes. See Table 9 for regression estimates and *p*-values before multiple comparisons correction. Complete model output including all covariate estimates is provided in Appendix G.

Table 9

Pooled Regression Estimates for Scaffolding Complexity Level as a Moderator of Scaffolding Rate on Children's Outcomes (RQ 4.1)

	Complexity Level	*b*	SE	*t*	*p*	95% CI
Math						
PENS	Scaf rate x Low	2.57	5.88	0.44	0.664	[-9.24, 14.38]
	Scaf rate x Med/High	9.74	16.55	0.59	0.559	[-23.54, 43.01]
CMA	Scaf rate x Low	-0.13	1.64	-0.08	0.939	[-3.40, 3.15]
	Scaf rate x Med/High	1.82	4.16	0.44	0.663	[-6.49, 10.14]
PALM	Scaf rate x Low	-1.33	2.63	-0.5	0.616	[-6.61, 3.96]
	Scaf rate x Med/High	-0.13	7.7	-0.02	0.986	[-15.55, 15.28]
NUMID	Scaf rate x Low	-0.12	1.94	-0.06	0.951	[-4.04, 3.80]
	Scaf rate x Med/High	3.71	5.68	0.65	0.518	[-7.83, 15.25]
CRDN	Scaf rate x Low	-0.03	1.56	-0.02	0.984	[-3.15, 3.08]
	Scaf rate x Med/High	-0.13	4.67	-0.03	0.977	[-9.43, 9.16]
Spatial						
TOSA	Scaf rate x Low	-8.76	10.51	-0.83	0.408	[-29.84, 12.31]
	Scaf rate x Med/High	-3.48	28.35	-0.12	0.903	[-60.46, 53.49]
EF						
DNS	Scaf rate x Low	-1.28	7.31	-0.18	0.862	[-16.00, 13.44]
	Scaf rate x Med/High	-3.98	21.57	-0.18	0.854	[-47.47, 39.51]
DCCS	Scaf rate x Low	5.68	4.95	1.15	0.255	[-4.21, 15.58]
	Scaf rate x Med/High	18.13	13.16	1.38	0.173	[-8.18, 44.44]
TOH	Scaf rate x Low	1.34	1.43	0.93	0.356	[-1.55, 4.22]
	Scaf rate x Med/High	1.16	4.49	0.26	0.797	[-7.87, 10.20]
HTKS	Scaf rate x Low	-1.65	23.96	-0.07	0.945	[-49.57, 46.27]
	Scaf rate x Med/High	-12.82	66.49	-0.19	0.848	[-146.00, 120.37]

Note. PENS = Preschool Early Numeracy Scale; CMA = Child Math Assessment; PALM = Preschool Mathematical Language Assessment; NUMID = Numeral Identification; CRDN = Cardinality; TOSA = Test of Spatial Assembly; DNS = Day-Night Stroop; DCCS = Dimensional Change Card Sort; TOH = Tower of Hanoi; HTKS = Head-Toes-Knees-Shoulders. Interaction terms represent the association between scaffolding rate and outcomes as moderated by complexity level of scaffolding (Low = Level 1; Medium/High = Levels 2 and 3 combined). Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. CI = confidence interval for *b*.

Research Question 4.2: Moderation by Condition

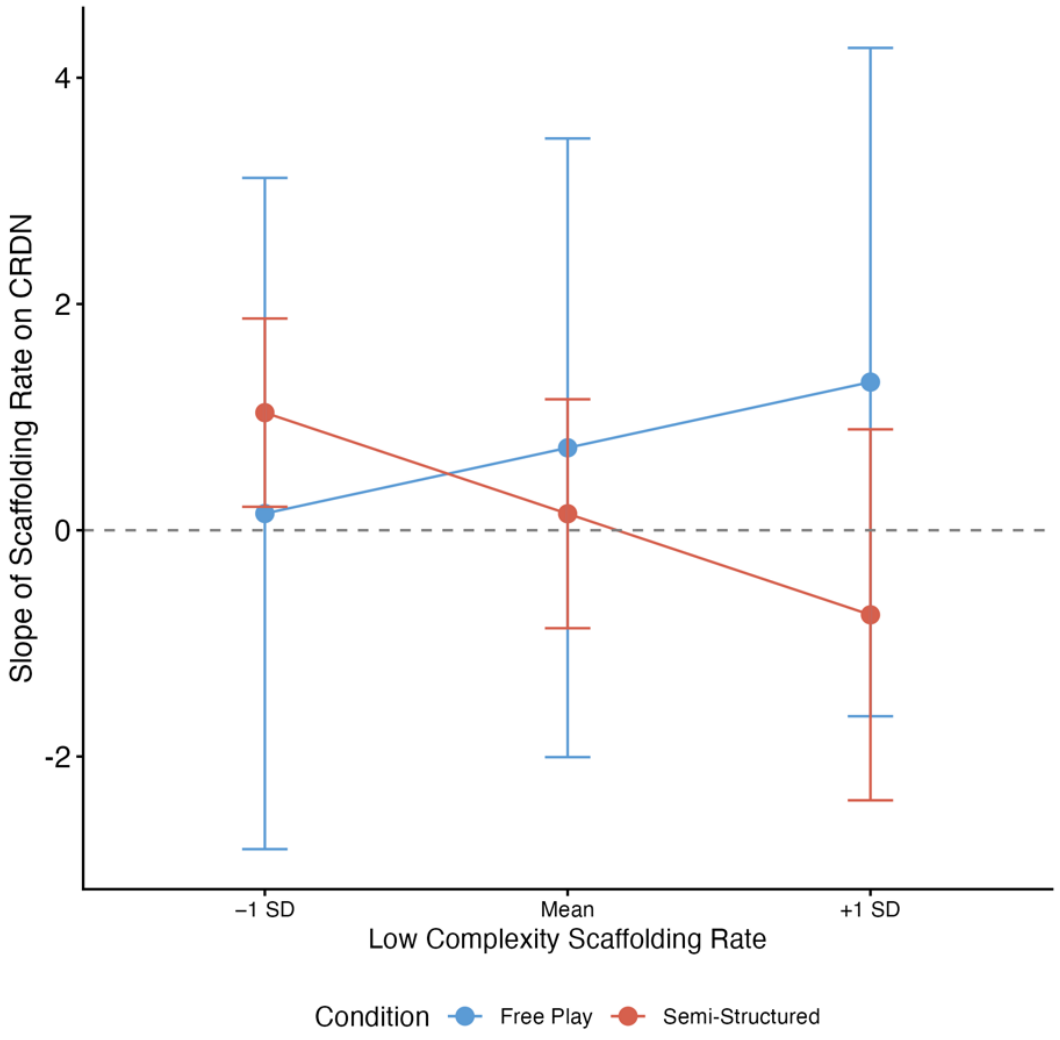
For research question 4.2, three-way interactions between condition, level, and scaffolding rate were included in each model from research question 4.1. Adjusting for all covariates, condition was not a significant moderator of the moderation of complexity level and scaffolding rates on children's outcomes. Without the Benjamini-Hochberg correction, the moderating effect of low-complexity scaffolding on the scaffolding rate–cardinality association was 4.9 units less in the semi-structured condition compared to free play (p =.041) That is, higher rates of low complexity level scaffolding were associated with a weaker relation between scaffolding rate and cardinality in semi-structure groups compared to free play. In addition, without the Benjamini-Hochberg correction, the moderating effect of low complexity level scaffolding on the scaffolding rate-PENS association was marginal – 15.1 units less in the semi-structured condition compared to free play (p = .100).

Descriptively, the patterns of simple slopes show that in the semi-structured condition, the association between scaffolding rate and child outcomes was positive at low levels of low-complexity scaffolding (CRDN: b = 1.04, SE = 0.42, p = .015; PENS: b = 3.61, SE = 1.84, p = .053), but the pattern reversed at high levels of low-complexity scaffolding (CRDN: b = −0.75, SE = 0.82, p = .367; PENS: b = −2.63, SE = 2.72, p = .337). See Figures 5 and 6. In the free play condition, slopes were consistently positive across all levels of low-complexity scaffolding and were not significant. These patterns should be interpreted with caution, as the three-way

interactions did not survive Benjamini-Hochberg correction for multiple comparisons. Complete model output including all covariate estimates is provided in Appendix H.

Figure 5

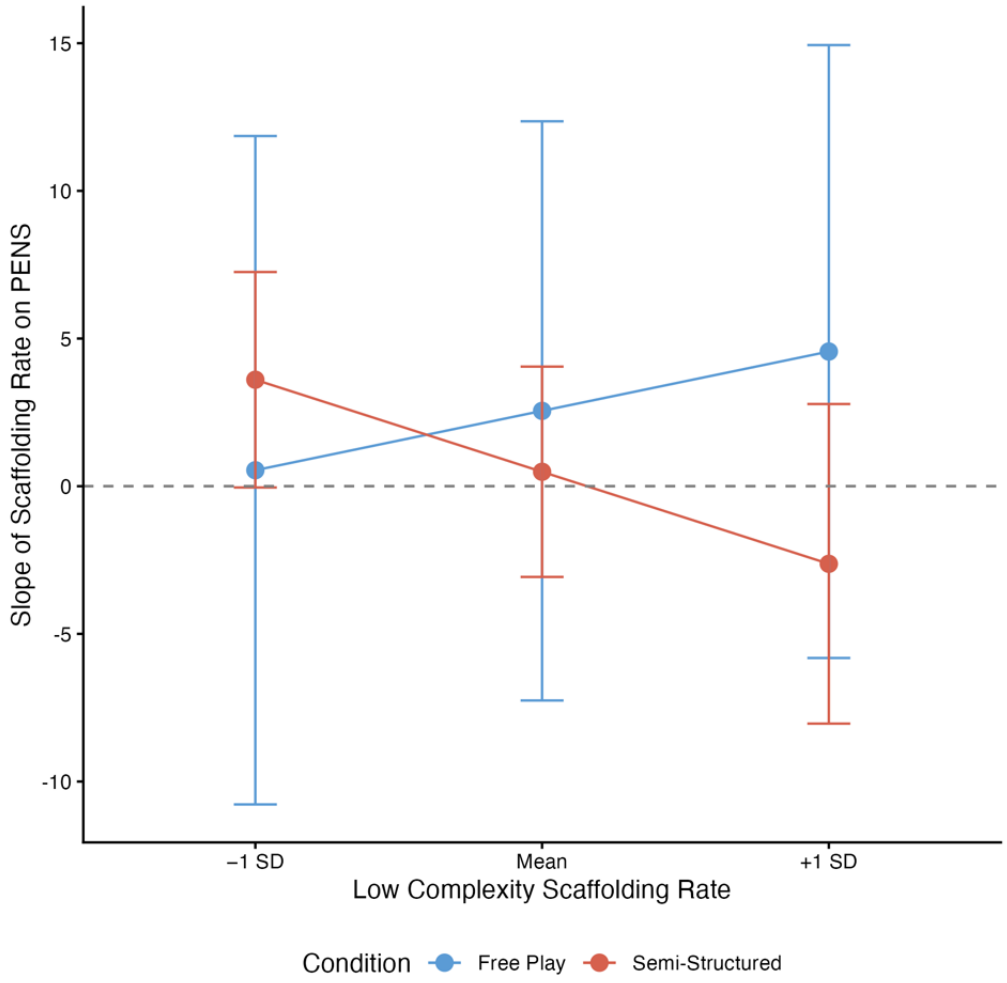
Simple Slopes of Scaffolding Rate on Cardinality Scores at Low, Mean, and High Levels of Low-Complexity Scaffolding by Condition



Note. The y-axis shows predicted values at ±1 SD of the rate of scaffolding for peer interaction. Error bars represent 95% confidence intervals around each predicted value, derived from pooled multiply-imputed estimates using Rubin's rules.

Figure 6

Simple Slopes of Scaffolding Rate on PENS Scores at Low, Mean, and High Levels of Low-Complexity Scaffolding by Condition



Note. The y-axis shows predicted values at ±1 SD of the rate of scaffolding for peer interaction. Error bars represent 95% confidence intervals around each predicted value, derived from pooled multiply-imputed estimates using Rubin's rules.

See Table 10 for regression estimates and *p*-values before multiple comparisons correction. Complete model output including all covariate estimates is provided in Appendix H.

Table 10

Three-Way Interaction of Scaffolding Rate × Complexity Level × Condition Predicting Child Outcomes (RQ 4.2)

	Interaction Term	*b*	SE	*t*	*p*	95% CI
Math						
PENS	Rate x Low x Semi	-15.10	9.01	-1.68	0.100	[-33.21, 3.01]
	Rate x Med/High x Semi	-24.63	28.11	-0.88	0.386	[-81.40, 32.14]
CMA	Rate x Low x Semi	-4.22	2.82	-1.50	0.139	[-9.84, 1.40]
	Rate x Med/High x Semi	0.03	8.24	0.00	0.997	[-16.47, 16.53]
PALM	Rate x Low x Semi	-2.17	4.44	-0.49	0.627	[-11.05, 6.72]
	Rate x Med/High x Semi	-12.83	13.50	-0.95	0.347	[-40.02, 14.37]
NUMID	Rate x Low x Semi	-4.79	3.57	-1.34	0.185	[-11.93, 2.35]
	Rate x Med/High x Semi	-5.33	10.18	-0.52	0.603	[-25.88, 15.22]
CRDN	Rate x Low x Semi	**-4.90**	**2.35**	**-2.08**	**0.041**	**[-9.59, -0.21]**
	Rate x Med/High x Semi	-8.64	8.19	-1.06	0.295	[-24.96, 7.67]
Spatial						
TOSA	Rate x Low x Semi	-12.97	18.40	-0.70	0.484	[-49.80, 23.86]
	Rate x Med/High x Semi	-17.44	48.57	-0.36	0.721	[-115.17, 80.30]
EF						
DNS	Rate x Low x Semi	-9.26	11.74	-0.79	0.434	[-32.76, 14.24]
	Rate x Med/High x Semi	-23.80	35.00	-0.68	0.500	[-94.50, 46.89]
DCCS	Rate x Low x Semi	-1.32	9.55	-0.14	0.891	[-20.33, 17.70]
	Rate x Med/High x Semi	12.67	25.79	0.49	0.625	[-38.80, 64.15]
TOH	Rate x Low x Semi	-0.12	2.61	-0.05	0.964	[-5.37, 5.13]
	Rate x Med/High x Semi	0.20	8.48	0.02	0.982	[-16.90, 17.30]
HTKS	Rate x Low x Semi	-7.96	34.84	-0.23	0.820	[-77.76, 61.84]
	Rate x Med/High x Semi	-48.89	107.69	-0.45	0.652	[-266.08, 168.30]

Note. PENS = Preschool Early Numeracy Scale; CMA = Child Math Assessment; PALM = Preschool Mathematical Language Assessment; NUMID = Numeral Identification; CRDN = Cardinality; TOSA = Test of Spatial Assembly; DNS = Day-Night Stroop; DCCS = Dimensional Change Card Sort; TOH = Tower of Hanoi; HTKS = Head-Toes-Knees-Shoulders. Each row reports the three-way interaction term (scaffolding rate × complexity level rate × condition) from a separate model. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Bold rows indicate $p < .05$ (unadjusted). CI = confidence interval for *b*.

CHAPTER IV

DISCUSSION

Effective scaffolding is an indicator of high-quality ECE characterized by an adult continuously observing children and providing support at the time and level it is needed (van de Pol et al., 2010; Zurek et al., 2014). In previous studies, scaffolding has been explored in terms of type, support level (Hardy et al., 2021; Hermkes et al., 2018; Pentimonti et al., 2017; Zurek et al., 2014), and its benefits for children's learning (Cadima et al., 2016; Fox et al., 2024; Rimm-Kaufman et al., 2009). The present dissertation examined the relation between naturally occurring scaffolding by interventionists during a preschool block play intervention, specifically its frequency, type, and complexity level, and children's math, spatial reasoning, and EF outcomes. Further, this dissertation explored whether these scaffolding facets differed between children who received building prompts (semi-structured) and children who engaged in free play. Because scaffolding is a process quality factor, and the literature on process quality in early childhood classrooms is mixed (Hamre, 2014; Hamre et al., 2014; Markowitz et al., 2017; Zaslow et al., 2016), this dissertation fills a gap in the ECE literature by expanding into block play in both semi-structured and free play contexts.

Overall, children in semi-structured groups were exposed to significantly more scaffolding than children in free play groups, but there was no significant difference in the rate of scaffolding exposure between the groups. Neither scaffolding rate nor type, nor the moderation of condition predicted children's math, spatial, or EF outcomes after applying the multiple comparisons correction. However, before the correction, condition marginally moderated the relation between scaffolding rate and HTKS scores, such that the negative association was stronger in the semi-structured condition than in the free play condition. Similarly, neither the interaction of scaffolding rate and complexity level nor the moderated moderation of condition

predicted children's outcomes after applying the correction. Though, before correction, the three-way interaction of scaffolding rate, complexity level, and condition was significant on cardinality scores and was marginally significant on PENS scores.

Aim 1: Description of Patterns of Scaffolding

The dissertation sample averaged 131 scaffolding utterances and 0.67 instances per minute across 16 sessions. On average, the semi-structured group was exposed to significantly more instances of scaffolding over the 16 sessions, but this significant difference went away after factoring intervention dosage in calculating scaffolding rate. This suggests that differences in total scaffolding were partially attributable to variation in intervention dosage. The rate of engagement scaffolding occurred significantly more than learning or peer interaction scaffolding. This may be explained by the training interventionists received to provide a "light touch" intervention to let the small group interactions and block play prompts to serve as the primary drivers of math, spatial, and EF skill development. In addition, low complexity scaffolding was significantly more common than medium/high complexity scaffolding in both conditions, with no significant differences between conditions**.** This finding is aligned with past scaffolding research, which found that preschool teachers use significantly more low complexity level scaffolding than high complexity level when teaching language (Pentimonti et al., 2017). Scaffolding levels have also been explored as low- and high-support (Birjandi & Jazebi, 2014). In a sample of 30 teachers across primary, intermediate, and high school at English institutes in Iran, they found that high-support scaffolding utterances predominated adult-child interactions. This is contrary to our findings, but their measure of low- and high-support scaffolding was measured as the number of words spoken by the teacher and student and the number of turn-of-phrases. The current dissertation conceptualized complexity level as the level of provision of

support needed to help the child understand a concept or to work towards skill mastery. Though, providing the appropriate amount of support is contingent upon the adult having content and child development knowledge to diagnose how much support is actually needed.

In regard to research question 1.2, I hypothesized that interventionist scaffolding would occur more frequently and be at a higher average complexity level in the semi-structured groups than the free play groups because the semi-structured groups were given a specific prompt each session that increased in complexity. These hypotheses were not supported. Past research on scaffolding in early childhood has found that adults adjust scaffolding based on tasks and complexity of tasks (Sun & Rao, 2012). In these studies, adults (e.g., parents and teachers; Huang et al., 2023; Neitzel & Stright, 2003; Sun & Rao, 2012) had established relationships with the children. Moreover, teachers are aware of children's pre-existing skills and may have adjusted scaffolding to help specific areas that the child needed. In contrast, the interventionists in the original block play study did not have contact with the children outside of the intervention weeks. Though children completed pretests, a different research assistant was assigned to work with children than their interventionist. In addition, interventionists may have prioritized group management over learning, which is suggested from the dominance of scaffolding for engagement in both conditions. Lastly, though all interventionists had prior experience working with children, the intervention design was made to be naturalistic and low-lift for practitioners, and as such, did not explicitly include training interventionists to scaffold or to employ other teaching strategies like modeling.

Aim 2: Scaffolding Rate and Child Outcomes

Scaffolding rate did not significantly predict math, spatial reasoning, or EF outcomes after adjusting for age at pretest, child sex, race/ethnicity, parent education level, corresponding

baseline outcome scores, and pretest receptive vocabulary skills. Further, condition did not significantly moderate the relation between scaffolding rate and any child outcome. The hypotheses that higher scaffolding rates per minute would predict greater gains in children's math, spatial, and EF outcomes and that the associations would be stronger in the semi-structured condition compared to the free play condition were not supported.

Theoretically, the ZPD (Vygotsky, 1978) posits that scaffolding focused on skill development and content mastery drives gains in skills. It is possible that the predominance of engagement-focused scaffolding, as opposed to learning-focused scaffolding, may have systematically undermined the mechanism through which the ZPD predicts learning gains. In other words, most scaffolding utterances in both conditions focused on compliance and participation instead of higher-order thinking like problem-solving (Weisberg et al., 2013). These findings also suggest that high rates of scaffolding (e.g., almost 1 per minute of intervention) do not necessarily translate to cognitive gains if the content of the scaffolding is not cognitively challenging.

The null findings between scaffolding rate and children's outcomes also suggest that critical components of effective scaffolding may have been missing during the intervention sessions. Researchers identify three key characteristics for scaffolding: diagnosis of children's current ZPD, responding to children's current ZPD and learning needs, and the transfer of responsibility from adult to children (i.e., fading; van de Pol et al., 2010; Smit et al., 2013). Given the time constraints, both in number of sessions and number of minutes, in addition to disruptions to the intervention schedule due to weather and the COVID-19 pandemic, it is possible that children were not ready for the transfer of responsibility of staying engaged, in math, spatial reasoning skills, or EF.

Aim 3: Scaffolding Types and Child Outcomes

I had no a priori hypotheses regarding which scaffolding type may be most strongly associated with children's outcomes or whether these associations would differ across experimental play conditions. No scaffolding type (engagement, learning, or peer interaction) nor the moderation of condition was significantly related to children's math, spatial, or EF outcomes after adjusting for all covariates and after multiple comparisons correction, but notably, one association emerged prior to the correction. After including the interaction of condition and scaffolding types into the models, I found that higher peer interaction scaffolding rates were associated with lower HTKS (working memory, cognitive flexibility, and inhibitory control) scores in the semi-structured condition compared to free play before the Benjamini-Hochberg correction ($b = -71.75$, $p = .049$).

It may be possible that the rate of peer interaction scaffolding happening in semi-structured groups interrupted children's opportunities for EF growth. When children are encouraged to problem-solve independently, this is called autonomy support (Grolnick & Ryan, 1989; Meuwissen & Carlson, 2019). Autonomy support is also defined as providing the appropriate level of help (not too little or too much) so that children begin to use their own skills to problem-solve and complete tasks (Meuwissen & Carlson, 2019). Meuwissen and Carlson found that after a brief parenting intervention, preschool children of parents who were more autonomy supportive had better self-regulation than children whose parents were less autonomy supportive. In the context of semi-structured block play intervention sessions, interventionists may have provided too little or too much peer interaction scaffolding to mark a positive effect on children's EF. They key difference in the conditions was the presence of a building prompt and a block structure visual to replicate in semi-structured sessions. One possible reason that lower

HTKS scores (i.e., working memory, cognitive flexibility, inhibitory control) were marginally related to high rates of peer interaction in semi-structured groups was that there may have been less opportunity to creatively problem solve or exercise cognitive flexibility during group building than in free play. Children in free play groups were also encouraged to build together, but without a specific building structure as the goal. Children's block play, and social rules (e.g., children delegating building jobs to peers, negotiating roles in pretend play with blocks) constantly shifted. In the semi-structured sessions, the goal stayed the same, which may have limited the opportunities to exercise working memory and cognitive flexibility.

Aim 4: Scaffolding Level, Rate, and Child Outcomes

The hypothesis that higher levels of high scaffolding complexity would strengthen the positive relation between scaffolding rate and child outcomes was not supported. I had no a priori hypotheses regarding the moderated moderation. I found that condition did not significantly moderate the moderation of complexity level on scaffolding rate and child outcomes after multiple comparisons correction. Before correction, the results suggested that in the semi-structured condition, each unit increase in low-level complexity scaffolding was associated with a 4.90 unit reduction in the positive association between scaffolding rate and cardinality scores, compared to free play. In addition, although not statistically significant before correction (p = .100), the pattern for the PENS outcome was in the same direction as the cardinality finding. Plainly stated, in the semi-structured condition, when low-complexity scaffolding was low, more scaffolding per minute was associated with better math outcomes in cardinality and PENS. Though, as low complexity scaffolding increased, the positive association weakened and then reversed so that more scaffolding per minute was associated with worse math outcomes in cardinality and PENS.

A possible theoretical interpretation of these before-correction findings is that in semi-structured block play, low-complexity scaffolding may leave little room for higher-order thinking interactions. When interventionists spent a large portion of time on simple directives focused on basic engagement (Aim 1), additional scaffolding utterances may have been disruptive to children's process in working towards the goal. Moreover, if interventionists were conscious of how much they were speaking, they may have only chosen to speak when children were disengaged to minimize how often they were interjecting in children's conversations with their peer and in their concentration. This pattern did not emerge in free play, where the association between scaffolding rate and outcomes stayed consistently positive regardless of low-complexity scaffolding level. In a meta-analysis on children's guided play, Skene et al. (2022) found that in guided play settings, children typically do not receive the level of choice or autonomy support that is needed to facilitate children's motivation in learning. It may be that in the free play condition, children retained more building autonomy and therefore, scaffolding did not carry the same dynamic (i.e., more scaffolding associated with worse cardinality and PENS before multiple comparisons correction) as in the semi-structured condition. Although these patterns did not survive correction for multiple comparisons and should be interpreted cautiously, they may warrant further investigation in future research with larger samples.

Summary

In summary, in the context of this block play intervention, scaffolding by interventionists did not predict children's math, spatial reasoning, or EF outcomes across any of the four aims. Several factors may help explain this pattern of null findings. Scaffolding utterances were dominated by engagement-type and low-complexity scaffolding in both conditions, which suggests that the content of scaffolding encouraged children to comply with the parameters of the

intervention session, and may not have been sufficiently cognitively challenging to drive learning gains consistent with ZPD theory (Vygotsky, 1978; Wood et al., 1976). Additionally, interventionists did not have established relationships with the children outside of the intervention, which may have limited their ability to accurately diagnose children's ZPD and provide appropriately calibrated support (van de Pol et al., 2010). Furthermore, key components of effective scaffolding, including fading and transfer of responsibility, may not have been achieved because of the time constraints of the intervention. Lastly, interventionists were not explicitly trained to scaffold or to employ specific teaching strategies, which may have reduced the quality and intentionality of scaffolding interactions. Scaffolding frequency alone may be insufficient to predict cognitive gains. Other factors such as outcome-specific content and the relationship of the adult and child may be contributing to children's outcomes more than how often scaffolding occurs.

Strengths, Limitations, and Future Directions

This dissertation has several contributions to the field of early childhood education and developmental science. First, scaffolding rate, type, and complexity level were systematically quantified during a block play intervention facilitated by adults who were unfamiliar to the children and not in a formal teaching role. Unlike much of the existing scaffolding literature, which has focused on teacher- or parent-child interactions (e.g., Huang et al., 2021; Skene et al., 2022; Sun & Rao, 2012), this dissertation provides ecologically valid (i.e., naturally occurring) insights into intervention implementation that aims to support early math, spatial, and EF development outside of traditional instructional interactions. Second, the use of multiple imputation and cluster-robust standard errors also strengthens the rigor of the findings by accounting for missing data and the nested structure of children in small groups. Third, the

findings suggest that interventionists, when not given explicit training on scaffolding strategies, default to engagement scaffolding, which has implications for intervention design in early childhood. Fourth, this dissertation examined the potential differences between semi-structured and free play conditions regarding children's scaffolding exposure and outcomes. The finding that total scaffolding was higher in the semi-structured condition but that rates did not differ between conditions suggests that simply adding structure (i.e., a prompt) to a play activity does not automatically increase the quality or frequency of adult–child interactions per unit of time. Practitioners who aim to increase meaningful scaffolding may need to focus less on structuring the activity itself and more on intentionally increasing the rate of responsive, learning-focused interactions within whatever play context is used. For intervention designers, future work may include accompanying guidance on how and how often to scaffold. In sum, interventions that aim to improve child outcomes through scaffolding quality may need to target rate and content explicitly, rather than assuming that a more structured activity will naturally elicit higher-quality adult support.

Despite the strengths of this dissertation, several limitations should be acknowledged. First, this dissertation is observational with respect to the scaffolding measures. Children's exposure to adult scaffolding was not experimentally manipulated, which limits the ability to make causal inferences about the effects of scaffolding rate, type, or complexity level on children's math, spatial, and EF outcomes. To test causal effects, future research may consider experimental designs in which scaffolding is systematically varied. For example, interventionists may be trained to deliver math and spatial reasoning-specific scaffolding, as low-complexity level content-specific scaffolding may also work as redirection for children if they become disengaged from block play.

Second, this sample was drawn from two midwestern states in the U.S. and all children came from low-income backgrounds, as defined by Head Start status or eligibility for free or reduced price lunch. This may limit the generalizability of findings to other preschool populations or settings. Although exploring potential predictors of children's outcomes in populations with low incomes is a strength in terms of examining a group that may benefit most from high-quality early childhood interventions, the income- and geographic-related homogeneity of the sample limits generalizability to populations in higher-income samples and children in other U.S. regions and other countries. Future research may test the findings in socioeconomically and geographically diverse samples.

Third, the coding of scaffolding types and complexity levels is inherently subjective. To help mitigate subjectivity, 33% of the session transcripts were double-coded by the master coder, though, some nuances of scaffolding, particularly those embedded in non-verbal interactions, may not have been fully captured. In addition, the dissertation quantified children's exposure to scaffolding at the group level and not at the child level. Future research may explore how scaffolding specified for a particular child relates to their math, spatial, and EF outcomes. Fourth, unmeasured confounding variables (e.g., interventionist-child relationship quality, individual child motivation, interventionist characteristics) may influence scaffolding exposure and child outcomes. As seen in past research featuring parent or teacher scaffolding, adults provide varying levels of autonomy support and emotion regulation that contributes to children's learning (Huang et al., 2021; Sun & Rao, 2012). Future work may intentionally adjust for adult characteristics and explore other facets of quality (i.e., adult fidelity of implementation).

Additionally, future research may examine the timing of scaffolding delivery. It is possible that greater learning occurs when children are allowed to productively struggle before

an adult intervenes, rather than receiving immediate support. Understanding how often adults scaffold, when, and under what conditions, may provide a more complete picture of what makes scaffolding effective in play-based intervention contexts. Further, the timing of post testing, which was two weeks after the intervention and between 12-16 weeks after pretesting, may have been too soon to see gains in children's skills. Other eight-week block play interventions have found similarly small effect sizes on children's skills, with Cohen's *d* values ranging from −0.64 to 0.39 across spatial outcomes and community samples (Casey et al., 2008). In comparison, other interventions that spanned across more than eight weeks have seen medium to large effect sizes on children's cognitive skills (Cai et al., 2022; Simoncini et al., 2020). Simoncini et al. (2020) found that young children in Papua New Guinea, who had access to building blocks (intervention condition) every school day for seven months, had higher math scores at the end of the school year compared to children who did not have access to blocks. Specifically, children in the intervention condition had medium to large effects on backward number word sequences (d = 0.73) and early arithmetic strategies (d = 0.71). In summary, this dissertation has practical considerations for education practitioners and researchers designing early childhood interventions with a component of interventionist training.

Conclusion

This dissertation contributes to the understanding of how naturally occurring scaffolding in semi-structured and free play contexts relates to children's math, spatial reasoning, and EF outcomes in a sample of preschoolers from low-income backgrounds. The findings suggest that scaffolding in this 16-session block play intervention was not a factor in predicting children's outcomes. The findings also give insight into how scaffolding was used in the intervention. Mostly, interventionists used scaffolding to redirect children back to the goal of the block play

sessions. Only a small proportion of scaffolding utterances were focused on math or spatial content. Additionally, scaffolding utterances were most often of low complexity level. These findings, coupled with confounding factors such as adult-child relationship and interventionist responsiveness, suggest that key components of effecting scaffolding were missing or undetected. This dissertation may inform future iterations of the block play intervention and guided play interventions to include explicit training on scaffolding strategies for adults working with young children.

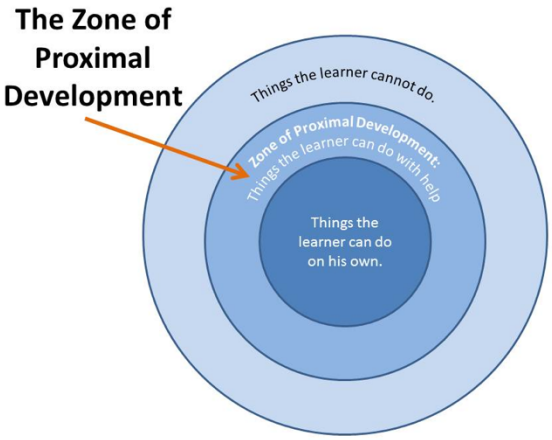
APPENDIX A

ADULT SCAFFOLDING PROTOCOL

Updated 9/17/2025

Scaffolding Background

Scaffolding by an adult occurs when the *adult intervenes to help a child when they are not able to achieve a goal independently*. In other words, scaffolding is the process of receiving help from a more knowledgeable person to master material. The more knowledgeable person adjusts their support to fit the student's learning needs. The idea of scaffolding is based on Vygotsky's theory of the Zone of Proximal Development, which can be visualized as three concentric circles. Dr. Jerome Bruner coined the term "scaffolding" and connected it to Vygotsky's work.



Getting started

1. Open the coding Excel for your assigned group and work on this online document. Files will automatically save. Do not save the file to your computer. */OneDrive/AdultScaffolding/Scaffolding Project – Phase 1*

2. For reliability transcripts and videos, open "Reliability Files." Coding Excel documents are in your personal-named folder.

Procedure

1. Read through prompts before coding semi-structured transcripts (listed below this protocol). Semi-structured groups sometimes have a second prompt for midway through the session. Semi-structured groups will have semi-structured in their file name (e.g., BO3_S11_semi-structured_completed.docx). These primary and secondary extension prompts are not scaffolding. Therefore, they will be coded as 0 for scaffolding. In sessions 11-16 for semi-structured groups, the secondary prompt includes the phrase "*but remember, what you're building needs to look like this structure in the picture,"*

code this as 0, as it is scripted and not naturally occurring scaffolding. You may count this as scaffolding for engagement. Free Play (free play) (e.g., BO5_S12_free play_completed.docx) prompt “you can build whatever you want together” will be coded as 0 for scaffolding.

2. Code for scaffolding in blank columns.

Column name	Action	Notes
scaf	Code 0 if it is not scaffolding; code 1 if it is scaffolding	
scaf_type	Code 1 for engagement; 2 for learning; 3 for peer interaction. If phrase can be more than one type, write both numbers (in number sequential order).	Example of multiple types: “Guys, maybe you could help.” Coded as 13. This is an instance where two groupmates were not engaged in block play and the interventionist helped to engage them (1). Also, this is scaffolding for peer interaction (3) because the adult encouraged the children to work together instead of independently.
safety	*If scaf_type coded as 1, code 0 for non-safety scaffolding and 1 for safety scaffolding. Leave blank if scaf_type is 2, 3, or 23	Example of safety scaffolding: “We don't throw the blocks, okay? They can be kind of heavy, so we don't wanna throw them.”
scaf_lev	Code for scaffolding complexity level. Code 1 for - Low: Simple prompts with minimal guidance. Code 2 for - Medium: Guided prompts requiring children to make connections. Code 3 for - High: Complex prompts involving multi-step problem solving.	1: Share, there’s plenty more *Peer interaction (type 3)* 2: But remember what you're building needs to look like the flat rocket in the picture. Okay? Does this look like the flat rocket in the picture? *Engagement (type 1)* 3: I see you're trying to build a bridge, but it keeps collapsing when

	A rule of thumb is that level one phrases are directives or statements. Level 2 will often be phrased as a question. Level 3 is when the adult is actively problem-solving with the children without child interruption.	you try to drive your toy car across. You've used the rectangular blocks for the base and the smaller cubes for the sides. Hmm, I wonder, what's causing it to fall? Think about how real bridges are built. They often use triangles or arches. How could you use some of these other shapes to make your bridge stronger and support the weight of the car? Maybe you could try a few different designs and test them out. What do you think might work best, and why? *Learning (type 2)*
notes	Write any notes you have that are not addressed currently.	Example: Each utterance from the interventionist in a conversation is a level 1 or 2, but the entire conversation from 01:23-03:45 is level 3 scaffolding.

3. If the interventionist timestamp or phrase is missing, insert the row between the appropriate before and after rows. Fill in the timestamp and exact phrase. Highlight this new row yellow.

   If only the phrase is missing from the coding Excel, please copy and paste from the transcript. You do not have to highlight this row if the row already existed.

4. Sometimes reading the interventionist phrase and context before and after in the transcript is not enough to label the instance as scaffolding. Refer to the corresponding video to watch for non-transcribed dialogue or non-verbal actions from children. We are not watching the entirety of the videos.

Definitions for the Current Study

Type	**Definition**	**Examples**
Engagement	Adult interacts with the children to encourage them to continue playing with the wooden blocks or to engage with the goal of the session (e.g., build a car; build a rocket).	"let's keep building" "can you help him build?" “What block are you going to add next?” (only in instances if child stops building or says they’re finished)

Safety	Safety is under the umbrella of scaffolding for engagement. Adults use this when needing to redirect children from being physically unsafe regarding blocks or building. Code phrases like “Play nicely with the blocks,” or “Use the blocks appropriately” as “block safety”. For “other safety,”the adult needs to explicitly add something about safety (e.g., you can get hurt, you might smash your finger, be careful, they are heavy so we don’t throw). A. Block safety B. Other safety (e.g., standing on chair, pinched fingers in door)	“Is it a good choice to stand on the chair to build?” “We don’t run on the blocks. You can slip and fall” “Careful walking on the blocks”
Block-Related Learning	Adult interacts with the children to develop understanding in building construction, complexity in building, math, and spatial skills. **If unsure if the phrase is learning or engagement, use this rule of thumb: If adult uses math or spatial language, code as learning	"What shape block do you want?" "I see your tower keeps falling down. How can you make it more stable?" “I wonder what you can add to your structure?” "There's lots of different ways to build"
Peer Interaction	Adult intervenes to stop negative interactions between children or to encourage children to work together. Scaffolding can be either explicitly about blocks or only about peer interaction without blocks (e.g., “play nicely together”).	“There’s a lot of space here. Would you like to move so your friend doesn’t knock your tower down?” “Why don’t you build the rocket together? You both have great ideas” “We speak kindly to each other” “Maybe you can ask and see if you can come up with a compromise."

Non-scaffolding

Non-scaffolding includes general comments not aimed at scaffolding (e.g., “Let’s clean up now” and “I can’t wait to see what you build” and “You can start now”); instances of praising (“You guys are building so well together” and “Your tower looks great so far”); and observational comments (“Wow, you’re using a lot of squares in your tower!” and “Your tower is so tall!”). Asking what the children made is a prompt for them to describe their creation, but it doesn't offer support to extend their building or play. It's a prompt for verbalization, not building. This is non-scaffolding.

A “rule-of-thumb" is that adult phrases are non-scaffolding if children are working towards the goal or achieving the goal without the adult’s help. Scaffolding only occurs when a child needs help accomplishing a goal.

This project is also considering comments regarding general behavior (or misbehavior) as non-scaffolding. That is, comments like, “We don’t touch the camera,” “Keep the door open,” and “We only use appropriate words” are non-scaffolding.

Week 1 – Simple Prompts

Session 1 - House

Prompt A: *Today, your job is to build a house together. I can’t wait to see what your house looks like!*
Prompt B: *Wow, that house looks awesome! I wonder if you could build a second story on the house and maybe even some stairs to get up to it!*

Session 2 – Car (Simple)

Prompt A: *The last time we were together, you built a house.* *Today, your job is to build a car together. I can’t wait to see the car you build!*
Prompt B: *Wow, that car looks awesome! I wonder if you can make a garage for the car.*

Week 2 – Simple Prompts AND Story Prompt

Session 3 – House (Story)

Prompt A: *The last few times we have been together, you built a house and a car.* *Today your job is to build another house for a small family of three people. They want to have rooms to sleep in and a space for them to eat together.*
Prompt B: *Wow! Your house looks fantastic! I wonder if you can build a house for a neighbor. The neighbors have five people in their family and two dogs, so they will need some rooms for everyone to sleep, a way for the dogs to stay in the yard, and a way to get in and out of the house like a door.*

Session 4 – King and Queen/Castle (Story)

Prompt A: *The last time we were together, you built some houses.* *Today, your job is to build a castle. In this castle, the King and Queen need a tower so they can look out and see who is coming to visit. The King and Queen are worried their tower might fall over, so they need a wall built in front of the tower to keep it from falling over.*
Prompt B: *Wow that castle is amazing! Can you make a large table for the King and Queen to eat a meal with all their friends? It needs to be long enough to fit many people and there needs to be a chair for the King and a chair for the Queen.*

Week 3 – Story Prompts

Session 5 – Zoo

Prompt A: *The last time we met, you built a castle, for a king and queen to live in.* *Today your job is to build a zoo where animals (both big and small) can live. In your zoo, you need to make spaces for the different sized animals and a wall around the zoo so the animals do not escape. I can't wait to see the zoo you build!*
Prompt B: *The zoo you made has many places for the animals to live; I want to see you build a wall to keep the animals safe that is three blocks high, with a place to provide shade for them.*

Session 6 - Ship

Prompt A: *The last time we were together, you built a zoo for different animals to live in.* *In a zoo there can be animals that live on the land and live in the water, we want to help the animals that live in water get to the zoo, we need a boat or a ship to get them to land. Today your job is to build a ship that will reach the animals. I can't wait to see the ship you build!*
Prompt B: *Wow, you built a large ship! When the ship arrives on land, how will the animals get off and on the ship? Where can you add a ramp for them to walk off the ship?*

Week 4 – Component Prompts

Session 7 – Passenger Train

Prompt A: *Last time we were together, you built ship for the animals; we want to be able to move all the animals to a new zoo on a train.* *Today, your job is build a passenger train which can take the animals, passengers, supplies and a conductor to places on land. The train needs to hold some animals and some people, and an engine car for the conductor to drive the train and a caboose at the end of the train.*
Prompt B: *Wow, your train looks fantastic! Now, there is one more part to add with your train. Everyone wants to see from the train, show me where you can you add windows to the train.*

Session 8 – Rocket Ship Components

Prompt A: *The last time we were together you built a train.*

Today, your job is to build another kind of vehicle that can take people (and animals) places, which is a rocket ship. But, the tricky thing is that this rocket ship needs to have some things that other rocket ships have. It needs to have the body of a rocket or a big place for passengers to sit and store their things, two wings, and a door that the pilot can shut when they are ready for take-off
Prompt B: *Wow, your rocket ship is coming together so well! Now, there is one more part to add to it, can you make a launch pad for the rocket?*

Week 5 – Component Prompts with Pictures

Session 9 – Airport with Control Towers (Three components)

Prompt A: *The last time we were together, you made a rocket ship.* *Today your job is to build an airport. I'm going to show you some pictures of structures you need to include in building your airport. It needs to have two towers called control towers (show picture), a window for people to see out of the towers (show picture) and a bridge (show picture) that connects the control towers.*
Prompt B: *The control towers are coming along and the bridge looks great. Now, how could you make a ramp (show picture) that is connected to the bridge for vehicles to go up and down?*

Control Tower



Window



Bridge



Ramp



Session 10 – Airplane and Runways with Four Components

Prompt A: *The last time we were together you built an airport, today your job is to build a plane. This plane needs to have, wings, two engines, a garage (show picture) where it can park and a tunnel (show picture) connected to the garage for people to walk through.*

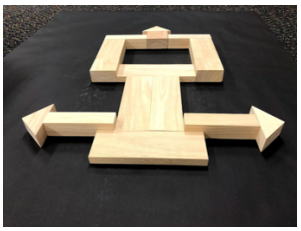
Prompt B: *Wow! You built a large plane, now can you show me where you can add a runway. Remember, the runway needs to be wide enough for your whole plane to fit on; we don't want the plane coming off of the runway.*

Garage **Tunnel**




Week 6 – Prompts with Models of Whole Structures

Session 11 – Flat Rocket



Prompt A: *The last few times we were together, you got pictures of different structures to add to your building projects.* *Today, I am going to show you a picture with a completed structure on it. Your job is to work together to build the structure you see in this picture (show picture). I would like you to build the structure exactly as you see it in the picture. I know you can do it! I will put the picture right here so you can look at it as you build.*
Prompt B: *I see that you are building so well! But remember, what you're building needs to look like this structure in the picture.* *Extension: Can you add a few cars to drive along the flat structure?*

Session 12- Whole structure 1 – flat structure



Prompt A: The last time we meet you built a flat rocket, today let's see if you can make a new structure (show picture). *Today, I am going to show you a picture with a completed structure on it. Your job is to work together to build the structure you see in this picture (show picture). I would like you to build*

the structure exactly as you see it in the picture. I know you can do it! I will put the picture right here so you can look at it as you build.
Prompt B: *I see that you are building so well! Can you add a pilot to your structure? Where would they sit, what could they sit on?* *Extension: Can you add two towers to the structure?*

Week 7 – Prompts with Pictures of Whole Structures

Session 13 – Whole structure flat house



Prompt A: *The last few times we were together, you got pictures of different structures to add to your building projects.* *Today, I am going to show you a picture with a completed structure on it. Your job is to work together to build the structure you see in this picture (show picture). I would like you to build the structure exactly as you see it in the picture. I know you can do it! I will put the picture right here so you can look at it as you build.*
Prompt B: *I see that you are building so well! But remember, what you're building needs to look like this structure in the picture.* *Extension: Can you add a wall with five blocks tall?*

Session 14- Structure flat complex rocket

Prompt A: *The last few times we were together, you got pictures of different structures to add to your building projects.* *Today, I am going to show you a picture with a completed structure on it. Your job is to work together to build the structure you see in this picture (show picture). I would like you to build the structure exactly as you see it in the picture. I know you can do it! I will put the picture right here so you can look at it as you build.*
Prompt B: *I see that you are building so well! But remember, what you're building needs to look like this structure in the picture.* *Extension: Can you add a garage to this structure?*





Week 8 – Prompts with Pictures of Whole Structures

Session 15 – Whole structure with 5 towers

Prompt A: *Today, we are going to do the same thing we did last time. I am going to show you a picture with a different structure on it. Your job is to work together to build the structure you see in this picture (show picture). I would like you to build the structure exactly as you see it in*

the picture, okay? I know you can do it! I will put the picture right here so you can look at it as you build.
Prompt B: *I see that you are building so well! But remember, what you're building needs to look like this structure in the picture.* *Extension: Can you build a garage for the vehicles that could drive up to this castle?*

Session 16 – Whole structure with five "houses"

Prompt A: *Today, I am going to show you a picture with a structure that I built on it. Your job is to work together to build the same structure you see in this picture (show picture). I would like you to build the structure exactly as you see it in the picture, okay? I know you can do it! I will put the picture right here so you can look at it as you build.*
Prompt B: *I see that you are building so well! But remember, what you're building needs to look like this structure in the picture.* *Extension: I'm looking at the structure you build…I wonder if you could add another house.*



APPENDIX B

SUPPLEMENTARY ANALYSES FOR AIMS 2-4 WITH MATH COMPOSITE

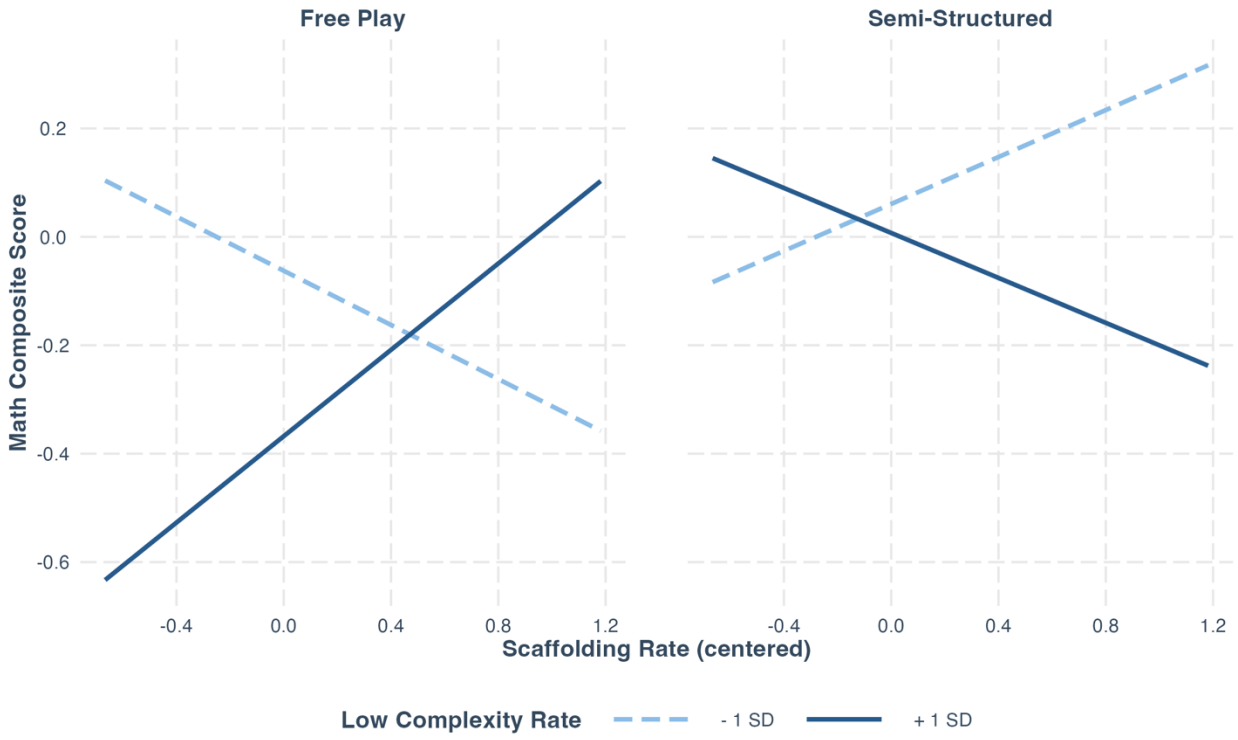
To create a posttest math composite score, the PENS, PALM, NUMID, and CRDN were standardized and averaged. The same multiple imputation, grand-mean centered continuous variables, and CR2 cluster-robust standard error approach used in the primary analyses for aims 2-4 were applied. For Aim 2, results mirrored the primary analyses. Scaffolding rate was not a significant predictor of children's posttest math skills, and intervention condition was also not a significant moderator in this relation. For Aim 3, none of the three scaffolding types (i.e., engagement, learning, peer interaction) predicted children's math, nor did intervention condition moderate the relation. Lastly, for Aim 4, the interaction of scaffolding rate and scaffolding complexity level at low and medium/high levels was not significantly associated with children's math skills. When the three-way interaction of scaffolding rate, complexity rates, and condition was included in the models, the unadjusted *p*-value was marginal (b = -1.51, SE = 0.88, p = .089). It suggested differences between semi-structured and free play groups in how low-complexity scaffolding moderated the relation between overall scaffolding rate and math skills. However, this marginally significant interaction did not survive the Benjamini-Hochberg correction (p = .473).

The three-way interaction pattern suggests that in semi-structured groups, higher rates of low-complexity scaffolding were associated with a weaker scaffolding rate–math composite association than in free play groups. Simple slopes were not significant at low and high rates of low complexity level scaffolding (low: b = 0.22, SE = 0.18, p = .24) and at high levels (b = -0.21, SE = 0.28, p = .46), in line with the nonsignificant, though marginal three-way interaction. Descriptively, there is a crossover pattern where in free play, higher peer interaction was associated with a positive link between scaffolding rate and math. In the semi-structured

condition, the pattern reversed, though this study may be underpowered to detect this. See Figure B1.

Figure B1

Three-Way Interaction of Scaffolding Rate and Low-Complexity Scaffolding by Condition on Math Composite Scores



Note. Based on $n = 112$. Lines represent the association between scaffolding rate and math composite scores at low (−1 *SD*) and high (+1 *SD*) levels of low-complexity scaffolding rate, separately by condition. Scaffolding rate is mean-centered. The math composite score is a standardized average of four math outcomes (PENS, PALM, NUMID, CRDN). The three-way interaction was marginal and did not survive Benjamini-Hochberg correction for multiple comparisons. No individual simple slopes were significant. Simple slopes were estimated using a single imputed dataset for illustrative purposes.

APPENDIX C

AIM 2: RESEARCH QUESTION 2.1 FULL MODELS

Table C1

Full Model Output for Scaffolding Rate Predicting Math Outcomes (RQ 2.1)

Term	*b*	SE	*t*	*p*	95% CI
PENS					
Intercept	**15.43**	**1.27**	**12.14**	**<.001**	**[12.90, 17.97]**
Scaffolding rate	0.34	1.52	0.22	.825	[−2.70, 3.38]
Age	0.11	0.10	1.06	.291	[−0.09, 0.31]
Sex (female)	−0.63	1.14	−0.55	.584	[−2.91, 1.65]
Race/ethnicity (ref = White)					
Asian	0.75	1.61	0.47	.642	[−2.46, 3.96]
Black/African American	2.40	2.03	1.18	.240	[−1.64, 6.43]
Hispanic/Latino	−1.49	1.59	−0.94	.350	[−4.66, 1.67]
Multiracial/Other	−0.20	1.55	−0.13	.900	[−3.28, 2.88]
Parent education	−0.12	0.34	−0.36	.720	[−0.81, 0.56]
PVT	**0.66**	**0.33**	**2.03**	**.046**	**[0.01, 1.31]**
Baseline PENS	**0.59**	**0.12**	**5.06**	**<.001**	**[0.35, 0.82]**
CMA					
Intercept	**3.59**	**0.33**	**10.91**	**<.001**	**[2.94, 4.25]**
Scaffolding rate	−0.17	0.51	−0.34	.738	[−1.19, 0.85]
Age	0.05	0.03	1.67	.098	[−0.01, 0.11]
Sex (female)	0.56	0.38	1.49	.140	[−0.19, 1.31]
Race/ethnicity (ref = White)					
Asian	0.03	0.56	0.05	.958	[−1.09, 1.15]
Black/African American	0.48	0.75	0.64	.522	[−1.00, 1.96]
Hispanic/Latino	0.13	0.46	0.29	.771	[−0.77, 1.04]
Multiracial/Other	0.75	0.49	1.52	.132	[−0.23, 1.74]
Parent education	−0.04	0.11	−0.37	.711	[−0.25, 0.17]
PVT	0.18	0.11	1.60	.114	[−0.04, 0.41]
Baseline CMA	**0.22**	**0.10**	**2.20**	**.031**	**[0.02, 0.41]**
PALM					
Intercept	**10.29**	**0.57**	**18.03**	**<.001**	**[9.13, 11.44]**
Scaffolding rate	−0.33	0.65	−0.50	.618	[−1.63, 0.98]
Age	0.08	0.05	1.52	.135	[−0.03, 0.19]
Sex (female)	−0.42	0.57	−0.74	.464	[−1.54, 0.71]
Race/ethnicity (ref = White)					
Asian	0.37	0.80	0.46	.651	[−1.24, 1.97]
Black/African American	1.35	0.97	1.39	.168	[−0.58, 3.29]

Table C1. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Hispanic/Latino	0.28	0.61	0.45	.651	[−0.94, 1.50]
Multiracial/Other	0.91	0.77	1.18	.241	[−0.63, 2.45]
Parent education	−0.05	0.15	−0.37	.713	[−0.35, 0.24]
PVT	**0.61**	**0.28**	**2.21**	**.031**	**[0.06, 1.16]**
Baseline PALM	**0.47**	**0.13**	**3.69**	**<.001**	**[0.21, 0.72]**
NUMID					
Intercept	**5.64**	**0.45**	**12.60**	**<.001**	**[4.74, 6.55]**
Scaffolding rate	−0.85	0.63	−1.34	.184	[−2.11, 0.41]
Age	−0.04	0.04	−0.94	.349	[−0.12, 0.04]
Sex (female)	−0.04	0.43	−0.10	.923	[−0.91, 0.82]
Race/ethnicity (ref = White)					
Asian	0.02	0.63	0.04	.970	[−1.25, 1.30]
Black/African American	−0.46	0.76	−0.60	.551	[−1.97, 1.06]
Hispanic/Latino	−0.88	0.65	−1.37	.176	[−2.18, 0.41]
Multiracial/Other	0.15	0.41	0.37	.714	[−0.66, 0.96]
Parent education	−0.12	0.11	−1.05	.298	[−0.35, 0.11]
PVT	0.13	0.14	0.92	.358	[−0.15, 0.42]
Baseline Numeral ID	**0.84**	**0.11**	**7.42**	**<.001**	**[0.62, 1.07]**
CRDN					
Intercept	**2.70**	**0.44**	**6.20**	**<.001**	**[1.83, 3.58]**
Scaffolding rate	0.23	0.48	0.49	.625	[−0.72, 1.18]
Age	0.03	0.03	0.85	.398	[−0.03, 0.08]
Sex (female)	−0.15	0.30	−0.52	.601	[−0.74, 0.43]
Race/ethnicity (ref = White)					
Asian	0.81	0.56	1.44	.155	[−0.31, 1.92]
Black/African American	−0.07	0.60	−0.12	.907	[−1.27, 1.13]
Hispanic/Latino	−0.04	0.52	−0.07	.946	[−1.08, 1.00]
Multiracial/Other	0.61	0.43	1.40	.163	[−0.25, 1.47]
Parent education	−0.01	0.10	−0.10	.917	[−0.21, 0.19]
PVT	0.15	0.11	1.34	.184	[−0.07, 0.37]
Baseline Cardinality	**0.54**	**0.11**	**4.67**	**<.001**	**[0.31, 0.77]**

Note. PENS = Preschool Early Numeracy Scale; CMA = Child Math Assessment; PALM = Preschool Mathematical Language Assessment; NUMID = Numeral Identification; CRDN = Cardinality. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table C2

Full Model Output for Scaffolding Rate Predicting Spatial Outcome (RQ 2.1)

Term	*b*	SE	*t*	*p*	95% CI
TOSA					
Intercept	**60.13**	**2.59**	**23.23**	**<.001**	**[54.93, 65.33]**
Scaffolding rate	−4.31	3.13	−1.38	.176	[−10.63, 2.00]
Age	0.14	0.21	0.67	.505	[−0.28, 0.56]
Sex (female)	−2.99	2.16	−1.39	.168	[−7.27, 1.29]
Race/ethnicity (ref = White)					
Asian	0.34	3.28	0.10	.918	[−6.23, 6.91]
Black/African American	1.96	4.78	0.41	.683	[−7.55, 11.46]
Hispanic/Latino	2.39	3.61	0.66	.510	[−4.80, 9.57]
Multiracial/Other	4.08	4.36	0.94	.353	[−4.63, 12.79]
Parent education	−0.72	0.67	−1.08	.285	[−2.04, 0.61]
PVT	−0.38	0.71	−0.54	.593	[−1.80, 1.04]
Baseline TOSA	**0.58**	**0.11**	**5.25**	**<.001**	**[0.36, 0.79]**

Note. TOSA = Test of Spatial Assembly. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table C3

Full Model Output for Scaffolding Rate Predicting EF Outcomes (RQ 2.1)

Term	*b*	SE	*t*	*p*	95% CI
DNS					
Intercept	**21.65**	**1.36**	**15.88**	**<.001**	**[18.93, 24.38]**
Scaffolding rate	0.34	1.77	0.19	.848	[−3.20, 3.88]
Age	0.19	0.15	1.28	.205	[−0.11, 0.49]
Sex (female)	−0.08	1.49	−0.05	.958	[−3.03, 2.88]
Race/ethnicity (ref = White)					
Asian	3.00	2.44	1.23	.224	[−1.88, 7.88]
Black/African American	**6.07**	**2.03**	**2.99**	**.004**	**[2.02, 10.12]**
Hispanic/Latino	1.28	2.11	0.61	.545	[−2.91, 5.47]
Multiracial/Other	3.06	2.60	1.17	.243	[−2.12, 8.23]
Parent education	−0.50	0.44	−1.13	.261	[−1.38, 0.38]

Table C3. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Baseline DNS	**0.39**	**0.12**	**3.38**	**.001**	**[0.16, 0.62]**
DCCS					
Intercept	**12.84**	**0.86**	**14.91**	**<.001**	**[11.11, 14.56]**
Scaffolding rate	1.18	1.50	0.79	.434	[−1.81, 4.17]
Age	0.08	0.10	0.79	.430	[−0.11, 0.27]
Sex (female)	1.17	0.87	1.35	.180	[−0.55, 2.89]
Race/ethnicity (ref = White)					
Asian	−0.64	1.52	−0.42	.675	[−3.67, 2.39]
Black/African American	1.70	2.47	0.69	.493	[−3.21, 6.60]
Hispanic/Latino	0.47	1.52	0.31	.758	[−2.55, 3.49]
Multiracial/Other	1.84	1.38	1.33	.186	[−0.91, 4.58]
Parent education	0.12	0.28	0.43	.670	[−0.44, 0.68]
PVT	**0.93**	**0.26**	**3.58**	**<.001**	**[0.42, 1.44]**
Baseline DCCS	**0.47**	**0.09**	**5.28**	**<.001**	**[0.29, 0.65]**
Tower of Hanoi					
Intercept	**2.49**	**0.34**	**7.37**	**<.001**	**[1.81, 3.16]**
Scaffolding rate	−0.28	0.51	−0.55	.586	[−1.29, 0.73]
Age	0.02	0.03	0.65	.520	[−0.04, 0.07]
Sex (female)	0.18	0.31	0.57	.568	[−0.44, 0.80]
Race/ethnicity (ref = White)					
Asian	0.24	0.52	0.46	.646	[−0.79, 1.28]
Black/African American	0.54	0.73	0.75	.457	[−0.91, 2.00]
Hispanic/Latino	0.31	0.52	0.59	.554	[−0.72, 1.34]
Multiracial/Other	−0.14	0.43	−0.32	.749	[−0.99, 0.72]
Parent education	−0.06	0.09	−0.67	.504	[−0.24, 0.12]
PVT	0.16	0.08	1.95	.055	[0.00, 0.32]
Baseline Tower of Hanoi	**0.28**	**0.10**	**2.82**	**.006**	**[0.08, 0.48]**
HTKS					
Intercept	**26.43**	**4.18**	**6.33**	**<.001**	**[18.20, 34.66]**
Scaffolding rate	−3.01	5.58	−0.54	.591	[−14.13, 8.12]
Age	0.37	0.35	1.06	.293	[−0.32, 1.06]
Sex (female)	4.50	3.35	1.34	.183	[−2.12, 11.13]
Race/ethnicity (ref = White)					
Asian	−3.30	5.82	−0.57	.572	[−14.84, 8.24]
Black/African American	10.88	8.11	1.34	.183	[−5.16, 26.93]
Hispanic/Latino	−2.97	5.80	−0.51	.610	[−14.47, 8.52]
Multiracial/Other	1.96	5.36	0.37	.716	[−8.68, 12.59]
Parent education	−0.52	1.28	−0.41	.685	[−3.05, 2.01]
PVT	**2.16**	**1.03**	**2.10**	**.039**	**[0.11, 4.20]**

Table C3. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Baseline HTKS	**0.48**	**0.09**	**5.29**	**<.001**	**[0.30, 0.67]**

Note. DNS = Day-Night Stroop; DCCS = Dimensional Change Card Sort; TOH = Tower of Hanoi; HTKS = Head-Toes-Knees-Shoulders. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

APPENDIX D

AIM 2: RESEARCH QUESTION 2.2 FULL MODELS

Table D1

Full Model Output for Scaffolding Rate × Condition Predicting Math Outcomes (RQ 2.2)

Term	*b*	SE	*t*	*p*	95% CI
PENS					
Intercept	**14.76**	**1.46**	**10.11**	**<.001**	**[11.85, 17.66]**
Scaffolding rate	0.35	3.68	0.09	.925	[−7.09, 7.79]
Condition (semi-structured)	0.71	1.25	0.57	.571	[−1.78, 3.20]
Age	0.10	0.10	1.01	.317	[−0.10, 0.30]
Sex (female)	−0.62	1.14	−0.54	.589	[−2.88, 1.64]
Race/ethnicity (ref = White)					
Asian	0.71	1.62	0.44	.663	[−2.53, 3.94]
Black/African American	2.45	2.07	1.18	.239	[−1.68, 6.58]
Hispanic/Latino	−1.53	1.62	−0.94	.349	[−4.77, 1.72]
Multiracial/Other	−0.19	1.57	−0.12	.906	[−3.31, 2.94]
Other/Multiracial	5.20	7.47	0.70	.501	[−9.73, 20.13]
Parent education	−0.11	0.35	−0.32	.751	[−0.80, 0.58]
PVT	**0.65**	**0.32**	**2.03**	**.046**	**[0.01, 1.28]**
Baseline PENS	**0.59**	**0.12**	**4.97**	**<.001**	**[0.36, 0.83]**
Scaf rate × Semi-structured	−0.04	3.94	−0.01	.992	[−7.98, 7.91]
CMA					
Intercept	**3.74**	**0.44**	**8.60**	**<.001**	**[2.87, 4.62]**
Scaffolding rate	−0.26	1.18	−0.22	.824	[−2.67, 2.14]
Condition (semi-structured)	−0.36	0.43	−0.85	.399	[−1.22, 0.49]
Age	0.05	0.03	1.47	.146	[−0.02, 0.11]
Sex (female)	0.62	0.37	1.68	.097	[−0.11, 1.35]
Race/ethnicity (ref = White)					
Asian	0.03	0.55	0.05	.957	[−1.07, 1.13]
Black/African American	0.52	0.75	0.69	.493	[−0.97, 2.00]
Hispanic/Latino	0.07	0.46	0.15	.885	[−0.85, 0.98]
Multiracial/Other	0.83	0.49	1.72	.090	[−0.13, 1.80]
Other/Multiracial	1.06	1.68	0.63	.541	[−2.65, 4.77]
Parent education	−0.02	0.11	−0.22	.823	[−0.24, 0.19]
PVT	0.19	0.11	1.64	.104	[−0.04, 0.41]
Baseline CMA	0.19	0.10	1.90	.061	[−0.01, 0.40]
Scaf rate × Semi-structured	0.25	1.28	0.19	.848	[−2.34, 2.83]

Table D1. (continued)

Term	*b*	SE	*t*	*p*	95% CI
PALM					
Intercept	**9.98**	**0.75**	**13.25**	**<.001**	**[8.44, 11.53]**
Scaffolding rate	−0.86	1.82	−0.47	.642	[−4.64, 2.92]
Condition (semi-structured)	0.63	0.59	1.06	.293	[−0.56, 1.81]
Age	0.08	0.05	1.57	.124	[−0.02, 0.19]
Sex (female)	−0.48	0.58	−0.83	.411	[−1.64, 0.68]
Race/ethnicity (ref = White)					
Asian	0.34	0.78	0.44	.663	[−1.22, 1.90]
Black/African American	1.32	0.97	1.36	.178	[−0.61, 3.25]
Hispanic/Latino	0.41	0.64	0.63	.531	[−0.88, 1.69]
Multiracial/Other	0.77	0.77	1.00	.321	[−0.77, 2.30]
Other/Multiracial	0.06	3.89	0.02	.987	[−9.40, 9.53]
Parent education	−0.08	0.15	−0.57	.573	[−0.38, 0.21]
PVT	**0.57**	**0.25**	**2.24**	**.028**	**[0.06, 1.08]**
Baseline PALM	**0.49**	**0.11**	**4.41**	**<.001**	**[0.27, 0.72]**
Scaf rate × Semi-structured	0.61	1.97	0.31	.760	[−3.44, 4.66]
NUMID					
Intercept	**5.64**	**0.57**	**9.89**	**<.001**	**[4.47, 6.81]**
Scaffolding rate	−1.58	1.23	−1.28	.208	[−4.07, 0.92]
Condition (semi-structured)	−0.08	0.45	−0.17	.869	[−1.00, 0.85]
Age	−0.04	0.04	−1.01	.315	[−0.13, 0.04]
Sex (female)	0.00	0.42	0.00	.997	[−0.84, 0.84]
Race/ethnicity (ref = White)					
Asian	−0.05	0.54	−0.09	.931	[−1.14, 1.05]
Black/African American	−0.37	0.77	−0.48	.629	[−1.91, 1.16]
Hispanic/Latino	−0.92	0.66	−1.39	.169	[−2.24, 0.40]
Multiracial/Other	0.19	0.38	0.50	.621	[−0.57, 0.95]
Other/Multiracial	0.44	3.01	0.15	.890	[−7.53, 8.40]
Parent education	−0.12	0.12	−1.03	.308	[−0.36, 0.12]
PVT	0.11	0.13	0.86	.392	[−0.15, 0.37]
Baseline Numeral ID	**0.85**	**0.11**	**8.01**	**<.001**	**[0.64, 1.06]**
Scaf rate × Semi-structured	1.15	1.38	0.83	.412	[−1.65, 3.94]
CRDN					
Intercept	**2.70**	**0.59**	**4.59**	**<.001**	**[1.51, 3.88]**
Scaffolding rate	0.17	1.16	0.15	.881	[−2.19, 2.54]
Condition (semi-structured)	0.00	0.45	0.00	.996	[−0.90, 0.90]
Age	0.03	0.03	0.81	.421	[−0.04, 0.09]
Sex (female)	−0.15	0.28	−0.55	.587	[−0.71, 0.40]
Race/ethnicity (ref = White)					
Asian	0.80	0.55	1.47	.145	[−0.28, 1.89]
Black/African American	−0.06	0.59	−0.10	.918	[−1.24, 1.11]

Table D1. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Hispanic/Latino	−0.03	0.56	−0.06	.954	[−1.14, 1.08]
Multiracial/Other	0.61	0.43	1.43	.157	[−0.24, 1.46]
Other/Multiracial	1.59	1.94	0.82	.438	[−2.89, 6.06]
Parent education	−0.01	0.10	−0.11	.909	[−0.20, 0.18]
PVT	0.15	0.10	1.47	.145	[−0.05, 0.35]
Baseline Cardinality	**0.54**	**0.11**	**4.98**	**<.001**	**[0.32, 0.75]**
Scaf rate × Semi-structured	0.10	1.23	0.08	.938	[−2.40, 2.59]

Note. PENS = Preschool Early Numeracy Scale; CMA = Child Math Assessment; PALM = Preschool Mathematical Language Assessment; NUMID = Numeral Identification; CRDN = Cardinality. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Scaf rate × Semi-structured = interaction between centered scaffolding rate and semi-structured condition (reference = free play). Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table D2

Full Model Output for Scaffolding Rate × Condition Predicting Spatial Outcome (RQ 2.2)

Term	*b*	SE	*t*	*p*	95% CI
TOSA					
Intercept	**59.06**	**3.51**	**16.83**	**<.001**	**[51.91, 66.20]**
Scaffolding rate	−4.76	6.93	−0.69	.499	[−19.09, 9.57]
Condition (semi-structured)	2.44	2.92	0.84	.408	[−3.46, 8.35]
Age	0.17	0.22	0.76	.447	[−0.27, 0.61]
Sex (female)	−3.32	2.17	−1.53	.129	[−7.62, 0.99]
Race/ethnicity (ref = White)					
Asian	0.30	3.24	0.09	.926	[−6.18, 6.78]
Black/African American	1.75	4.68	0.37	.709	[−7.57, 11.08]
Hispanic/Latino	2.80	3.75	0.75	.459	[−4.69, 10.28]
Multiracial/Other	3.58	4.36	0.82	.414	[−5.12, 12.29]
Other/Multiracial	3.71	12.22	0.30	.770	[−24.70, 32.12]
Parent education	−0.81	0.66	−1.22	.224	[−2.13, 0.51]
PVT	−0.39	0.71	−0.54	.590	[−1.80, 1.03]
Baseline TOSA	**0.58**	**0.11**	**5.24**	**<.001**	**[0.36, 0.80]**
Scaf rate × Semi-structured	−0.05	7.36	−0.01	.995	[−15.04, 14.94]

Note. TOSA = Test of Spatial Ability. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Scaf rate × Semi-structured = interaction between centered scaffolding rate and semi-structured condition (reference = free play). Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table D3

Full Model Output for Scaffolding Rate × Condition Predicting EF Outcomes (RQ 2.2)

Term	*b*	SE	*t*	*p*	95% CI
DNS					
Intercept	**22.38**	**1.77**	**12.64**	**<.001**	**[18.83, 25.93]**
Scaffolding rate	0.35	3.43	0.10	.919	[−6.60, 7.30]
Condition (semi-structured)	−1.63	1.57	−1.04	.303	[−4.76, 1.50]
Age	0.17	0.16	1.06	.292	[−0.15, 0.48]
Sex (female)	0.12	1.54	0.08	.938	[−2.94, 3.18]
Race/ethnicity (ref = White)					
Asian	2.96	2.45	1.21	.232	[−1.94, 7.85]
Black/African American	**6.20**	**2.04**	**3.05**	**.003**	**[2.14, 10.26]**
Hispanic/Latino	0.98	2.21	0.44	.658	[−3.41, 5.37]
Multiracial/Other	3.40	2.71	1.25	.213	[−1.99, 8.80]
Other/Multiracial	8.39	8.67	0.97	.357	[−11.03, 27.82]
Parent education	−0.44	0.42	−1.06	.292	[−1.27, 0.39]
PVT	0.20	0.44	0.46	.643	[−0.67, 1.08]
Baseline DNS	**0.40**	**0.12**	**3.39**	**.001**	**[0.16, 0.63]**
Scaf rate × Semi-structured	0.46	3.71	0.12	.903	[−7.01, 7.92]
DCCS					
Intercept	**13.20**	**1.18**	**11.15**	**<.001**	**[10.78, 15.61]**
Scaffolding rate	2.26	3.03	0.75	.461	[−3.94, 8.47]
Condition (semi-structured)	−0.68	1.38	−0.49	.626	[−3.45, 2.10]
Age	0.07	0.10	0.66	.510	[−0.14, 0.28]
Sex (female)	1.22	0.89	1.37	.175	[−0.55, 3.00]
Race/ethnicity (ref = White)					
Asian	−0.56	1.52	−0.37	.712	[−3.59, 2.46]
Black/African American	1.65	2.47	0.67	.506	[−3.27, 6.57]
Hispanic/Latino	−0.91	1.63	−0.56	.577	[−4.15, 2.33]
Multiracial/Other	−0.05	1.67	−0.03	.978	[−3.38, 3.28]
Other/Multiracial	2.40	6.86	0.35	.736	[−13.44, 18.23]
Parent education	−0.16	0.40	−0.40	.693	[−0.95, 0.64]
PVT	**0.98**	**0.37**	**2.62**	**.010**	**[0.24, 1.72]**

Table D3. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Baseline DCCS	**0.40**	**0.10**	**4.08**	**<.001**	**[0.21, 0.60]**
Scaf rate × Semi-structured	−1.48	3.55	−0.42	.679	[−8.64, 5.69]
TOH					
Intercept	**2.68**	**0.51**	**5.24**	**<.001**	**[1.66, 3.69]**
Scaffolding rate	0.05	1.06	0.05	.961	[−2.07, 2.18]
Condition (semi-structured)	−0.85	0.43	−1.97	.052	[−1.70, 0.01]
Age	−0.02	0.03	−0.85	.398	[−0.08, 0.03]
Sex (female)	−0.02	0.37	−0.07	.946	[−0.76, 0.71]
Race/ethnicity (ref = White)					
Asian	−0.28	0.60	−0.47	.639	[−1.48, 0.91]
Black/African American	0.40	0.64	0.63	.531	[−0.87, 1.68]
Hispanic/Latino	−0.07	0.51	−0.13	.894	[−1.07, 0.94]
Multiracial/Other	0.70	0.54	1.30	.197	[−0.37, 1.78]
Other/Multiracial	−0.49	0.75	−0.65	.519	[−2.02, 1.04]
Parent education	−0.18	0.12	−1.48	.142	[−0.42, 0.06]
PVT	**0.40**	**0.09**	**4.62**	**<.001**	**[0.23, 0.58]**
Baseline Tower of Hanoi	0.14	0.10	1.48	.143	[−0.05, 0.34]
Scaf rate × Semi-structured	−0.26	1.09	−0.24	.814	[−2.44, 1.92]
HTKS					
Intercept	**29.07**	**4.91**	**5.92**	**<.001**	**[19.07, 39.07]**
Scaffolding rate	10.09	11.54	0.87	.388	[−13.37, 33.55]
Condition (semi-structured)	−3.45	4.66	−0.74	.463	[−12.83, 5.93]
Age	0.59	0.40	1.47	.147	[−0.22, 1.40]
Sex (female)	2.74	4.00	0.69	.495	[−5.22, 10.71]
Race/ethnicity (ref = White)					
Asian	2.68	6.47	0.41	.680	[−10.22, 15.59]
Black/African American	15.72	10.10	1.56	.123	[−4.37, 35.82]
Hispanic/Latino	−0.22	5.34	−0.04	.967	[−10.99, 10.55]
Multiracial/Other	−4.60	5.41	−0.85	.398	[−15.41, 6.21]
Other/Multiracial	7.30	20.52	0.36	.726	[−35.33, 49.93]
Parent education	−0.78	1.58	−0.49	.627	[−3.99, 2.43]
PVT	**3.36**	**1.29**	**2.61**	**.011**	**[0.80, 5.92]**
Baseline HTKS	**0.68**	**0.12**	**5.84**	**<.001**	**[0.45, 0.91]**
Scaf rate × Semi-structured	−19.25	12.38	−1.55	.128	[−44.32, 5.81]

Note. DNS = Day-Night Stroop; DCCS = Dimensional Change Card Sort; TOH = Tower of Hanoi; HTKS = Head-Toes-Knees-Shoulders. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Scaf rate × Semi-structured = interaction between centered scaffolding rate and semi-structured condition (reference = free play). Bold rows indicate $p < .05$. CI = confidence interval for *b*.

APPENDIX E

AIM 3: RESEARCH QUESTION 3.1 FULL MODELS

Table E1

Full Model Output for Scaffolding Type Rates Predicting PENS (RQ 3.1)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**15.45**	**1.29**	**11.97**	**<.001**	**[12.88, 18.03]**
Engagement rate	0.33	2.34	0.14	0.890	[-4.35, 5.00]
Age	0.11	0.10	1.11	0.269	[-0.09, 0.30]
Sex (female)	-0.65	1.12	-0.58	0.562	[-2.89, 1.58]
Race/ethnicity (ref = White)					
Asian	0.72	1.62	0.44	0.658	[-2.51, 3.95]
Black/African American	2.39	2.09	1.14	0.256	[-1.77, 6.55]
Hispanic/Latino	-1.53	1.61	-0.95	0.345	[-4.74, 1.68]
Multiracial/Other	-0.18	1.58	-0.11	0.909	[-3.32, 2.96]
Other/Multiracial	5.86	7.17	0.82	0.435	[-10.37, 22.09]
Parent education	-0.13	0.35	-0.38	0.708	[-0.83, 0.57]
PVT	0.65	0.35	1.88	0.065	[-0.04, 1.34]
Baseline PENS	**0.59**	**0.12**	**5.04**	**<.001**	**[0.35, 0.82]**
Learning rate model					
Intercept	**15.60**	**1.28**	**12.17**	**<.001**	**[13.04, 18.16]**
Learning rate	-2.57	5.50	-0.47	0.642	[-13.54, 8.40]
Age	0.11	0.10	1.12	0.267	[-0.09, 0.31]
Sex (female)	-0.71	1.12	-0.63	0.529	[-2.93, 1.52]
Race/ethnicity (ref = White)					
Asian	0.53	1.68	0.31	0.755	[-2.83, 3.88]
Black/African American	2.25	1.96	1.15	0.254	[-1.65, 6.15]
Hispanic/Latino	-1.79	1.67	-1.07	0.288	[-5.12, 1.54]
Multiracial/Other	-0.32	1.52	-0.21	0.836	[-3.34, 2.71]
Other/Multiracial	5.35	7.10	0.75	0.469	[-10.60, 21.31]
Parent education	-0.15	0.35	-0.42	0.673	[-0.85, 0.55]
PVT	0.61	0.35	1.74	0.087	[-0.09, 1.31]
Baseline PENS	**0.58**	**0.12**	**4.92**	**<.001**	**[0.35, 0.82]**
Peer rate model					
Intercept	**15.50**	**1.25**	**12.36**	**<.001**	**[13.00, 18.01]**
Peer rate	-0.12	6.41	-0.02	0.985	[-12.93, 12.70]
Age	0.11	0.10	1.07	0.287	[-0.09, 0.31]
Sex (female)	-0.66	1.12	-0.59	0.559	[-2.90, 1.58]
Race/ethnicity (ref = White)					
Asian	0.65	1.69	0.39	0.701	[-2.73, 4.04]
Black/African American	2.32	1.99	1.17	0.247	[-1.64, 6.27]
Hispanic/Latino	-1.61	1.61	-1.00	0.320	[-4.82, 1.60]
Multiracial/Other	-0.25	1.54	-0.16	0.872	[-3.31, 2.81]
Other/Multiracial	5.77	6.92	0.83	0.425	[-9.74, 21.28]
Parent education	-0.13	0.35	-0.38	0.702	[-0.83, 0.56]
PVT	0.64	0.35	1.82	0.074	[-0.06, 1.34]

Table E1. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Baseline PENS	**0.59**	**0.12**	**4.96**	**<.001**	**[0.35, 0.82]**

Note. PENS = Preschool Early Numeracy Screener. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table E2

Full Model Output for Scaffolding Type Rates Predicting CMA (RQ 3.1)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**3.62**	**0.33**	**11.08**	**<.001**	**[2.97, 4.27]**
Engagement rate	-0.46	0.76	-0.60	0.549	[-1.97, 1.06]
Age	0.05	0.03	1.64	0.104	[-0.01, 0.10]
Sex (female)	0.57	0.36	1.58	0.118	[-0.15, 1.29]
Race/ethnicity (ref = White)					
Asian	-0.00	0.56	-0.00	0.998	[-1.12, 1.12]
Black/African American	0.43	0.76	0.56	0.574	[-1.08, 1.93]
Hispanic/Latino	0.09	0.46	0.20	0.844	[-0.82, 1.00]
Multiracial/Other	0.69	0.49	1.40	0.164	[-0.29, 1.66]
Other/Multiracial	0.85	1.62	0.52	0.611	[-2.73, 4.43]
Parent education	-0.03	0.11	-0.31	0.758	[-0.25, 0.18]
PVT	0.18	0.12	1.51	0.134	[-0.06, 0.41]
Baseline CMA	**0.21**	**0.10**	**2.13**	**0.036**	**[0.01, 0.41]**
Learning rate model					
Intercept	**3.54**	**0.34**	**10.52**	**<.001**	**[2.87, 4.22]**
Learning rate	0.53	1.42	0.37	0.710	[-2.30, 3.36]
Age	0.05	0.03	1.64	0.105	[-0.01, 0.11]
Sex (female)	0.58	0.37	1.59	0.114	[-0.14, 1.31]
Race/ethnicity (ref = White)					
Asian	0.10	0.57	0.18	0.858	[-1.03, 1.24]
Black/African American	0.53	0.73	0.73	0.467	[-0.92, 1.98]
Hispanic/Latino	0.23	0.46	0.49	0.625	[-0.70, 1.15]
Multiracial/Other	0.79	0.50	1.58	0.118	[-0.21, 1.79]
Other/Multiracial	1.09	1.61	0.67	0.514	[-2.44, 4.61]
Parent education	-0.03	0.10	-0.31	0.758	[-0.24, 0.18]
PVT	0.20	0.12	1.71	0.091	[-0.03, 0.43]
Baseline CMA	**0.22**	**0.10**	**2.29**	**0.025**	**[0.03, 0.41]**
Peer rate model					
Intercept	**3.51**	**0.35**	**9.92**	**<.001**	**[2.80, 4.21]**
Peer rate	1.14	1.73	0.66	0.511	[-2.30, 4.58]
Age	0.04	0.03	1.47	0.146	[-0.02, 0.11]
Sex (female)	0.59	0.37	1.60	0.113	[-0.14, 1.33]
Race/ethnicity (ref = White)					
Asian	0.17	0.59	0.29	0.773	[-1.00, 1.34]
Black/African American	0.54	0.72	0.74	0.459	[-0.90, 1.98]
Hispanic/Latino	0.30	0.49	0.62	0.540	[-0.67, 1.27]

Table E2. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Multiracial/Other	0.82	0.50	1.65	0.102	[-0.17, 1.81]
Other/Multiracial	1.23	1.61	0.77	0.458	[-2.28, 4.75]
Parent education	-0.02	0.11	-0.18	0.861	[-0.23, 0.20]
PVT	0.20	0.12	1.74	0.086	[-0.03, 0.43]
Baseline CMA	**0.22**	**0.09**	**2.39**	**0.020**	**[0.04, 0.41]**

Note. CMA = Child Math Assessment. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table E3

Full Model Output for Scaffolding Type Rates Predicting PALM (RQ 3.1)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**10.32**	**0.57**	**18.02**	**<.001**	**[9.16, 11.48]**
Engagement rate	-0.75	1.03	-0.73	0.468	[-2.80, 1.30]
Age	0.08	0.05	1.45	0.152	[-0.03, 0.18]
Sex (female)	-0.40	0.57	-0.70	0.486	[-1.53, 0.73]
Race/ethnicity (ref = White)					
Asian	0.32	0.79	0.41	0.684	[-1.25, 1.90]
Black/African American	1.28	0.98	1.30	0.196	[-0.67, 3.22]
Hispanic/Latino	0.22	0.59	0.36	0.716	[-0.96, 1.39]
Multiracial/Other	0.81	0.76	1.07	0.287	[-0.70, 2.32]
Other/Multiracial	0.47	3.74	0.13	0.904	[-8.48, 9.42]
Parent education	-0.05	0.15	-0.30	0.764	[-0.35, 0.26]
PVT	**0.60**	**0.29**	**2.11**	**0.040**	**[0.03, 1.17]**
Baseline PALM	**0.47**	**0.13**	**3.57**	**<.001**	**[0.20, 0.73]**
Learning rate model					
Intercept	**10.28**	**0.62**	**16.60**	**<.001**	**[9.03, 11.53]**
Learning rate	-1.29	2.15	-0.60	0.552	[-5.60, 3.02]
Age	0.08	0.05	1.54	0.130	[-0.03, 0.19]
Sex (female)	-0.41	0.56	-0.74	0.464	[-1.54, 0.71]
Race/ethnicity (ref = White)					
Asian	0.36	0.85	0.43	0.671	[-1.34, 2.07]
Black/African American	1.37	0.97	1.41	0.161	[-0.56, 3.31]
Hispanic/Latino	0.27	0.70	0.39	0.699	[-1.12, 1.67]
Multiracial/Other	0.93	0.78	1.20	0.234	[-0.62, 2.49]
Other/Multiracial	0.45	3.83	0.12	0.910	[-8.57, 9.47]

Table E3. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Parent education	-0.06	0.15	-0.39	0.695	[-0.35, 0.23]
PVT	**0.61**	**0.29**	**2.14**	**0.038**	**[0.04, 1.19]**
Baseline PALM	**0.46**	**0.13**	**3.58**	**<.001**	**[0.20, 0.72]**
Peer rate model					
Intercept	**10.21**	**0.62**	**16.45**	**<.001**	**[8.96, 11.46]**
Peer rate	0.31	2.89	0.11	0.914	[-5.47, 6.09]
Age	0.08	0.05	1.50	0.140	[-0.03, 0.19]
Sex (female)	-0.38	0.55	-0.70	0.488	[-1.48, 0.71]
Race/ethnicity (ref = White)					
Asian	0.47	0.93	0.51	0.613	[-1.38, 2.32]
Black/African American	1.43	0.98	1.46	0.148	[-0.52, 3.37]
Hispanic/Latino	0.40	0.76	0.53	0.597	[-1.11, 1.92]
Multiracial/Other	0.98	0.80	1.22	0.225	[-0.62, 2.57]
Other/Multiracial	0.76	3.71	0.20	0.844	[-7.86, 9.37]
Parent education	-0.04	0.15	-0.27	0.791	[-0.35, 0.27]
PVT	**0.64**	**0.28**	**2.23**	**0.030**	**[0.06, 1.21]**
Baseline PALM	**0.46**	**0.13**	**3.61**	**<.001**	**[0.20, 0.72]**

Note. PALM = Preschool Mathematical Language Assessment. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table E4

Full Model Output for Scaffolding Type Rates Predicting Numeral ID (RQ 3.1)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**5.66**	**0.45**	**12.69**	**<.001**	**[4.76, 6.56]**
Engagement rate	-1.36	0.89	-1.53	0.130	[-3.12, 0.41]
Age	-0.05	0.04	-1.11	0.270	[-0.13, 0.04]
Sex (female)	0.01	0.44	0.02	0.987	[-0.86, 0.87]
Race/ethnicity (ref = White)					
Asian	0.01	0.62	0.02	0.986	[-1.26, 1.28]
Black/African American	-0.54	0.76	-0.72	0.473	[-2.05, 0.96]
Hispanic/Latino	-0.91	0.65	-1.39	0.169	[-2.22, 0.40]
Multiracial/Other	0.02	0.42	0.04	0.972	[-0.82, 0.85]
Other/Multiracial	0.45	2.87	0.16	0.882	[-7.03, 7.93]
Parent education	-0.10	0.11	-0.88	0.381	[-0.32, 0.12]
PVT	0.13	0.15	0.92	0.363	[-0.16, 0.43]

Table E4. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Baseline Numeral ID	**0.84**	**0.11**	**7.44**	**<.001**	**[0.62, 1.07]**
Learning rate model					
Intercept	**5.56**	**0.47**	**11.74**	**<.001**	**[4.61, 6.52]**
Learning rate	-1.69	1.67	-1.01	0.317	[-5.03, 1.65]
Age	-0.04	0.04	-0.85	0.397	[-0.12, 0.05]
Sex (female)	-0.03	0.44	-0.08	0.939	[-0.91, 0.84]
Race/ethnicity (ref = White)					
Asian	0.18	0.63	0.28	0.783	[-1.12, 1.48]
Black/African American	-0.34	0.77	-0.44	0.660	[-1.87, 1.19]
Hispanic/Latino	-0.74	0.69	-1.07	0.287	[-2.11, 0.64]
Multiracial/Other	0.22	0.41	0.55	0.583	[-0.59, 1.04]
Other/Multiracial	0.52	2.78	0.19	0.858	[-6.44, 7.48]
Parent education	-0.11	0.11	-0.98	0.329	[-0.32, 0.11]
PVT	0.17	0.15	1.15	0.254	[-0.12, 0.46]
Baseline Numeral ID	**0.82**	**0.11**	**7.23**	**<.001**	**[0.59, 1.05]**
Peer rate model					
Intercept	**5.62**	**0.47**	**11.93**	**<.001**	**[4.67, 6.57]**
Peer rate	-2.38	2.03	-1.17	0.246	[-6.43, 1.68]
Age	-0.03	0.04	-0.74	0.462	[-0.11, 0.05]
Sex (female)	-0.05	0.43	-0.11	0.915	[-0.91, 0.82]
Race/ethnicity (ref = White)					
Asian	0.06	0.63	0.10	0.919	[-1.21, 1.34]
Black/African American	-0.33	0.74	-0.45	0.656	[-1.81, 1.15]
Hispanic/Latino	-0.84	0.67	-1.26	0.211	[-2.18, 0.49]
Multiracial/Other	0.19	0.42	0.44	0.658	[-0.66, 1.03]
Other/Multiracial	0.31	2.84	0.11	0.918	[-6.70, 7.32]
Parent education	-0.13	0.12	-1.10	0.275	[-0.37, 0.11]
PVT	0.17	0.14	1.20	0.235	[-0.11, 0.45]
Baseline Numeral ID	**0.82**	**0.11**	**7.30**	**<.001**	**[0.60, 1.05]**

Note. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table E5

Full Model Output for Scaffolding Type Rates Predicting Cardinality (RQ 3.1)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**2.70**	**0.44**	**6.16**	**<.001**	**[1.82, 3.59]**
Engagement rate	0.33	0.71	0.46	0.649	[-1.10, 1.75]
Age	0.03	0.03	0.95	0.346	[-0.03, 0.08]
Sex (female)	-0.17	0.29	-0.58	0.565	[-0.75, 0.41]
Race/ethnicity (ref = White)					
Asian	0.80	0.56	1.42	0.160	[-0.32, 1.93]
Black/African American	-0.06	0.62	-0.09	0.929	[-1.28, 1.17]
Hispanic/Latino	-0.04	0.53	-0.08	0.940	[-1.09, 1.01]
Multiracial/Other	0.64	0.46	1.39	0.169	[-0.28, 1.55]
Other/Multiracial	1.56	1.88	0.83	0.427	[-2.67, 5.79]
Parent education	-0.02	0.10	-0.16	0.870	[-0.22, 0.19]
PVT	0.15	0.11	1.28	0.206	[-0.08, 0.38]
Baseline Cardinality	**0.54**	**0.12**	**4.63**	**<.001**	**[0.30, 0.77]**
Learning rate model					
Intercept	**2.76**	**0.44**	**6.29**	**<.001**	**[1.88, 3.65]**
Learning rate	-0.47	1.46	-0.32	0.748	[-3.37, 2.43]
Age	0.03	0.03	0.88	0.382	[-0.03, 0.09]
Sex (female)	-0.18	0.29	-0.62	0.538	[-0.76, 0.40]
Race/ethnicity (ref = White)					
Asian	0.72	0.58	1.24	0.221	[-0.45, 1.89]
Black/African American	-0.13	0.58	-0.22	0.826	[-1.29, 1.03]
Hispanic/Latino	-0.14	0.54	-0.26	0.796	[-1.23, 0.95]
Multiracial/Other	0.56	0.41	1.37	0.175	[-0.25, 1.38]
Other/Multiracial	1.39	1.86	0.75	0.473	[-2.78, 5.55]
Parent education	-0.02	0.10	-0.19	0.851	[-0.22, 0.18]
PVT	0.13	0.12	1.08	0.285	[-0.11, 0.37]
Baseline Cardinality	**0.54**	**0.12**	**4.55**	**<.001**	**[0.30, 0.77]**
Peer rate model					
Intercept	**2.70**	**0.44**	**6.20**	**<.001**	**[1.83, 3.58]**
Peer rate	0.78	1.51	0.52	0.607	[-2.22, 3.77]
Age	0.02	0.03	0.72	0.471	[-0.04, 0.08]
Sex (female)	-0.16	0.30	-0.53	0.595	[-0.75, 0.43]
Race/ethnicity (ref = White)					
Asian	0.82	0.59	1.38	0.172	[-0.37, 2.00]
Black/African American	-0.10	0.59	-0.17	0.869	[-1.27, 1.08]
Hispanic/Latino	-0.03	0.54	-0.06	0.955	[-1.10, 1.04]
Multiracial/Other	0.60	0.43	1.41	0.163	[-0.25, 1.45]

Other/Multiracial					
Asian	***b***	**SE**	***t***	***p***	**95% CI**
Black/African American	1.63	1.93	0.85	0.417	[-2.68, 5.95]
Parent education	-0.00	0.10	-0.04	0.972	[-0.21, 0.20]
PVT	0.14	0.11	1.23	0.224	[-0.09, 0.37]
Baseline Cardinality	**0.54**	**0.12**	**4.59**	**<.001**	**[0.30, 0.78]**

Note. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table E6

Full Model Output for Scaffolding Type Rates Predicting TOSA (RQ 3.1)

Term	***b***	**SE**	***t***	***p***	**95% CI**
Engagement rate model					
Intercept	**60.08**	**2.54**	**23.65**	**<.001**	**[54.98, 65.17]**
Engagement rate	-5.89	5.50	-1.07	0.291	[-17.02, 5.25]
Age	0.11	0.20	0.53	0.598	[-0.30, 0.51]
Sex (female)	-2.71	2.19	-1.24	0.219	[-7.07, 1.64]
Race/ethnicity (ref = White)					
Asian	0.42	3.24	0.13	0.898	[-6.07, 6.90]
Black/African American	1.68	4.94	0.34	0.734	[-8.14, 11.51]
Hispanic/Latino	2.46	3.56	0.69	0.492	[-4.63, 9.54]
Multiracial/Other	3.58	4.57	0.78	0.436	[-5.54, 12.70]
Other/Multiracial	5.41	11.89	0.45	0.661	[-21.69, 32.50]
Parent education	-0.60	0.66	-0.91	0.366	[-1.93, 0.72]
PVT	-0.34	0.74	-0.46	0.648	[-1.81, 1.14]
Baseline TOSA	**0.57**	**0.11**	**5.28**	**<.001**	**[0.36, 0.79]**
Learning rate model					
Intercept	**59.58**	**2.88**	**20.71**	**<.001**	**[53.77, 65.39]**
Learning rate	-5.77	9.16	-0.63	0.531	[-24.11, 12.56]
Age	0.15	0.21	0.69	0.492	[-0.28, 0.57]
Sex (female)	-2.75	2.19	-1.25	0.213	[-7.10, 1.61]
Race/ethnicity (ref = White)					
Asian	1.05	3.66	0.29	0.777	[-6.32, 8.41]
Black/African American	2.60	5.00	0.52	0.604	[-7.35, 12.55]
Hispanic/Latino	3.28	3.96	0.83	0.410	[-4.62, 11.17]
Multiracial/Other	4.65	4.42	1.05	0.296	[-4.17, 13.47]
Other/Multiracial	6.13	12.51	0.49	0.636	[-22.01, 34.27]
Parent education	-0.67	0.68	-0.99	0.323	[-2.03, 0.68]
PVT	-0.19	0.74	-0.26	0.795	[-1.67, 1.28]

Table E6. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Baseline TOSA	**0.57**	**0.11**	**5.25**	**<.001**	**[0.35, 0.78]**
Peer rate model					
Intercept	**60.22**	**2.71**	**22.23**	**<.001**	**[54.74, 65.70]**
Peer rate	-15.94	10.02	-1.59	0.116	[-35.96, 4.07]
Age	0.18	0.22	0.83	0.410	[-0.25, 0.61]
Sex (female)	-2.95	2.08	-1.42	0.159	[-7.09, 1.18]
Race/ethnicity (ref = White)					
Asian	-0.14	3.62	-0.04	0.970	[-7.42, 7.15]
Black/African American	2.38	4.79	0.50	0.621	[-7.14, 11.90]
Hispanic/Latino	2.10	3.76	0.56	0.578	[-5.41, 9.61]
Multiracial/Other	4.19	4.41	0.95	0.346	[-4.62, 13.00]
Other/Multiracial	3.62	12.02	0.30	0.770	[-23.92, 31.17]
Parent education	-0.89	0.71	-1.27	0.210	[-2.30, 0.52]
PVT	-0.31	0.70	-0.44	0.661	[-1.71, 1.09]
Baseline TOSA	**0.58**	**0.11**	**5.42**	**<.001**	**[0.37, 0.79]**

Note. TOSA = Test of Spatial Awareness. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table E7

Full Model Output for Scaffolding Type Rates Predicting DNS (RQ 3.1)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**21.97**	**1.30**	**16.96**	**<.001**	**[19.38, 24.56]**
Engagement rate	-1.95	3.10	-0.63	0.531	[-8.11, 4.22]
Age	0.18	0.15	1.20	0.233	[-0.12, 0.47]
Sex (female)	-0.15	1.52	-0.10	0.921	[-3.18, 2.87]
Race/ethnicity (ref = White)					
Asian	2.57	2.46	1.04	0.301	[-2.35, 7.49]
Black/African American	**5.64**	**2.09**	**2.70**	**0.009**	**[1.48, 9.80]**
Hispanic/Latino	0.75	2.05	0.37	0.716	[-3.34, 4.84]
Multiracial/Other	2.62	2.52	1.04	0.301	[-2.39, 7.63]
Other/Multiracial	6.83	8.57	0.80	0.444	[-12.22, 25.87]
Parent education	-0.51	0.46	-1.10	0.273	[-1.42, 0.41]
PVT	0.12	0.48	0.26	0.797	[-0.84, 1.08]
Baseline DNS	**0.40**	**0.11**	**3.54**	**<.001**	**[0.17, 0.62]**

Table E7. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Learning rate model					
Intercept	**21.68**	**1.46**	**14.82**	**<.001**	**[18.76, 24.61]**
Learning rate	0.67	6.77	0.10	0.921	[-12.91, 14.25]
Age	0.19	0.15	1.27	0.209	[-0.11, 0.49]
Sex (female)	-0.09	1.46	-0.06	0.951	[-3.00, 2.82]
Race/ethnicity (ref = White)					
Asian	2.96	2.58	1.15	0.256	[-2.21, 8.12]
Black/African American	**6.05**	**2.06**	**2.93**	**0.004**	**[1.94, 10.15]**
Hispanic/Latino	1.23	2.26	0.54	0.588	[-3.27, 5.73]
Multiracial/Other	3.01	2.61	1.15	0.252	[-2.18, 8.20]
Other/Multiracial	7.58	8.41	0.90	0.386	[-10.86, 26.01]
Parent education	-0.50	0.46	-1.11	0.272	[-1.41, 0.40]
PVT	0.22	0.46	0.48	0.632	[-0.69, 1.13]
Baseline DNS	**0.39**	**0.12**	**3.38**	**0.001**	**[0.16, 0.62]**
Peer rate model					
Intercept	**21.48**	**1.47**	**14.57**	**<.001**	**[18.53, 24.43]**
Peer rate	4.51	6.91	0.65	0.517	[-9.38, 18.40]
Age	0.17	0.15	1.18	0.242	[-0.12, 0.47]
Sex (female)	-0.03	1.49	-0.02	0.984	[-2.99, 2.93]
Race/ethnicity (ref = White)					
Asian	3.32	2.63	1.26	0.213	[-1.96, 8.61]
Black/African American	**6.12**	**2.02**	**3.02**	**0.003**	**[2.08, 10.15]**
Hispanic/Latino	1.63	2.27	0.72	0.476	[-2.90, 6.16]
Multiracial/Other	3.16	2.67	1.19	0.238	[-2.13, 8.46]
Other/Multiracial	8.41	8.36	1.01	0.336	[-9.95, 26.77]
Parent education	-0.44	0.47	-0.93	0.355	[-1.37, 0.50]
PVT	0.25	0.45	0.56	0.580	[-0.66, 1.16]
Baseline DNS	**0.39**	**0.11**	**3.47**	**<.001**	**[0.17, 0.62]**

Note. DNS = Day-Night Stroop. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table E8

Full Model Output for Scaffolding Type Rates Predicting DCCS (RQ 3.1)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**12.90**	**0.88**	**14.66**	**<.001**	**[11.13, 14.66]**
Engagement rate	1.25	2.13	0.58	0.561	[-3.01, 5.50]
Age	0.08	0.10	0.85	0.396	[-0.11, 0.28]
Sex (female)	1.09	0.89	1.23	0.222	[-0.67, 2.86]
Race/ethnicity (ref = White)					
Asian	-0.72	1.54	-0.47	0.643	[-3.78, 2.35]
Black/African American	1.71	2.49	0.69	0.495	[-3.25, 6.66]
Hispanic/Latino	-0.91	1.56	-0.59	0.560	[-4.02, 2.19]
Multiracial/Other	-0.10	1.77	-0.05	0.956	[-3.63, 3.43]
Other/Multiracial	1.82	6.64	0.27	0.793	[-13.95, 17.59]
Parent education	-0.21	0.39	-0.54	0.588	[-0.98, 0.56]
PVT	**0.92**	**0.37**	**2.50**	**0.014**	**[0.19, 1.66]**
Baseline DCCS	**0.41**	**0.10**	**3.92**	**<.001**	**[0.20, 0.61]**
Learning rate model					
Intercept	**12.93**	**0.91**	**14.28**	**<.001**	**[11.10, 14.75]**
Learning rate	2.78	5.46	0.51	0.612	[-8.08, 13.64]
Age	0.07	0.10	0.77	0.446	[-0.12, 0.27]
Sex (female)	1.14	0.85	1.33	0.186	[-0.56, 2.83]
Race/ethnicity (ref = White)					
Asian	-0.75	1.53	-0.49	0.624	[-3.79, 2.29]
Black/African American	1.58	2.45	0.64	0.521	[-3.29, 6.44]
Hispanic/Latino	-0.95	1.64	-0.58	0.563	[-4.22, 2.32]
Multiracial/Other	-0.28	1.69	-0.17	0.869	[-3.64, 3.08]
Other/Multiracial	2.02	6.49	0.31	0.763	[-12.97, 17.02]
Parent education	-0.18	0.39	-0.47	0.638	[-0.96, 0.59]
PVT	**0.91**	**0.38**	**2.41**	**0.018**	**[0.16, 1.66]**
Baseline DCCS	**0.41**	**0.11**	**3.90**	**<.001**	**[0.20, 0.62]**
Peer rate model					
Intercept	**12.85**	**0.91**	**14.06**	**<.001**	**[11.01, 14.68]**
Peer rate	3.79	4.97	0.76	0.447	[-6.10, 13.68]
Age	0.07	0.09	0.70	0.483	[-0.12, 0.25]
Sex (female)	1.15	0.88	1.31	0.193	[-0.59, 2.89]
Race/ethnicity (ref = White)					
Asian	-0.57	1.58	-0.36	0.719	[-3.72, 2.58]
Black/African American	1.57	2.49	0.63	0.530	[-3.38, 6.51]
Hispanic/Latino	-0.79	1.60	-0.50	0.622	[-3.97, 2.39]
Multiracial/Other	-0.21	1.72	-0.12	0.902	[-3.62, 3.20]

Table E8. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Other/Multiracial	2.32	6.43	0.36	0.727	[-12.53, 17.17]
Parent education	-0.15	0.40	-0.37	0.714	[-0.94, 0.65]
PVT	**0.91**	**0.36**	**2.52**	**0.014**	**[0.19, 1.64]**
Baseline DCCS	**0.41**	**0.10**	**3.93**	**<.001**	**[0.20, 0.62]**

Note. DCCS = Dimensional Card Change Sort. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table E9

Full Model Output for Scaffolding Type Rates Predicting Tower of Hanoi (RQ 3.1)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**2.24**	**0.43**	**5.16**	**<.001**	**[1.38, 3.11]**
Engagement rate	-0.01	0.79	-0.01	0.988	[-1.58, 1.56]
Age	-0.01	0.03	-0.51	0.608	[-0.07, 0.04]
Sex (female)	-0.11	0.35	-0.30	0.767	[-0.81, 0.60]
Race/ethnicity (ref = White)					
Asian	-0.24	0.59	-0.40	0.688	[-1.42, 0.94]
Black/African American	0.42	0.69	0.60	0.549	[-0.96, 1.80]
Hispanic/Latino	0.15	0.52	0.30	0.767	[-0.87, 1.18]
Multiracial/Other	0.58	0.61	0.95	0.346	[-0.64, 1.80]
Other/Multiracial	-0.80	0.84	-0.96	0.343	[-2.50, 0.89]
Parent education	-0.20	0.12	-1.75	0.084	[-0.44, 0.03]
PVT	**0.41**	**0.09**	**4.64**	**<.001**	**[0.24, 0.59]**
Baseline Tower of Hanoi	0.16	0.09	1.66	0.101	[-0.03, 0.34]
Learning rate model					
Intercept	**2.31**	**0.41**	**5.61**	**<.001**	**[1.49, 3.12]**
Learning rate	-1.56	1.68	-0.93	0.358	[-4.91, 1.79]
Age	-0.01	0.03	-0.42	0.676	[-0.07, 0.04]
Sex (female)	-0.13	0.35	-0.38	0.705	[-0.83, 0.56]
Race/ethnicity (ref = White)					
Asian	-0.33	0.55	-0.59	0.554	[-1.41, 0.76]
Black/African American	0.37	0.63	0.58	0.564	[-0.89, 1.63]
Hispanic/Latino	0.03	0.47	0.07	0.941	[-0.90, 0.97]
Multiracial/Other	0.53	0.57	0.95	0.346	[-0.59, 1.66]
Other/Multiracial	-1.07	0.83	-1.28	0.207	[-2.75, 0.61]
Parent education	-0.22	0.12	-1.80	0.076	[-0.45, 0.02]

Table E9. (continued)

Term	*b*	SE	*t*	*p*	95% CI
PVT	**0.40**	**0.08**	**4.89**	**<.001**	**[0.23, 0.56]**
Baseline Tower of Hanoi	0.15	0.10	1.51	0.135	[-0.05, 0.34]
Peer rate model					
Intercept	**2.29**	**0.42**	**5.47**	**<.001**	**[1.46, 3.12]**
Peer rate	-0.94	2.09	-0.45	0.654	[-5.09, 3.21]
Age	-0.01	0.03	-0.36	0.723	[-0.07, 0.05]
Sex (female)	-0.12	0.35	-0.35	0.726	[-0.81, 0.57]
Race/ethnicity (ref = White)					
Asian	-0.32	0.63	-0.51	0.613	[-1.58, 0.94]
Black/African American	0.40	0.64	0.62	0.536	[-0.88, 1.68]
Hispanic/Latino	0.06	0.57	0.10	0.918	[-1.08, 1.20]
Multiracial/Other	0.55	0.58	0.94	0.349	[-0.61, 1.70]
Other/Multiracial	-1.00	0.86	-1.17	0.248	[-2.71, 0.72]
Parent education	-0.22	0.12	-1.82	0.074	[-0.46, 0.02]
PVT	**0.41**	**0.09**	**4.64**	**<.001**	**[0.23, 0.58]**
Baseline Tower of Hanoi	0.15	0.10	1.61	0.111	[-0.04, 0.34]

Note. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table E10

Full Model Output for Scaffolding Type Rates Predicting HTKS (RQ 3.1)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**26.93**	**4.22**	**6.38**	**<.001**	**[18.44, 35.42]**
Engagement rate	-5.32	7.86	-0.68	0.501	[-21.04, 10.40]
Age	0.57	0.39	1.45	0.152	[-0.22, 1.35]
Sex (female)	2.97	3.75	0.79	0.430	[-4.49, 10.44]
Race/ethnicity (ref = White)					
Asian	1.52	7.03	0.22	0.829	[-12.52, 15.57]
Black/African American	16.28	10.08	1.62	0.110	[-3.76, 36.31]
Hispanic/Latino	-0.14	5.41	-0.03	0.980	[-11.03, 10.76]
Multiracial/Other	-5.63	5.99	-0.94	0.351	[-17.58, 6.33]
Other/Multiracial	5.29	21.08	0.25	0.804	[-38.40, 48.98]
Parent education	-0.86	1.65	-0.52	0.605	[-4.20, 2.47]
PVT	**3.00**	**1.36**	**2.20**	**0.031**	**[0.28, 5.71]**
Baseline HTKS	**0.69**	**0.12**	**5.86**	**<.001**	**[0.45, 0.92]**

Table E10. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Learning rate model					
Intercept	**26.77**	**4.14**	**6.47**	**<.001**	**[18.42, 35.12]**
Learning rate	-12.09	26.21	-0.46	0.646	[-64.27, 40.09]
Age	0.62	0.40	1.54	0.130	[-0.19, 1.43]
Sex (female)	2.79	3.76	0.74	0.460	[-4.69, 10.27]
Race/ethnicity (ref = White)					
Asian	1.68	6.81	0.25	0.806	[-11.92, 15.27]
Black/African American	16.95	9.86	1.72	0.089	[-2.65, 36.55]
Hispanic/Latino	0.05	5.41	0.01	0.992	[-10.90, 11.01]
Multiracial/Other	-4.77	6.07	-0.79	0.434	[-16.89, 7.34]
Other/Multiracial	4.70	20.06	0.23	0.817	[-36.66, 46.05]
Parent education	-0.97	1.68	-0.57	0.568	[-4.36, 2.42]
PVT	**3.05**	**1.32**	**2.30**	**0.025**	**[0.40, 5.69]**
Baseline HTKS	**0.68**	**0.12**	**5.64**	**<.001**	**[0.44, 0.92]**
Peer rate model					
Intercept	**26.71**	**4.00**	**6.68**	**<.001**	**[18.66, 34.76]**
Peer rate	-8.22	20.31	-0.40	0.687	[-48.78, 32.35]
Age	0.62	0.40	1.55	0.127	[-0.18, 1.43]
Sex (female)	2.87	3.70	0.77	0.441	[-4.50, 10.23]
Race/ethnicity (ref = White)					
Asian	1.61	6.85	0.24	0.814	[-12.06, 15.28]
Black/African American	17.11	9.76	1.75	0.083	[-2.30, 36.51]
Hispanic/Latino	0.17	5.64	0.03	0.976	[-11.20, 11.55]
Multiracial/Other	-4.80	6.09	-0.79	0.434	[-16.96, 7.37]
Other/Multiracial	5.09	20.05	0.25	0.802	[-36.45, 46.62]
Parent education	-1.02	1.70	-0.60	0.551	[-4.46, 2.41]
PVT	**3.11**	**1.36**	**2.29**	**0.025**	**[0.40, 5.82]**
Baseline HTKS	**0.69**	**0.12**	**5.80**	**<.001**	**[0.45, 0.92]**

Note. HTKS = Head-Toes-Knees-Shoulders. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

APPENDIX F

AIM 3: RESEARCH QUESTION 3.2 FULL MODELS

Table F1

Full Model Output for Scaffolding Type × Condition Predicting PENS (RQ 3.2)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**15.45**	**1.70**	**9.10**	**<.001**	**[12.04, 18.86]**
Engagement rate	0.97	5.60	0.17	0.863	[-10.39, 12.33]
Condition (semi-structured)	0.09	1.31	0.07	0.946	[-2.54, 2.72]
Age	0.11	0.10	1.10	0.277	[-0.09, 0.32]
Sex (female)	-0.69	1.12	-0.62	0.535	[-2.92, 1.53]
Race/ethnicity (ref = White)					
Asian	0.77	1.58	0.49	0.627	[-2.38, 3.92]
Black/African American	2.36	2.09	1.13	0.262	[-1.80, 6.52]
Hispanic/Latino	-1.50	1.68	-0.89	0.374	[-4.84, 1.84]
Multiracial/Other	-0.22	1.56	-0.14	0.888	[-3.33, 2.89]
Other/Multiracial	5.83	7.33	0.79	0.449	[-10.93, 22.59]
Parent education	-0.13	0.35	-0.37	0.710	[-0.84, 0.57]
PVT	**0.66**	**0.33**	**2.02**	**0.047**	**[0.01, 1.32]**
Baseline PENS	**0.58**	**0.11**	**5.28**	**<.001**	**[0.36, 0.80]**
Engagement rate × Condition	-1.02	5.96	-0.17	0.866	[-13.10, 11.07]
Learning rate model					
Intercept	**15.50**	**1.63**	**9.50**	**<.001**	**[12.23, 18.77]**
Learning rate	0.23	9.16	0.02	0.980	[-18.30, 18.76]
Condition (semi-structured)	0.23	1.24	0.19	0.852	[-2.25, 2.71]
Age	0.12	0.10	1.11	0.273	[-0.09, 0.33]
Sex (female)	-0.70	1.10	-0.64	0.527	[-2.89, 1.49]
Race/ethnicity (ref = White)					
Asian	0.57	1.67	0.34	0.732	[-2.76, 3.91]
Black/African American	2.10	2.02	1.04	0.303	[-1.94, 6.13]
Hispanic/Latino	-1.68	1.75	-0.96	0.340	[-5.17, 1.81]
Multiracial/Other	-0.37	1.50	-0.24	0.808	[-3.34, 2.61]
Other/Multiracial	5.10	7.25	0.70	0.499	[-11.29, 21.49]
Parent education	-0.17	0.36	-0.48	0.632	[-0.89, 0.54]
PVT	**0.66**	**0.32**	**2.08**	**0.041**	**[0.03, 1.30]**
Baseline PENS	**0.58**	**0.12**	**4.87**	**<.001**	**[0.34, 0.82]**
Learning rate × Condition	-5.26	11.50	-0.46	0.649	[-28.34, 17.82]
Peer rate model					
Intercept	**15.44**	**1.62**	**9.53**	**<.001**	**[12.20, 18.69]**

Table F1. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Peer rate	0.75	10.89	0.07	0.945	[-21.12, 22.62]
Condition (semi-structured)	0.15	1.23	0.12	0.903	[-2.30, 2.60]
Age	0.11	0.11	1.04	0.301	[-0.10, 0.33]
Sex (female)	-0.66	1.10	-0.61	0.546	[-2.85, 1.52]
Race/ethnicity (ref = White)					
Asian	0.66	1.68	0.39	0.696	[-2.70, 4.02]
Black/African American	2.31	1.96	1.18	0.243	[-1.60, 6.23]
Hispanic/Latino	-1.57	1.68	-0.94	0.353	[-4.93, 1.79]
Multiracial/Other	-0.30	1.50	-0.20	0.844	[-3.29, 2.69]
Other/Multiracial	5.62	7.09	0.79	0.448	[-10.42, 21.66]
Parent education	-0.14	0.36	-0.39	0.697	[-0.86, 0.57]
PVT	0.65	0.33	1.94	0.057	[-0.02, 1.32]
Baseline PENS	**0.59**	**0.12**	**4.94**	**<.001**	**[0.35, 0.82]**
Peer rate × Condition	-1.79	12.34	-0.15	0.885	[-26.42, 22.83]

Note. PENS = Preschool Early Numeracy Screener. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction between scaffolding type rate and semi-structured condition (reference = free play). Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table F2

Full Model Output for Scaffolding Type × Condition Predicting CMA (RQ 3.2)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**3.74**	**0.45**	**8.31**	**<.001**	**[2.83, 4.65]**
Engagement rate	-0.68	1.90	-0.36	0.721	[-4.54, 3.18]
Condition (semi-structured)	-0.34	0.45	-0.75	0.454	[-1.23, 0.56]
Age	0.04	0.03	1.47	0.146	[-0.02, 0.10]
Sex (female)	0.63	0.35	1.80	0.076	[-0.07, 1.33]
Race/ethnicity (ref = White)					
Asian	-0.00	0.56	-0.00	0.997	[-1.12, 1.12]
Black/African American	0.47	0.76	0.62	0.537	[-1.04, 1.98]
Hispanic/Latino	0.03	0.46	0.07	0.947	[-0.89, 0.95]
Multiracial/Other	0.78	0.48	1.62	0.108	[-0.18, 1.74]
Other/Multiracial	1.01	1.66	0.61	0.557	[-2.68, 4.69]
Parent education	-0.02	0.11	-0.20	0.842	[-0.24, 0.20]
PVT	0.18	0.12	1.55	0.126	[-0.05, 0.42]

Table F2. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Baseline CMA	0.19	0.10	1.88	0.063	[-0.01, 0.40]
Engagement rate × Condition	0.50	2.01	0.25	0.806	[-3.57, 4.56]
Learning rate model					
Intercept	**3.72**	**0.44**	**8.54**	**<.001**	**[2.85, 4.60]**
Learning rate	1.69	2.27	0.74	0.462	[-2.90, 6.27]
Condition (semi-structured)	-0.39	0.41	-0.95	0.345	[-1.21, 0.43]
Age	0.04	0.03	1.39	0.168	[-0.02, 0.10]
Sex (female)	0.65	0.36	1.82	0.072	[-0.06, 1.35]
Race/ethnicity (ref = White)					
Asian	0.11	0.56	0.20	0.841	[-1.00, 1.23]
Black/African American	0.50	0.73	0.69	0.492	[-0.95, 1.95]
Hispanic/Latino	0.18	0.47	0.38	0.707	[-0.75, 1.11]
Multiracial/Other	0.87	0.50	1.72	0.089	[-0.13, 1.86]
Other/Multiracial	1.24	1.65	0.75	0.468	[-2.37, 4.85]
Parent education	-0.02	0.11	-0.20	0.846	[-0.24, 0.20]
PVT	0.21	0.12	1.86	0.067	[-0.01, 0.44]
Baseline CMA	**0.21**	**0.10**	**2.11**	**0.038**	**[0.01, 0.41]**
Learning rate × Condition	-1.66	3.06	-0.54	0.590	[-7.78, 4.47]
Peer rate model					
Intercept	**3.69**	**0.44**	**8.37**	**<.001**	**[2.80, 4.58]**
Peer rate	1.03	3.19	0.32	0.747	[-5.33, 7.39]
Condition (semi-structured)	-0.46	0.41	-1.11	0.269	[-1.28, 0.36]
Age	0.04	0.03	1.21	0.231	[-0.02, 0.10]
Sex (female)	0.65	0.36	1.83	0.070	[-0.06, 1.36]
Race/ethnicity (ref = White)					
Asian	0.20	0.58	0.35	0.728	[-0.95, 1.35]
Black/African American	0.56	0.72	0.78	0.438	[-0.87, 1.98]
Hispanic/Latino	0.23	0.49	0.47	0.640	[-0.75, 1.22]
Multiracial/Other	0.93	0.49	1.87	0.065	[-0.06, 1.91]
Other/Multiracial	1.52	1.67	0.91	0.381	[-2.12, 5.15]
Parent education	0.00	0.11	0.04	0.966	[-0.22, 0.23]
PVT	0.21	0.12	1.78	0.078	[-0.02, 0.44]
Baseline CMA	**0.19**	**0.10**	**2.02**	**0.046**	**[0.00, 0.39]**
Peer rate × Condition	0.93	3.51	0.26	0.792	[-6.07, 7.92]

Note. CMA = Child Math Assessment. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction between scaffolding type rate and semi-structured condition (reference = free play). Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table F3

Full Model Output for Scaffolding Type × Condition Predicting PALM (RQ 3.2)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**9.90**	**0.81**	**12.27**	**<.001**	**[8.24, 11.56]**
Engagement rate	-2.62	2.77	-0.95	0.352	[-8.28, 3.05]
Condition (semi-structured)	0.71	0.60	1.17	0.247	[-0.51, 1.93]
Age	0.07	0.05	1.39	0.171	[-0.03, 0.18]
Sex (female)	-0.40	0.57	-0.71	0.479	[-1.53, 0.72]
Race/ethnicity (ref = White)					
Asian	0.25	0.76	0.33	0.741	[-1.26, 1.77]
Black/African American	1.26	0.97	1.30	0.197	[-0.66, 3.18]
Hispanic/Latino	0.37	0.65	0.58	0.567	[-0.92, 1.67]
Multiracial/Other	0.67	0.76	0.89	0.377	[-0.84, 2.19]
Other/Multiracial	-0.06	3.85	-0.01	0.989	[-9.37, 9.26]
Parent education	-0.08	0.15	-0.55	0.584	[-0.38, 0.21]
PVT	**0.55**	**0.27**	**2.05**	**0.045**	**[0.01, 1.08]**
Baseline PALM	**0.51**	**0.11**	**4.55**	**<.001**	**[0.28, 0.73]**
Engagement rate × Condition	2.48	2.98	0.83	0.413	[-3.63, 8.58]
Learning rate model					
Intercept	**10.02**	**0.74**	**13.54**	**<.001**	**[8.51, 11.53]**
Learning rate	0.51	4.86	0.10	0.917	[-9.29, 10.30]
Condition (semi-structured)	0.61	0.55	1.11	0.271	[-0.49, 1.72]
Age	0.09	0.05	1.58	0.121	[-0.02, 0.20]
Sex (female)	-0.46	0.57	-0.81	0.419	[-1.59, 0.67]
Race/ethnicity (ref = White)					
Asian	0.40	0.83	0.48	0.635	[-1.27, 2.06]
Black/African American	1.21	1.01	1.19	0.236	[-0.80, 3.22]
Hispanic/Latino	0.45	0.71	0.64	0.526	[-0.96, 1.86]
Multiracial/Other	0.79	0.77	1.03	0.308	[-0.74, 2.32]

Table F3. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Other/Multiracial	-0.06	3.87	-0.02	0.987	[-9.42, 9.29]
Parent education	-0.09	0.14	-0.67	0.504	[-0.38, 0.19]
PVT	**0.63**	**0.27**	**2.28**	**0.026**	**[0.08, 1.18]**
Baseline PALM	**0.48**	**0.12**	**4.16**	**<.001**	**[0.25, 0.72]**
Learning rate × Condition	-3.88	5.35	-0.73	0.472	[-14.65, 6.89]
Peer rate model					
Intercept	**9.98**	**0.74**	**13.49**	**<.001**	**[8.47, 11.49]**
Peer rate	1.22	4.95	0.25	0.806	[-8.76, 11.20]
Condition (semi-structured)	0.57	0.54	1.06	0.297	[-0.52, 1.66]
Age	0.09	0.05	1.62	0.113	[-0.02, 0.19]
Sex (female)	-0.44	0.55	-0.80	0.428	[-1.53, 0.65]
Race/ethnicity (ref = White)					
Asian	0.46	0.91	0.51	0.609	[-1.34, 2.27]
Black/African American	1.36	0.98	1.39	0.169	[-0.59, 3.31]
Hispanic/Latino	0.52	0.76	0.69	0.494	[-1.00, 2.04]
Multiracial/Other	0.81	0.80	1.00	0.319	[-0.79, 2.41]
Other/Multiracial	0.20	3.75	0.05	0.958	[-8.71, 9.12]
Parent education	-0.07	0.15	-0.46	0.650	[-0.38, 0.24]
PVT	**0.62**	**0.27**	**2.30**	**0.025**	**[0.08, 1.17]**
Baseline PALM	**0.49**	**0.12**	**4.18**	**<.001**	**[0.25, 0.72]**
Peer rate × Condition	-2.66	5.36	-0.50	0.622	[-13.41, 8.09]

Note. PALM = Preschool Mathematical Language Assessment. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction between scaffolding type rate and semi-structured condition (reference = free play). Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table F4

Full Model Output for Scaffolding Type × Condition Predicting Numeral ID (RQ 3.2)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**5.64**	**0.60**	**9.42**	**<.001**	**[4.40, 6.87]**
Engagement rate	-1.95	1.89	-1.03	0.310	[-5.81, 1.91]
Condition (semi-structured)	-0.04	0.46	-0.09	0.931	[-0.97, 0.89]
Age	-0.05	0.04	-1.15	0.252	[-0.13, 0.04]

Table F4. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Sex (female)	0.04	0.42	0.10	0.923	[-0.79, 0.87]
Race/ethnicity (ref = White)					
Asian	-0.02	0.56	-0.04	0.968	[-1.15, 1.11]
Black/African American	-0.50	0.76	-0.66	0.508	[-2.01, 1.00]
Hispanic/Latino	-0.92	0.68	-1.36	0.180	[-2.28, 0.44]
Multiracial/Other	0.05	0.40	0.12	0.905	[-0.74, 0.84]
Other/Multiracial	0.47	2.98	0.16	0.881	[-7.55, 8.50]
Parent education	-0.10	0.11	-0.89	0.378	[-0.32, 0.12]
PVT	0.13	0.14	0.92	0.359	[-0.15, 0.41]
Baseline Numeral ID	**0.84**	**0.11**	**7.77**	**<.001**	**[0.63, 1.06]**
Engagement rate × Condition	0.92	2.14	0.43	0.671	[-3.44, 5.27]
Learning rate model					
Intercept	**5.63**	**0.59**	**9.51**	**<.001**	**[4.42, 6.84]**
Learning rate	-3.76	3.25	-1.16	0.253	[-10.31, 2.78]
Condition (semi-structured)	-0.17	0.43	-0.39	0.696	[-1.04, 0.70]
Age	-0.04	0.04	-0.88	0.383	[-0.12, 0.05]
Sex (female)	-0.04	0.43	-0.10	0.923	[-0.90, 0.82]
Race/ethnicity (ref = White)					
Asian	0.15	0.60	0.26	0.800	[-1.07, 1.38]
Black/African American	-0.22	0.78	-0.28	0.777	[-1.78, 1.33]
Hispanic/Latino	-0.81	0.71	-1.14	0.261	[-2.24, 0.62]
Multiracial/Other	0.27	0.39	0.69	0.491	[-0.51, 1.05]
Other/Multiracial	0.71	2.87	0.25	0.816	[-6.77, 8.18]
Parent education	-0.09	0.11	-0.82	0.414	[-0.31, 0.13]
PVT	0.14	0.14	0.99	0.325	[-0.14, 0.41]
Baseline Numeral ID	**0.82**	**0.11**	**7.56**	**<.001**	**[0.60, 1.04]**
Learning rate × Condition	3.87	3.75	1.03	0.308	[-3.69, 11.44]
Peer rate model					
Intercept	**5.65**	**0.59**	**9.62**	**<.001**	**[4.45, 6.84]**
Peer rate	-3.34	3.53	-0.95	0.348	[-10.42, 3.74]
Condition (semi-structured)	-0.09	0.45	-0.21	0.835	[-1.01, 0.82]
Age	-0.03	0.04	-0.80	0.428	[-0.12, 0.05]
Sex (female)	-0.05	0.43	-0.11	0.915	[-0.90, 0.81]
Race/ethnicity (ref = White)					
Asian	0.05	0.60	0.09	0.929	[-1.16, 1.27]
Black/African American	-0.32	0.75	-0.43	0.668	[-1.82, 1.17]
Hispanic/Latino	-0.87	0.70	-1.24	0.219	[-2.26, 0.53]
Multiracial/Other	0.23	0.40	0.57	0.569	[-0.57, 1.04]
Other/Multiracial	0.43	2.98	0.14	0.891	[-7.12, 7.97]
Parent education	-0.13	0.13	-1.03	0.309	[-0.39, 0.12]
PVT	0.16	0.13	1.18	0.244	[-0.11, 0.43]

Table F4. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Baseline Numeral ID	**0.82**	**0.11**	**7.56**	**<.001**	**[0.61, 1.04]**
Peer rate × Condition	1.88	3.75	0.50	0.617	[-5.61, 9.37]

Note. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction between scaffolding type rate and semi-structured condition (reference = free play). Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table F5

Full Model Output for Scaffolding Type × Condition Predicting Cardinality (RQ 3.2)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**2.70**	**0.60**	**4.51**	**<.001**	**[1.48, 3.91]**
Engagement rate	0.21	1.76	0.12	0.906	[-3.40, 3.82]
Condition (semi-structured)	-0.01	0.45	-0.01	0.991	[-0.91, 0.90]
Age	0.03	0.03	0.89	0.374	[-0.03, 0.09]
Sex (female)	-0.16	0.28	-0.59	0.558	[-0.71, 0.39]
Race/ethnicity (ref = White)					
Asian	0.80	0.54	1.46	0.147	[-0.29, 1.88]
Black/African American	-0.04	0.60	-0.07	0.942	[-1.24, 1.15]
Hispanic/Latino	-0.04	0.56	-0.07	0.946	[-1.16, 1.08]
Multiracial/Other	0.64	0.45	1.44	0.154	[-0.25, 1.54]
Other/Multiracial	1.57	1.91	0.82	0.436	[-2.85, 5.98]
Parent education	-0.02	0.10	-0.18	0.857	[-0.21, 0.18]
PVT	0.15	0.11	1.37	0.176	[-0.07, 0.36]
Baseline Cardinality	**0.54**	**0.11**	**4.92**	**<.001**	**[0.32, 0.76]**
Engagement rate × Condition	0.18	1.90	0.10	0.924	[-3.71, 4.08]
Learning rate model					
Intercept	**2.74**	**0.59**	**4.61**	**<.001**	**[1.54, 3.94]**
Learning rate	-0.12	3.35	-0.04	0.971	[-6.79, 6.55]
Condition (semi-structured)	0.05	0.44	0.11	0.914	[-0.83, 0.92]
Age	0.03	0.03	0.85	0.395	[-0.04, 0.09]
Sex (female)	-0.18	0.28	-0.65	0.518	[-0.74, 0.38]
Race/ethnicity (ref = White)					
Asian	0.72	0.58	1.25	0.215	[-0.43, 1.88]
Black/African American	-0.15	0.59	-0.26	0.798	[-1.32, 1.02]

Table F5. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Hispanic/Latino	-0.12	0.58	-0.21	0.836	[-1.29, 1.05]
Multiracial/Other	0.55	0.40	1.38	0.171	[-0.24, 1.34]
Other/Multiracial	1.35	1.88	0.72	0.492	[-2.94, 5.63]
Parent education	-0.02	0.10	-0.23	0.821	[-0.22, 0.18]
PVT	0.13	0.11	1.27	0.209	[-0.08, 0.35]
Baseline Cardinality	**0.54**	**0.11**	**4.71**	**<.001**	**[0.31, 0.76]**
Learning rate × Condition	-0.66	3.87	-0.17	0.864	[-8.36, 7.03]
Peer rate model					
Intercept	**2.71**	**0.57**	**4.71**	**<.001**	**[1.55, 3.86]**
Peer rate	0.88	2.48	0.36	0.723	[-4.07, 5.83]
Condition (semi-structured)	-0.01	0.44	-0.02	0.984	[-0.88, 0.86]
Age	0.02	0.03	0.69	0.491	[-0.04, 0.09]
Sex (female)	-0.16	0.28	-0.55	0.583	[-0.72, 0.41]
Race/ethnicity (ref = White)					
Asian	0.82	0.57	1.43	0.159	[-0.33, 1.97]
Black/African American	-0.10	0.59	-0.17	0.866	[-1.26, 1.06]
Hispanic/Latino	-0.03	0.57	-0.05	0.963	[-1.16, 1.11]
Multiracial/Other	0.60	0.43	1.41	0.162	[-0.25, 1.45]
Other/Multiracial	1.64	1.96	0.84	0.426	[-2.85, 6.12]
Parent education	-0.00	0.10	-0.03	0.979	[-0.21, 0.20]
PVT	0.14	0.11	1.31	0.195	[-0.08, 0.36]
Baseline Cardinality	**0.54**	**0.11**	**4.70**	**<.001**	**[0.31, 0.77]**
Peer rate × Condition	-0.16	2.65	-0.06	0.952	[-5.44, 5.12]

Note. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction between scaffolding type rate and semi-structured condition (reference = free play). Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table F6

Full Model Output for Scaffolding Type × Condition Predicting TOSA (RQ 3.2)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**58.90**	**3.60**	**16.35**	**<.001**	**[51.55, 66.26]**
Engagement rate	-7.44	11.78	-0.63	0.534	[-31.77, 16.89]
Condition (semi-structured)	2.56	3.05	0.84	0.407	[-3.61, 8.73]

Table F6. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Age	0.13	0.21	0.62	0.536	[-0.29, 0.55]
Sex (female)	-2.98	2.20	-1.36	0.177	[-7.35, 1.38]
Race/ethnicity (ref = White)					
Asian	0.34	3.22	0.11	0.916	[-6.10, 6.78]
Black/African American	1.48	4.78	0.31	0.757	[-8.02, 10.99]
Hispanic/Latino	2.86	3.70	0.77	0.441	[-4.50, 10.23]
Multiracial/Other	3.01	4.57	0.66	0.513	[-6.12, 12.13]
Other/Multiracial	4.09	12.06	0.34	0.743	[-23.81, 32.00]
Parent education	-0.69	0.66	-1.05	0.299	[-2.01, 0.62]
PVT	-0.35	0.73	-0.47	0.640	[-1.81, 1.12]
Baseline TOSA	**0.58**	**0.11**	**5.28**	**<.001**	**[0.36, 0.79]**
Engagement rate × Condition	1.13	11.98	0.09	0.925	[-23.21, 25.48]
Learning rate model					
Intercept	**58.68**	**3.54**	**16.59**	**<.001**	**[51.47, 65.89]**
Learning rate	0.63	18.13	0.03	0.972	[-35.75, 37.01]
Condition (semi-structured)	2.08	2.77	0.75	0.456	[-3.48, 7.64]
Age	0.17	0.22	0.78	0.438	[-0.27, 0.61]
Sex (female)	-2.91	2.19	-1.33	0.187	[-7.25, 1.44]
Race/ethnicity (ref = White)					
Asian	1.14	3.65	0.31	0.755	[-6.19, 8.48]
Black/African American	2.10	4.99	0.42	0.676	[-7.83, 12.02]
Hispanic/Latino	3.81	4.12	0.92	0.359	[-4.43, 12.04]
Multiracial/Other	4.24	4.33	0.98	0.332	[-4.42, 12.89]
Other/Multiracial	4.65	12.59	0.37	0.720	[-23.95, 33.26]
Parent education	-0.80	0.69	-1.16	0.250	[-2.16, 0.57]
PVT	-0.07	0.75	-0.09	0.928	[-1.55, 1.42]
Baseline TOSA	**0.57**	**0.11**	**5.11**	**<.001**	**[0.35, 0.79]**
Learning rate × Condition	-13.66	19.59	-0.70	0.489	[-52.92, 25.60]
Peer rate model					
Intercept	**59.09**	**3.48**	**16.96**	**<.001**	**[51.99, 66.19]**
Peer rate	-13.71	16.91	-0.81	0.421	[-47.60, 20.19]
Condition (semi-structured)	2.79	2.74	1.02	0.315	[-2.74, 8.32]
Age	0.23	0.23	0.97	0.334	[-0.24, 0.69]
Sex (female)	-3.26	2.04	-1.59	0.114	[-7.32, 0.80]
Race/ethnicity (ref = White)					
Asian	-0.25	3.62	-0.07	0.946	[-7.52, 7.03]
Black/African American	2.19	4.65	0.47	0.639	[-7.06, 11.44]
Hispanic/Latino	2.51	3.90	0.64	0.522	[-5.29, 10.32]

Table F6. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Multiracial/Other	3.49	4.40	0.79	0.431	[-5.31, 12.29]
Other/Multiracial	1.53	12.06	0.13	0.902	[-26.77, 29.83]
Parent education	-1.03	0.69	-1.48	0.143	[-2.41, 0.36]
PVT	-0.27	0.69	-0.39	0.697	[-1.64, 1.11]
Baseline TOSA	**0.59**	**0.11**	**5.43**	**<.001**	**[0.37, 0.80]**
Peer rate × Condition	-8.82	19.98	-0.44	0.660	[-48.66, 31.02]

Note. TOSA = Test of Spatial Ability. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction between scaffolding type rate and semi-structured condition (reference = free play). Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table F7

Full Model Output for Scaffolding Type × Condition Predicting DNS (RQ 3.2)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**22.49**	**1.82**	**12.36**	**<.001**	**[18.84, 26.14]**
Engagement rate	-3.11	6.27	-0.50	0.622	[-15.74, 9.52]
Condition (semi-structured)	-1.37	1.63	-0.84	0.404	[-4.62, 1.88]
Age	0.16	0.15	1.03	0.309	[-0.15, 0.46]
Sex (female)	0.06	1.53	0.04	0.970	[-2.98, 3.09]
Race/ethnicity (ref = White)					
Asian	2.47	2.43	1.02	0.312	[-2.38, 7.33]
Black/African American	**5.85**	**2.05**	**2.85**	**0.006**	**[1.76, 9.94]**
Hispanic/Latino	0.50	2.14	0.23	0.816	[-3.76, 4.76]
Multiracial/Other	3.00	2.66	1.13	0.262	[-2.29, 8.29]
Other/Multiracial	7.55	8.73	0.86	0.408	[-12.01, 27.10]
Parent education	-0.47	0.43	-1.09	0.281	[-1.33, 0.39]
PVT	0.10	0.47	0.20	0.840	[-0.84, 1.03]
Baseline DNS	**0.41**	**0.11**	**3.64**	**<.001**	**[0.18, 0.63]**
Engagement rate × Condition	2.39	6.96	0.34	0.733	[-11.59, 16.37]
Learning rate model					
Intercept	**22.44**	**1.77**	**12.68**	**<.001**	**[18.89, 25.98]**
Learning rate	4.12	10.72	0.38	0.703	[-17.74, 25.98]
Condition (semi-structured)	-1.58	1.54	-1.03	0.308	[-4.65, 1.48]
Age	0.17	0.16	1.04	0.301	[-0.15, 0.48]

Table F7. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Sex (female)	0.12	1.49	0.08	0.935	[-2.84, 3.08]
Race/ethnicity (ref = White)					
Asian	2.95	2.67	1.11	0.273	[-2.38, 8.28]
Black/African American	**5.97**	**2.13**	**2.81**	**0.007**	**[1.72, 10.22]**
Hispanic/Latino	0.97	2.39	0.40	0.687	[-3.79, 5.73]
Multiracial/Other	3.31	2.69	1.23	0.222	[-2.03, 8.65]
Other/Multiracial	8.29	8.58	0.97	0.355	[-10.61, 27.19]
Parent education	-0.46	0.43	-1.07	0.287	[-1.31, 0.39]
PVT	0.24	0.44	0.53	0.595	[-0.65, 1.12]
Baseline DNS	**0.39**	**0.12**	**3.34**	**0.001**	**[0.16, 0.63]**
Learning rate × Condition	-4.53	12.08	-0.38	0.709	[-28.83, 19.77]
Peer rate model					
Intercept	**22.38**	**1.76**	**12.75**	**<.001**	**[18.86, 25.90]**
Peer rate	13.26	11.53	1.15	0.257	[-10.00, 36.52]
Condition (semi-structured)	-1.86	1.54	-1.21	0.231	[-4.91, 1.20]
Age	0.16	0.16	0.96	0.341	[-0.17, 0.48]
Sex (female)	0.28	1.48	0.19	0.850	[-2.66, 3.22]
Race/ethnicity (ref = White)					
Asian	3.43	2.70	1.27	0.209	[-1.98, 8.84]
Black/African American	**6.15**	**2.04**	**3.02**	**0.004**	**[2.09, 10.21]**
Hispanic/Latino	1.44	2.43	0.59	0.556	[-3.41, 6.28]
Multiracial/Other	3.42	2.76	1.24	0.219	[-2.07, 8.90]
Other/Multiracial	9.18	8.56	1.07	0.307	[-9.74, 28.09]
Parent education	-0.33	0.44	-0.75	0.457	[-1.22, 0.55]
PVT	0.29	0.45	0.63	0.529	[-0.62, 1.19]
Baseline DNS	**0.40**	**0.11**	**3.50**	**<.001**	**[0.17, 0.63]**
Peer rate × Condition	-12.45	11.90	-1.05	0.300	[-36.28, 11.38]

Note. DNS = Day-Night Stroop. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction between scaffolding type rate and semi-structured condition (reference = free play). Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table F8

Full Model Output for Scaffolding Type × Condition Predicting DCCS (RQ 3.2)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**13.26**	**1.27**	**10.45**	**<.001**	**[10.67, 15.86]**
Engagement rate	2.55	4.58	0.56	0.583	[-6.95, 12.05]
Condition (semi-structured)	-0.67	1.42	-0.47	0.638	[-3.51, 2.17]
Age	0.08	0.10	0.75	0.453	[-0.13, 0.29]
Sex (female)	1.12	0.90	1.24	0.219	[-0.68, 2.92]
Race/ethnicity (ref = White)					
Asian	-0.67	1.53	-0.43	0.665	[-3.72, 2.38]
Black/African American	1.71	2.48	0.69	0.493	[-3.23, 6.65]
Hispanic/Latino	-1.01	1.62	-0.62	0.536	[-4.25, 2.23]
Multiracial/Other	0.02	1.76	0.01	0.991	[-3.47, 3.52]
Other/Multiracial	2.15	6.87	0.31	0.763	[-13.91, 18.21]
Parent education	-0.19	0.40	-0.48	0.635	[-0.98, 0.60]
PVT	**0.93**	**0.37**	**2.55**	**0.013**	**[0.20, 1.66]**
Baseline DCCS	**0.41**	**0.10**	**4.14**	**<.001**	**[0.21, 0.60]**
Engagement rate × Condition	-1.67	5.14	-0.32	0.748	[-12.20, 8.87]
Learning rate model					
Intercept	**13.22**	**1.18**	**11.21**	**<.001**	**[10.81, 15.62]**
Learning rate	7.59	6.32	1.20	0.238	[-5.25, 20.43]
Condition (semi-structured)	-0.58	1.33	-0.44	0.665	[-3.24, 2.08]
Age	0.07	0.11	0.62	0.536	[-0.14, 0.28]
Sex (female)	1.26	0.90	1.40	0.167	[-0.54, 3.06]
Race/ethnicity (ref = White)					
Asian	-0.70	1.56	-0.45	0.657	[-3.81, 2.42]
Black/African American	1.39	2.47	0.56	0.575	[-3.52, 6.30]
Hispanic/Latino	-0.98	1.73	-0.57	0.572	[-4.44, 2.48]
Multiracial/Other	-0.17	1.62	-0.10	0.917	[-3.39, 3.06]
Other/Multiracial	2.14	6.79	0.32	0.759	[-13.18, 17.46]
Parent education	-0.18	0.41	-0.46	0.650	[-0.99, 0.62]
PVT	**0.99**	**0.38**	**2.58**	**0.012**	**[0.23, 1.75]**
Baseline DCCS	**0.40**	**0.11**	**3.82**	**<.001**	**[0.19, 0.61]**
Learning rate × Condition	-8.02	11.09	-0.72	0.472	[-30.13, 14.09]
Peer rate model					
Intercept	**13.19**	**1.20**	**10.98**	**<.001**	**[10.75, 15.63]**
Peer rate	7.13	7.68	0.93	0.357	[-8.23, 22.49]
Condition (semi-structured)	-0.72	1.34	-0.54	0.593	[-3.39, 1.96]
Age	0.06	0.10	0.58	0.563	[-0.15, 0.27]
Sex (female)	1.28	0.90	1.41	0.161	[-0.52, 3.07]

Table F8. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Race/ethnicity (ref = White)					
Asian	-0.51	1.60	-0.32	0.750	[-3.69, 2.66]
Black/African American	1.59	2.51	0.63	0.528	[-3.40, 6.59]
Hispanic/Latino	-0.87	1.67	-0.52	0.605	[-4.22, 2.47]
Multiracial/Other	-0.10	1.71	-0.06	0.952	[-3.50, 3.30]
Other/Multiracial	2.61	6.69	0.39	0.706	[-12.58, 17.80]
Parent education	-0.11	0.42	-0.26	0.796	[-0.94, 0.72]
PVT	**0.95**	**0.38**	**2.49**	**0.015**	**[0.19, 1.70]**
Baseline DCCS	**0.40**	**0.10**	**3.90**	**<.001**	**[0.20, 0.61]**
Peer rate × Condition	-4.80	10.10	-0.48	0.636	[-24.89, 15.29]

Note. DCCS = Dimensional Card Change Sort. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction between scaffolding type rate and semi-structured condition (reference = free play). Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table F9

Full Model Output for Scaffolding Type × Condition Predicting Tower of Hanoi (RQ 3.2)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**2.66**	**0.53**	**5.01**	**<.001**	**[1.60, 3.72]**
Engagement rate	0.63	1.72	0.37	0.716	[-2.82, 4.08]
Condition (semi-structured)	**-0.89**	**0.44**	**-2.04**	**0.045**	**[-1.77, -0.02]**
Age	-0.02	0.03	-0.86	0.392	[-0.08, 0.03]
Sex (female)	-0.02	0.36	-0.05	0.960	[-0.74, 0.70]
Race/ethnicity (ref = White)					
Asian	-0.21	0.61	-0.35	0.729	[-1.42, 1.00]
Black/African American	0.47	0.68	0.69	0.489	[-0.88, 1.82]
Hispanic/Latino	0.01	0.51	0.03	0.979	[-0.99, 1.02]
Multiracial/Other	0.78	0.57	1.37	0.174	[-0.35, 1.90]
Other/Multiracial	-0.34	0.77	-0.45	0.658	[-1.90, 1.22]
Parent education	-0.17	0.12	-1.44	0.154	[-0.41, 0.07]
PVT	**0.42**	**0.09**	**4.70**	**<.001**	**[0.24, 0.59]**
Baseline Tower of Hanoi	0.15	0.09	1.57	0.121	[-0.04, 0.33]
Engagement rate × Condition	-0.54	1.78	-0.31	0.761	[-4.11, 3.02]
Learning rate model					
Intercept	**2.68**	**0.50**	**5.41**	**<.001**	**[1.70, 3.67]**

Table F9. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Learning rate	-0.62	2.43	-0.26	0.799	[-5.54, 4.29]
Condition (semi-structured)	**-0.82**	**0.41**	**-2.02**	**0.046**	**[-1.63, -0.01]**
Age	-0.02	0.03	-0.82	0.414	[-0.08, 0.03]
Sex (female)	-0.03	0.36	-0.07	0.943	[-0.75, 0.70]
Race/ethnicity (ref = White)					
Asian	-0.32	0.56	-0.58	0.562	[-1.43, 0.78]
Black/African American	0.38	0.62	0.61	0.540	[-0.85, 1.62]
Hispanic/Latino	-0.11	0.48	-0.22	0.825	[-1.06, 0.84]
Multiracial/Other	0.69	0.52	1.32	0.191	[-0.35, 1.74]
Other/Multiracial	-0.66	0.71	-0.93	0.359	[-2.10, 0.78]
Parent education	-0.19	0.12	-1.52	0.132	[-0.43, 0.06]
PVT	**0.40**	**0.08**	**4.99**	**<.001**	**[0.24, 0.56]**
Baseline Tower of Hanoi	0.14	0.10	1.40	0.164	[-0.06, 0.33]
Learning rate × Condition	-0.81	2.81	-0.29	0.775	[-6.48, 4.87]
Peer rate model					
Intercept	**2.66**	**0.49**	**5.39**	**<.001**	**[1.68, 3.65]**
Peer rate	0.40	3.56	0.11	0.910	[-6.71, 7.52]
Condition (semi-structured)	-0.85	0.45	-1.88	0.064	[-1.75, 0.05]
Age	-0.02	0.03	-0.74	0.462	[-0.09, 0.04]
Sex (female)	-0.01	0.37	-0.02	0.988	[-0.74, 0.73]
Race/ethnicity (ref = White)					
Asian	-0.28	0.62	-0.45	0.652	[-1.51, 0.95]
Black/African American	0.44	0.64	0.68	0.496	[-0.83, 1.71]
Hispanic/Latino	-0.05	0.54	-0.09	0.925	[-1.12, 1.02]
Multiracial/Other	0.71	0.55	1.29	0.199	[-0.38, 1.80]
Other/Multiracial	-0.50	0.77	-0.65	0.520	[-2.05, 1.05]
Parent education	-0.18	0.13	-1.40	0.165	[-0.43, 0.07]
PVT	**0.41**	**0.09**	**4.41**	**<.001**	**[0.23, 0.59]**
Baseline Tower of Hanoi	0.14	0.10	1.49	0.139	[-0.05, 0.34]
Peer rate × Condition	-0.97	3.62	-0.27	0.790	[-8.20, 6.26]

Note. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction between scaffolding type rate and semi-structured condition (reference = free play). Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table F10

Full Model Output for Scaffolding Type × Condition Predicting HTKS (RQ 3.2)

Term	*b*	SE	*t*	*p*	95% CI
Engagement rate model					
Intercept	**29.30**	**5.36**	**5.47**	**<.001**	**[18.41, 40.19]**
Engagement rate	9.08	17.45	0.52	0.606	[-26.41, 44.57]
Condition (semi-structured)	-3.34	4.89	-0.68	0.498	[-13.18, 6.50]
Age	0.56	0.40	1.40	0.166	[-0.24, 1.36]
Sex (female)	2.73	4.06	0.67	0.503	[-5.34, 10.81]
Race/ethnicity (ref = White)					
Asian	2.14	6.90	0.31	0.757	[-11.63, 15.92]
Black/African American	15.74	10.21	1.54	0.127	[-4.56, 36.04]
Hispanic/Latino	-0.59	5.48	-0.11	0.915	[-11.65, 10.48]
Multiracial/Other	-5.39	5.51	-0.98	0.332	[-16.40, 5.62]
Other/Multiracial	6.80	21.02	0.32	0.749	[-36.90, 50.50]
Parent education	-0.70	1.62	-0.43	0.666	[-3.99, 2.58]
PVT	**3.09**	**1.33**	**2.33**	**0.023**	**[0.44, 5.74]**
Baseline HTKS	**0.69**	**0.12**	**5.95**	**<.001**	**[0.46, 0.92]**
Engagement rate × Condition	-20.34	18.58	-1.09	0.280	[-57.90, 17.22]
Learning rate model					
Intercept	**28.34**	**4.81**	**5.89**	**<.001**	**[18.54, 38.14]**
Learning rate	20.48	37.44	0.55	0.587	[-55.00, 95.97]
Condition (semi-structured)	-3.18	4.51	-0.70	0.484	[-12.24, 5.88]
Age	0.60	0.41	1.46	0.151	[-0.23, 1.43]
Sex (female)	3.52	3.81	0.92	0.358	[-4.07, 11.10]
Race/ethnicity (ref = White)					
Asian	2.09	6.50	0.32	0.749	[-10.90, 15.08]
Black/African American	15.94	9.93	1.61	0.112	[-3.81, 35.69]
Hispanic/Latino	0.11	5.52	0.02	0.984	[-11.08, 11.30]
Multiracial/Other	-4.04	5.69	-0.71	0.481	[-15.40, 7.32]
Other/Multiracial	5.29	19.98	0.26	0.794	[-36.01, 46.58]
Parent education	-0.96	1.67	-0.58	0.566	[-4.32, 2.40]
PVT	**3.57**	**1.31**	**2.72**	**0.008**	**[0.95, 6.18]**
Baseline HTKS	**0.65**	**0.12**	**5.46**	**<.001**	**[0.42, 0.89]**
Learning rate × Condition	-55.07	40.11	-1.37	0.176	[-135.71, 25.57]
Peer rate model					
Intercept	**28.55**	**4.74**	**6.03**	**<.001**	**[18.90, 38.21]**
Peer rate	34.55	35.99	0.96	0.341	[-37.60, 106.70]
Condition (semi-structured)	-3.24	4.60	-0.71	0.484	[-12.49, 6.00]
Age	0.66	0.41	1.60	0.115	[-0.16, 1.49]

Table F10. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Sex (female)	3.77	3.77	1.00	0.320	[-3.73, 11.28]
Race/ethnicity (ref = White)					
Asian	2.12	6.61	0.32	0.749	[-11.06, 15.30]
Black/African American	17.29	9.99	1.73	0.087	[-2.58, 37.17]
Hispanic/Latino	0.09	5.78	0.02	0.988	[-11.55, 11.73]
Multiracial/Other	-4.76	5.45	-0.87	0.386	[-15.64, 6.13]
Other/Multiracial	4.92	19.89	0.25	0.807	[-36.43, 46.27]
Parent education	-0.77	1.58	-0.49	0.629	[-3.98, 2.44]
PVT	**3.47**	**1.34**	**2.59**	**0.012**	**[0.80, 6.14]**
Baseline HTKS	**0.67**	**0.12**	**5.71**	**<.001**	**[0.44, 0.90]**
Peer rate × Condition	-71.14	36.01	-1.98	0.053	[-143.20, 0.93]

Note. HTKS = Head-Toes-Knees-Shoulders. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction between scaffolding type rate and semi-structured condition (reference = free play). Bold rows indicate $p < .05$. CI = confidence interval for *b*.

APPENDIX G

AIM 4: RESEARCH QUESTION 4.1 FULL MODELS

Table G1

Full Model Output for Scaffolding Rate × Complexity Level Predicting PENS (RQ 4.1)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**17.62**	**1.66**	**10.59**	**<.001**	**[14.29, 20.94]**
Scaffolding rate	1.51	2.38	0.63	0.530	[-3.27, 6.28]
Low complexity rate	**-5.41**	**2.59**	**-2.08**	**0.041**	**[-10.59, -0.22]**
Age	0.12	0.10	1.14	0.258	[-0.09, 0.32]
Sex (female)	-0.60	1.01	-0.60	0.553	[-2.61, 1.41]
Race/ethnicity (ref = White)					
Asian	0.37	1.65	0.23	0.822	[-2.92, 3.67]
Black/African American	2.36	1.90	1.24	0.219	[-1.43, 6.15]
Hispanic/Latino	-1.74	1.69	-1.03	0.307	[-5.11, 1.63]
Multiracial/Other	-0.28	1.47	-0.19	0.850	[-3.21, 2.65]
Other/Multiracial	6.84	7.27	0.94	0.372	[-9.66, 23.33]
Parent education	-0.08	0.33	-0.25	0.800	[-0.73, 0.56]
PVT	0.57	0.31	1.83	0.072	[-0.05, 1.18]
Baseline PENS	**0.62**	**0.11**	**5.55**	**<.001**	**[0.40, 0.84]**
Scaf rate × Low complexity	2.57	5.88	0.44	0.664	[-9.24, 14.38]
Medium/High complexity model					
Intercept	**15.33**	**2.55**	**6.02**	**<.001**	**[10.20, 20.46]**
Scaffolding rate	-0.96	4.78	-0.20	0.842	[-10.57, 8.66]
Medium/High complexity rate	-2.64	11.23	-0.24	0.815	[-25.20, 19.92]
Age	0.12	0.10	1.30	0.199	[-0.07, 0.31]
Sex (female)	-0.31	1.11	-0.28	0.777	[-2.52, 1.89]
Race/ethnicity (ref = White)					
Asian	0.72	1.72	0.42	0.677	[-2.73, 4.17]
Black/African American	2.61	2.00	1.31	0.194	[-1.36, 6.59]
Hispanic/Latino	-1.51	1.62	-0.93	0.355	[-4.74, 1.72]
Multiracial/Other	-0.26	1.55	-0.17	0.866	[-3.35, 2.83]
Other/Multiracial	6.21	6.96	0.89	0.393	[-9.32, 21.74]
Parent education	-0.12	0.37	-0.34	0.733	[-0.85, 0.60]
PVT	0.65	0.35	1.85	0.069	[-0.05, 1.34]
Baseline PENS	**0.60**	**0.12**	**4.98**	**<.001**	**[0.36, 0.84]**
Scaf rate × Med/High complexity	9.74	16.55	0.59	0.559	[-23.54, 43.01]

Note. PENS = Preschool Early Numeracy Screener. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Scaf rate × Level = interaction between centered scaffolding rate and complexity level rate. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table G2

Full Model Output for Scaffolding Rate × Complexity Level Predicting CMA (RQ 4.1)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**3.91**	**0.50**	**7.79**	**<.001**	**[2.91, 4.91]**
Scaffolding rate	0.14	0.78	0.19	0.853	[-1.41, 1.69]
Low complexity rate	-0.62	1.06	-0.59	0.559	[-2.74, 1.49]
Age	0.05	0.03	1.72	0.090	[-0.01, 0.11]
Sex (female)	0.54	0.37	1.45	0.152	[-0.20, 1.27]
Race/ethnicity (ref = White)					
Asian	-0.05	0.57	-0.08	0.934	[-1.18, 1.09]
Black/African American	0.47	0.75	0.62	0.537	[-1.03, 1.97]
Hispanic/Latino	0.06	0.45	0.14	0.887	[-0.82, 0.95]
Multiracial/Other	0.74	0.52	1.43	0.157	[-0.29, 1.77]
Other/Multiracial	0.90	1.72	0.52	0.612	[-2.88, 4.67]
Parent education	-0.04	0.10	-0.34	0.732	[-0.25, 0.17]
PVT	0.17	0.11	1.56	0.122	[-0.05, 0.39]
Baseline CMA	**0.21**	**0.10**	**2.13**	**0.036**	**[0.01, 0.41]**
Scaf rate × Low complexity	-0.13	1.64	-0.08	0.939	[-3.40, 3.15]
Medium/High complexity model					
Intercept	**2.86**	**0.65**	**4.40**	**<.001**	**[1.56, 4.17]**
Scaffolding rate	-1.30	1.28	-1.02	0.311	[-3.86, 1.25]
Medium/High complexity rate	3.67	2.98	1.23	0.223	[-2.28, 9.62]
Age	0.04	0.03	1.34	0.183	[-0.02, 0.10]
Sex (female)	0.62	0.36	1.72	0.088	[-0.10, 1.34]
Race/ethnicity (ref = White)					
Asian	0.20	0.57	0.35	0.728	[-0.93, 1.33]
Black/African American	0.45	0.78	0.58	0.566	[-1.10, 2.00]
Hispanic/Latino	0.28	0.45	0.61	0.541	[-0.62, 1.17]
Multiracial/Other	0.75	0.52	1.44	0.152	[-0.28, 1.78]
Other/Multiracial	1.44	1.60	0.90	0.389	[-2.08, 4.96]
Parent education	0.01	0.12	0.07	0.941	[-0.23, 0.24]
PVT	0.17	0.11	1.47	0.144	[-0.06, 0.40]

Table G2. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Baseline CMA	**0.23**	**0.10**	**2.36**	**0.021**	**[0.04, 0.42]**
Scaf rate × Med/High complexity	1.82	4.16	0.44	0.663	[-6.49, 10.14]

Note. CMA = Child Math Assessment. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Scaf rate × Level = interaction between centered scaffolding rate and complexity level rate. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table G3

Full Model Output for Scaffolding Rate × Complexity Level Predicting PALM (RQ 4.1)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**9.77**	**0.90**	**10.91**	**<.001**	**[7.99, 11.55]**
Scaffolding rate	-0.42	1.18	-0.35	0.724	[-2.78, 1.94]
Low complexity rate	1.56	1.59	0.98	0.331	[-1.62, 4.73]
Age	0.07	0.05	1.32	0.194	[-0.04, 0.18]
Sex (female)	-0.45	0.54	-0.85	0.400	[-1.52, 0.61]
Race/ethnicity (ref = White)					
Asian	0.34	0.85	0.40	0.691	[-1.35, 2.02]
Black/African American	1.30	0.93	1.39	0.167	[-0.55, 3.16]
Hispanic/Latino	0.25	0.68	0.37	0.709	[-1.09, 1.60]
Multiracial/Other	0.93	0.77	1.20	0.233	[-0.61, 2.47]
Other/Multiracial	0.05	3.93	0.01	0.990	[-9.26, 9.36]
Parent education	-0.08	0.15	-0.52	0.607	[-0.38, 0.22]
PVT	**0.62**	**0.26**	**2.33**	**0.023**	**[0.09, 1.14]**
Baseline PALM	**0.46**	**0.12**	**3.72**	**<.001**	**[0.21, 0.72]**
Scaf rate × Low complexity	-1.33	2.63	-0.50	0.616	[-6.61, 3.96]
Medium/High complexity model					
Intercept	**9.82**	**1.42**	**6.92**	**<.001**	**[6.99, 12.65]**
Scaffolding rate	-0.89	2.36	-0.38	0.707	[-5.62, 3.83]
Medium/High complexity rate	2.76	5.99	0.46	0.647	[-9.22, 14.73]
Age	0.07	0.05	1.40	0.165	[-0.03, 0.17]
Sex (female)	-0.42	0.55	-0.76	0.450	[-1.50, 0.67]
Race/ethnicity (ref = White)					
Asian	0.48	0.93	0.51	0.610	[-1.38, 2.33]
Black/African American	1.29	0.95	1.36	0.177	[-0.60, 3.18]

Table G3. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Hispanic/Latino	0.38	0.74	0.52	0.604	[-1.08, 1.85]
Multiracial/Other	0.92	0.78	1.18	0.241	[-0.63, 2.47]
Other/Multiracial	0.82	3.82	0.22	0.835	[-7.94, 9.59]
Parent education	-0.02	0.17	-0.13	0.898	[-0.36, 0.32]
PVT	**0.60**	**0.28**	**2.16**	**0.035**	**[0.04, 1.15]**
Baseline PALM	**0.47**	**0.12**	**3.80**	**<.001**	**[0.22, 0.72]**
Scaf rate × Med/High complexity	-0.13	7.70	-0.02	0.986	[-15.55, 15.28]

Note. PALM = Preschool Mathematical Language Assessment. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Scaf rate × Level = interaction between centered scaffolding rate and complexity level rate. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table G4

Full Model Output for Scaffolding Rate × Complexity Level Predicting Numeral ID (RQ 4.1)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**5.96**	**0.58**	**10.23**	**<.001**	**[4.80, 7.13]**
Scaffolding rate	-0.54	0.98	-0.55	0.586	[-2.51, 1.43]
Low complexity rate	-0.63	1.04	-0.61	0.546	[-2.72, 1.46]
Age	-0.04	0.04	-0.98	0.328	[-0.12, 0.04]
Sex (female)	-0.06	0.43	-0.13	0.899	[-0.92, 0.81]
Race/ethnicity (ref = White)					
Asian	-0.08	0.57	-0.15	0.883	[-1.24, 1.07]
Black/African American	-0.47	0.74	-0.64	0.526	[-1.95, 1.00]
Hispanic/Latino	-0.96	0.65	-1.47	0.145	[-2.27, 0.34]
Multiracial/Other	0.14	0.41	0.34	0.736	[-0.68, 0.96]
Other/Multiracial	0.41	2.85	0.14	0.892	[-6.96, 7.78]
Parent education	-0.12	0.11	-1.11	0.272	[-0.34, 0.10]
PVT	0.12	0.14	0.83	0.408	[-0.16, 0.40]
Baseline Numeral ID	**0.85**	**0.11**	**7.67**	**<.001**	**[0.63, 1.08]**
Scaf rate × Low complexity	-0.12	1.94	-0.06	0.951	[-4.04, 3.80]
Medium/High complexity model					
Intercept	**5.48**	**0.84**	**6.55**	**<.001**	**[3.79, 7.18]**
Scaffolding rate	-1.50	1.69	-0.89	0.379	[-4.92, 1.92]

Table G4. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Medium/High complexity rate	-0.30	3.10	-0.10	0.923	[-6.56, 5.95]
Age	-0.03	0.04	-0.84	0.401	[-0.12, 0.05]
Sex (female)	0.09	0.46	0.20	0.843	[-0.82, 1.00]
Race/ethnicity (ref = White)					
Asian	0.04	0.62	0.06	0.954	[-1.22, 1.29]
Black/African American	-0.38	0.75	-0.51	0.610	[-1.86, 1.10]
Hispanic/Latino	-0.87	0.65	-1.33	0.187	[-2.18, 0.43]
Multiracial/Other	0.13	0.41	0.31	0.760	[-0.69, 0.94]
Other/Multiracial	0.56	2.80	0.20	0.848	[-6.37, 7.49]
Parent education	-0.11	0.12	-0.93	0.356	[-0.36, 0.13]
PVT	0.13	0.15	0.85	0.400	[-0.17, 0.43]
Baseline Numeral ID	**0.86**	**0.12**	**7.08**	**<.001**	**[0.61, 1.10]**
Scaf rate × Med/High complexity	3.71	5.68	0.65	0.518	[-7.83, 15.25]

Note. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Scaf rate × Level = interaction between centered scaffolding rate and complexity level rate. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table G5

Full Model Output for Scaffolding Rate × Complexity Level Predicting Cardinality (RQ 4.1)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**3.16**	**0.50**	**6.30**	**<.001**	**[2.16, 4.16]**
Scaffolding rate	0.65	0.65	1.00	0.320	[-0.64, 1.94]
Low complexity rate	-0.96	0.65	-1.47	0.147	[-2.26, 0.34]
Age	0.03	0.03	0.85	0.399	[-0.03, 0.08]
Sex (female)	-0.18	0.29	-0.62	0.538	[-0.75, 0.39]
Race/ethnicity (ref = White)					
Asian	0.68	0.55	1.25	0.216	[-0.41, 1.77]
Black/African American	-0.09	0.60	-0.15	0.883	[-1.27, 1.10]
Hispanic/Latino	-0.14	0.53	-0.26	0.794	[-1.20, 0.92]
Multiracial/Other	0.59	0.44	1.33	0.187	[-0.29, 1.47]
Other/Multiracial	1.62	1.94	0.83	0.424	[-2.72, 5.96]
Parent education	-0.01	0.10	-0.07	0.941	[-0.20, 0.19]
PVT	0.13	0.11	1.16	0.250	[-0.09, 0.34]

Table G5. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Baseline Cardinality	**0.56**	**0.11**	**4.89**	**<.001**	**[0.33, 0.79]**
Scaf rate × Low complexity	-0.03	1.56	-0.02	0.984	[-3.15, 3.08]
Medium/High complexity model					
Intercept	**2.65**	**0.72**	**3.69**	**<.001**	**[1.21, 4.09]**
Scaffolding rate	0.18	1.31	0.14	0.888	[-2.43, 2.80]
Medium/High complexity rate	0.35	2.70	0.13	0.898	[-5.04, 5.73]
Age	0.02	0.03	0.81	0.418	[-0.03, 0.08]
Sex (female)	-0.16	0.31	-0.50	0.615	[-0.78, 0.47]
Race/ethnicity (ref = White)					
Asian	0.82	0.59	1.38	0.172	[-0.37, 2.00]
Black/African American	-0.08	0.59	-0.13	0.893	[-1.26, 1.10]
Hispanic/Latino	-0.03	0.53	-0.05	0.960	[-1.10, 1.04]
Multiracial/Other	0.61	0.44	1.39	0.168	[-0.26, 1.49]
Other/Multiracial	1.60	1.98	0.81	0.436	[-2.79, 6.00]
Parent education	-0.01	0.11	-0.06	0.950	[-0.23, 0.21]
PVT	0.15	0.12	1.19	0.240	[-0.10, 0.40]
Baseline Cardinality	**0.54**	**0.12**	**4.31**	**<.001**	**[0.29, 0.79]**
Scaf rate × Med/High complexity	-0.13	4.67	-0.03	0.977	[-9.43, 9.16]

Note. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Scaf rate × Level = interaction between centered scaffolding rate and complexity level rate. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table G6

Full Model Output for Scaffolding Rate × Complexity Level Predicting TOSA (RQ 4.1)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**63.41**	**3.16**	**20.04**	**<.001**	**[57.10, 69.72]**
Scaffolding rate	1.19	4.57	0.26	0.796	[-7.94, 10.32]
Low complexity rate	-4.13	5.57	-0.74	0.460	[-15.22, 6.95]
Age	0.13	0.20	0.65	0.518	[-0.27, 0.53]
Sex (female)	-3.60	2.12	-1.70	0.093	[-7.81, 0.61]
Race/ethnicity (ref = White)					
Asian	-1.19	3.24	-0.37	0.714	[-7.65, 5.27]

Table G6. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Black/African American	1.57	4.79	0.33	0.744	[-7.95, 11.10]
Hispanic/Latino	1.04	3.66	0.28	0.776	[-6.23, 8.31]
Multiracial/Other	3.95	4.15	0.95	0.345	[-4.34, 12.24]
Other/Multiracial	3.20	12.67	0.25	0.807	[-25.71, 32.11]
Parent education	-0.75	0.63	-1.19	0.236	[-2.00, 0.50]
PVT	-0.53	0.71	-0.76	0.451	[-1.94, 0.87]
Baseline TOSA	**0.56**	**0.11**	**5.06**	**<.001**	**[0.34, 0.78]**
Scaf rate × Low complexity	-8.76	10.51	-0.83	0.408	[-29.84, 12.31]
Medium/High complexity model					
Intercept	**62.09**	**4.90**	**12.67**	**<.001**	**[52.10, 72.08]**
Scaffolding rate	-1.47	8.25	-0.18	0.860	[-18.21, 15.28]
Medium/High complexity rate	-10.21	19.66	-0.52	0.607	[-49.96, 29.54]
Age	0.16	0.21	0.76	0.447	[-0.26, 0.58]
Sex (female)	-3.12	2.30	-1.35	0.179	[-7.69, 1.46]
Race/ethnicity (ref = White)					
Asian	-0.18	3.56	-0.05	0.960	[-7.35, 6.99]
Black/African American	2.08	4.87	0.43	0.671	[-7.62, 11.77]
Hispanic/Latino	2.01	3.73	0.54	0.591	[-5.43, 9.46]
Multiracial/Other	4.06	4.40	0.92	0.359	[-4.72, 12.85]
Other/Multiracial	3.76	12.49	0.30	0.771	[-24.84, 32.36]
Parent education	-0.86	0.74	-1.16	0.253	[-2.34, 0.63]
PVT	-0.37	0.71	-0.52	0.605	[-1.79, 1.05]
Baseline TOSA	**0.58**	**0.11**	**5.37**	**<.001**	**[0.37, 0.80]**
Scaf rate × Med/High complexity	-3.48	28.35	-0.12	0.903	[-60.46, 53.49]

Note. TOSA = Test of Spatial Ability. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Scaf rate × Level = interaction between centered scaffolding rate and complexity level rate. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table G7

Full Model Output for Scaffolding Rate × Complexity Level Predicting DNS (RQ 4.1)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**21.19**	**2.31**	**9.19**	**<.001**	**[16.60, 25.79]**
Scaffolding rate	0.30	3.24	0.09	0.926	[-6.19, 6.80]
Low complexity rate	1.41	3.82	0.37	0.713	[-6.19, 9.01]
Age	0.18	0.15	1.20	0.233	[-0.12, 0.48]
Sex (female)	-0.11	1.51	-0.08	0.940	[-3.12, 2.90]
Race/ethnicity (ref = White)					
Asian	2.97	2.75	1.08	0.285	[-2.54, 8.48]
Black/African American	**6.01**	**2.00**	**3.00**	**0.004**	**[2.02, 9.99]**
Hispanic/Latino	1.26	2.35	0.54	0.594	[-3.42, 5.94]
Multiracial/Other	3.08	2.62	1.17	0.243	[-2.13, 8.29]
Other/Multiracial	7.16	8.50	0.84	0.415	[-11.25, 25.56]
Parent education	-0.52	0.46	-1.13	0.262	[-1.44, 0.40]
PVT	0.23	0.47	0.50	0.622	[-0.70, 1.17]
Baseline DNS	**0.39**	**0.12**	**3.34**	**0.001**	**[0.16, 0.62]**
Scaf rate × Low complexity	-1.28	7.31	-0.18	0.862	[-16.00, 13.44]
Medium/High complexity model					
Intercept	**20.40**	**3.72**	**5.48**	**<.001**	**[12.91, 27.89]**
Scaffolding rate	-0.79	6.63	-0.12	0.905	[-14.13, 12.54]
Medium/High complexity rate	8.77	14.72	0.60	0.554	[-20.80, 38.34]
Age	0.16	0.15	1.05	0.298	[-0.14, 0.45]
Sex (female)	-0.22	1.59	-0.14	0.890	[-3.38, 2.93]
Race/ethnicity (ref = White)					
Asian	3.26	2.79	1.17	0.248	[-2.34, 8.86]
Black/African American	**5.86**	**2.06**	**2.84**	**0.006**	**[1.76, 9.97]**
Hispanic/Latino	1.56	2.31	0.67	0.502	[-3.05, 6.17]
Multiracial/Other	3.10	2.64	1.17	0.244	[-2.16, 8.35]
Other/Multiracial	8.48	8.35	1.02	0.328	[-9.49, 26.45]
Parent education	-0.42	0.53	-0.79	0.431	[-1.47, 0.64]
PVT	0.19	0.47	0.41	0.682	[-0.75, 1.14]
Baseline DNS	**0.40**	**0.11**	**3.58**	**<.001**	**[0.18, 0.63]**
Scaf rate × Med/High complexity	-3.98	21.57	-0.18	0.854	[-47.47, 39.51]

Note. DNS = Day-Night Stroop. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Scaf rate × Level = interaction between centered scaffolding rate and complexity level rate. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table G8

Full Model Output for Scaffolding Rate × Complexity Level Predicting DCCS (RQ 4.1)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**13.86**	**1.27**	**10.90**	**<.001**	**[11.33, 16.39]**
Scaffolding rate	0.48	2.20	0.22	0.827	[-3.90, 4.87]
Low complexity rate	-4.08	2.69	-1.52	0.133	[-9.42, 1.26]
Age	0.11	0.09	1.14	0.256	[-0.08, 0.30]
Sex (female)	1.41	0.80	1.77	0.080	[-0.17, 2.99]
Race/ethnicity (ref = White)					
Asian	-0.26	1.62	-0.16	0.872	[-3.49, 2.96]
Black/African American	1.94	2.47	0.79	0.432	[-2.96, 6.85]
Hispanic/Latino	-0.50	1.64	-0.31	0.760	[-3.77, 2.77]
Multiracial/Other	-0.22	1.66	-0.13	0.896	[-3.52, 3.08]
Other/Multiracial	3.77	6.61	0.57	0.583	[-11.45, 19.00]
Parent education	-0.11	0.36	-0.29	0.771	[-0.83, 0.61]
PVT	**0.94**	**0.36**	**2.60**	**0.011**	**[0.22, 1.66]**
Baseline DCCS	**0.42**	**0.10**	**4.06**	**<.001**	**[0.21, 0.63]**
Scaf rate × Low complexity	5.68	4.95	1.15	0.255	[-4.21, 15.58]
Medium/High complexity model					
Intercept	**11.61**	**1.87**	**6.20**	**<.001**	**[7.83, 15.38]**
Scaffolding rate	-2.49	3.87	-0.64	0.522	[-10.24, 5.25]
Medium/High complexity rate	1.02	8.91	0.11	0.909	[-16.80, 18.84]
Age	0.10	0.09	1.09	0.279	[-0.08, 0.28]
Sex (female)	**1.75**	**0.87**	**2.02**	**0.047**	**[0.03, 3.48]**
Race/ethnicity (ref = White)					
Asian	-0.34	1.59	-0.21	0.833	[-3.50, 2.82]
Black/African American	2.05	2.50	0.82	0.415	[-2.92, 7.02]
Hispanic/Latino	-0.58	1.54	-0.38	0.706	[-3.64, 2.48]
Multiracial/Other	-0.28	1.68	-0.17	0.868	[-3.62, 3.06]
Other/Multiracial	3.27	6.19	0.53	0.611	[-10.96, 17.50]
Parent education	-0.10	0.41	-0.26	0.799	[-0.91, 0.70]
PVT	**0.92**	**0.39**	**2.38**	**0.020**	**[0.15, 1.70]**

Table G8. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Baseline DCCS	**0.42**	**0.11**	**3.99**	**<.001**	**[0.21, 0.63]**
Scaf rate × Med/High complexity	18.13	13.16	1.38	0.173	[-8.18, 44.44]

Note. DCCS = Dimensional Card Change Sort. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Scaf rate × Level = interaction between centered scaffolding rate and complexity level rate. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table G9

Full Model Output for Scaffolding Rate × Complexity Level Predicting Tower of Hanoi (RQ 4.1)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**3.04**	**0.60**	**5.04**	**<.001**	**[1.84, 4.24]**
Scaffolding rate	0.01	0.93	0.01	0.990	[-1.84, 1.86]
Low complexity rate	**-2.04**	**0.91**	**-2.23**	**0.028**	**[-3.85, -0.22]**
Age	-0.00	0.03	-0.08	0.939	[-0.06, 0.06]
Sex (female)	-0.10	0.34	-0.30	0.763	[-0.78, 0.57]
Race/ethnicity (ref = White)					
Asian	-0.32	0.61	-0.52	0.604	[-1.52, 0.89]
Black/African American	0.42	0.60	0.71	0.482	[-0.76, 1.61]
Hispanic/Latino	0.04	0.51	0.08	0.933	[-0.98, 1.06]
Multiracial/Other	0.51	0.52	0.97	0.334	[-0.53, 1.55]
Other/Multiracial	-0.45	0.85	-0.53	0.597	[-2.16, 1.26]
Parent education	-0.18	0.11	-1.61	0.112	[-0.41, 0.04]
PVT	**0.39**	**0.08**	**4.83**	**<.001**	**[0.23, 0.55]**
Baseline Tower of Hanoi	0.14	0.10	1.44	0.152	[-0.05, 0.34]
Scaf rate × Low complexity	1.34	1.43	0.93	0.356	[-1.55, 4.22]
Medium/High complexity model					
Intercept	**2.31**	**0.81**	**2.86**	**0.006**	**[0.69, 3.93]**
Scaffolding rate	-0.40	1.36	-0.29	0.772	[-3.14, 2.35]
Medium/High complexity rate	-0.49	3.62	-0.13	0.893	[-7.73, 6.75]
Age	-0.01	0.03	-0.30	0.766	[-0.08, 0.06]
Sex (female)	-0.09	0.37	-0.24	0.807	[-0.82, 0.64]
Race/ethnicity (ref = White)					
Asian	-0.31	0.65	-0.48	0.635	[-1.60, 0.98]

Table G9. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Black/African American	0.40	0.65	0.62	0.537	[-0.88, 1.68]
Hispanic/Latino	0.07	0.57	0.12	0.906	[-1.07, 1.21]
Multiracial/Other	0.53	0.58	0.91	0.366	[-0.63, 1.68]
Other/Multiracial	-0.92	0.87	-1.05	0.298	[-2.67, 0.83]
Parent education	-0.21	0.13	-1.59	0.118	[-0.48, 0.06]
PVT	**0.40**	**0.09**	**4.47**	**<.001**	**[0.22, 0.58]**
Baseline Tower of Hanoi	0.15	0.10	1.59	0.115	[-0.04, 0.35]
Scaf rate × Med/High complexity	1.16	4.49	0.26	0.797	[-7.87, 10.20]

Note. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Scaf rate × Level = interaction between centered scaffolding rate and complexity level rate. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table G10

Full Model Output for Scaffolding Rate × Complexity Level Predicting HTKS (RQ 4.1)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**27.19**	**5.46**	**4.98**	**<.001**	**[16.27, 38.10]**
Scaffolding rate	-2.23	8.77	-0.25	0.801	[-19.84, 15.38]
Low complexity rate	-0.21	10.30	-0.02	0.984	[-20.86, 20.45]
Age	0.60	0.40	1.48	0.144	[-0.21, 1.40]
Sex (female)	2.67	3.61	0.74	0.462	[-4.53, 9.88]
Race/ethnicity (ref = White)					
Asian	1.42	6.96	0.20	0.839	[-12.43, 15.27]
Black/African American	16.65	9.95	1.67	0.098	[-3.13, 36.43]
Hispanic/Latino	-0.17	5.60	-0.03	0.977	[-11.46, 11.13]
Multiracial/Other	-5.03	6.01	-0.84	0.405	[-17.03, 6.96]
Other/Multiracial	4.89	19.89	0.25	0.808	[-36.24, 46.01]
Parent education	-0.96	1.66	-0.58	0.563	[-4.31, 2.38]
PVT	**2.99**	**1.26**	**2.37**	**0.020**	**[0.48, 5.51]**
Baseline HTKS	**0.69**	**0.12**	**5.79**	**<.001**	**[0.45, 0.92]**
Scaf rate × Low complexity	-1.65	23.96	-0.07	0.945	[-49.57, 46.27]
Medium/High complexity model					
Intercept	**27.61**	**7.74**	**3.57**	**<.001**	**[12.00, 43.22]**
Scaffolding rate	-0.55	15.81	-0.04	0.972	[-32.42, 31.32]

Table G10. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Medium/High complexity rate	-0.13	37.74	-0.00	0.997	[-75.79, 75.53]
Age	0.59	0.41	1.42	0.160	[-0.24, 1.41]
Sex (female)	2.37	3.79	0.63	0.533	[-5.19, 9.94]
Race/ethnicity (ref = White)					
Asian	1.39	6.77	0.20	0.838	[-12.12, 14.89]
Black/African American	16.45	10.02	1.64	0.104	[-3.48, 36.39]
Hispanic/Latino	-0.09	5.57	-0.02	0.987	[-11.33, 11.15]
Multiracial/Other	-4.93	6.06	-0.81	0.419	[-17.04, 7.17]
Other/Multiracial	4.81	18.86	0.26	0.801	[-34.16, 43.78]
Parent education	-1.00	1.73	-0.58	0.565	[-4.49, 2.49]
PVT	**3.03**	**1.40**	**2.17**	**0.033**	**[0.25, 5.81]**
Baseline HTKS	**0.68**	**0.12**	**5.69**	**<.001**	**[0.44, 0.92]**
Scaf rate × Med/High complexity	-12.82	66.49	-0.19	0.848	[-146.00, 120.37]

Note. HTKS = Head-Toes-Knees-Shoulders. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. Scaf rate × Level = interaction between centered scaffolding rate and complexity level rate. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

APPENDIX H

AIM 4: RESARCH QUESTION 4.2 FULL MODELS

Table H1

Full Model Output for Scaffolding Rate × Complexity × Condition Predicting PENS (RQ 4.2)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**17.56**	**2.83**	**6.20**	**<.001**	**[11.77, 23.34]**
Scaffolding rate	-0.93	6.02	-0.15	0.879	[-13.13, 11.28]
Low complexity rate	-7.12	5.16	-1.38	0.176	[-17.56, 3.32]
Condition (semi-structured)	-0.50	2.51	-0.20	0.843	[-5.64, 4.63]
Age	0.12	0.11	1.09	0.281	[-0.10, 0.33]
Sex (female)	-0.40	1.00	-0.40	0.687	[-2.38, 1.58]
Race/ethnicity (ref = White)					
Asian	0.56	1.51	0.37	0.710	[-2.46, 3.58]
Black/African American	2.71	1.93	1.40	0.166	[-1.15, 6.57]
Hispanic/Latino	-1.12	1.71	-0.65	0.515	[-4.54, 2.30]
Multiracial/Other	-0.42	1.44	-0.29	0.771	[-3.28, 2.44]
Other/Multiracial	6.28	7.29	0.86	0.415	[-10.64, 23.20]
Parent education	-0.08	0.33	-0.23	0.822	[-0.74, 0.59]
PVT	**0.69**	**0.28**	**2.45**	**0.016**	**[0.13, 1.26]**
Baseline PENS	**0.60**	**0.11**	**5.63**	**<.001**	**[0.39, 0.81]**
Scaf rate × Low complexity	8.74	8.08	1.08	0.286	[-7.56, 25.04]
Scaf rate × Condition	4.87	6.32	0.77	0.446	[-7.93, 17.66]
Low complexity × Condition	4.32	5.52	0.78	0.438	[-6.79, 15.43]
Scaf rate × Low complexity × Condition	-15.10	9.01	-1.68	0.100	[-33.21, 3.01]
Medium/High complexity model					
Intercept	**14.55**	**4.23**	**3.44**	**0.001**	**[5.99, 23.11]**
Scaffolding rate	-3.41	9.26	-0.37	0.714	[-22.06, 15.23]
Medium/High complexity rate	-0.92	19.22	-0.05	0.962	[-39.65, 37.81]
Condition (semi-structured)	2.00	4.24	0.47	0.640	[-6.53, 10.53]
Age	0.14	0.11	1.30	0.199	[-0.07, 0.35]
Sex (female)	-0.30	1.02	-0.30	0.768	[-2.33, 1.72]
Race/ethnicity (ref = White)					
Asian	0.79	1.64	0.48	0.630	[-2.48, 4.07]
Black/African American	2.95	2.07	1.42	0.159	[-1.18, 7.09]
Hispanic/Latino	-1.31	1.74	-0.75	0.455	[-4.78, 2.17]
Multiracial/Other	-0.32	1.51	-0.21	0.832	[-3.32, 2.68]
Other/Multiracial	5.81	7.28	0.80	0.445	[-10.62, 22.25]
Parent education	-0.17	0.38	-0.44	0.661	[-0.93, 0.59]

Table H1. (continued)

Term	*b*	SE	*t*	*p*	95% CI
PVT	**0.77**	**0.26**	**2.98**	**0.004**	**[0.26, 1.29]**
Baseline PENS	**0.59**	**0.11**	**5.28**	**<.001**	**[0.37, 0.81]**
Scaf rate × Med/High complexity	20.87	27.36	0.76	0.450	[-34.49, 76.24]
Scaf rate × Condition	5.97	9.70	0.62	0.541	[-13.51, 25.45]
Med/High complexity × Condition	-5.71	22.58	-0.25	0.801	[-50.91, 39.50]
Scaf rate × Med/High complexity × Condition	-24.63	28.11	-0.88	0.386	[-81.40, 32.14]

Note. PENS = Preschool Early Numeracy Screener. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction with semi-structured condition (reference = free play). The three-way interaction term tests whether complexity level moderates the scaffolding rate–outcome association differently by condition. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table H2

Full Model Output for Scaffolding Rate × Complexity × Condition Predicting CMA (RQ 4.2)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**4.40**	**1.09**	**4.05**	**<.001**	**[2.23, 6.57]**
Scaffolding rate	-0.17	2.13	-0.08	0.936	[-4.44, 4.10]
Low complexity rate	-1.97	2.15	-0.92	0.363	[-6.27, 2.33]
Condition (semi-structured)	-1.09	1.17	-0.93	0.355	[-3.41, 1.24]
Age	0.05	0.03	1.67	0.099	[-0.01, 0.11]
Sex (female)	0.63	0.36	1.75	0.084	[-0.09, 1.35]
Race/ethnicity (ref = White)					
Asian	0.06	0.57	0.11	0.913	[-1.07, 1.20]
Black/African American	0.58	0.75	0.77	0.442	[-0.92, 2.08]
Hispanic/Latino	0.22	0.45	0.49	0.628	[-0.68, 1.13]
Multiracial/Other	0.74	0.47	1.57	0.120	[-0.20, 1.69]
Other/Multiracial	0.88	1.69	0.52	0.614	[-2.84, 4.59]
Parent education	-0.01	0.11	-0.11	0.916	[-0.23, 0.20]
PVT	0.20	0.11	1.76	0.081	[-0.02, 0.42]
Baseline CMA	0.19	0.10	1.90	0.061	[-0.01, 0.39]
Scaf rate × Low complexity	1.73	2.10	0.82	0.413	[-2.48, 5.95]
Scaf rate × Condition	0.90	2.36	0.38	0.705	[-3.82, 5.62]
Low complexity × Condition	2.58	2.43	1.06	0.292	[-2.26, 7.42]

Table H2. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Scaf rate × Low complexity × Condition	-4.22	2.82	-1.50	0.139	[-9.84, 1.40]
Medium/High complexity model					
Intercept	**3.08**	**1.00**	**3.08**	**0.004**	**[1.05, 5.10]**
Scaffolding rate	-1.49	2.14	-0.69	0.492	[-5.83, 2.86]
Medium/High complexity rate	3.43	4.96	0.69	0.493	[-6.55, 13.40]
Condition (semi-structured)	-0.74	1.07	-0.69	0.494	[-2.88, 1.41]
Age	0.03	0.03	1.08	0.284	[-0.03, 0.10]
Sex (female)	0.69	0.36	1.94	0.056	[-0.02, 1.41]
Race/ethnicity (ref = White)					
Asian	0.24	0.55	0.43	0.667	[-0.85, 1.32]
Black/African American	0.48	0.80	0.60	0.551	[-1.11, 2.06]
Hispanic/Latino	0.20	0.45	0.45	0.658	[-0.70, 1.11]
Multiracial/Other	0.87	0.53	1.64	0.104	[-0.18, 1.91]
Other/Multiracial	1.78	1.70	1.04	0.319	[-1.97, 5.53]
Parent education	0.04	0.12	0.30	0.767	[-0.21, 0.28]
PVT	0.18	0.12	1.46	0.148	[-0.06, 0.42]
Baseline CMA	0.19	0.10	1.91	0.060	[-0.01, 0.39]
Scaf rate × Med/High complexity	2.20	6.06	0.36	0.718	[-10.08, 14.48]
Scaf rate × Condition	0.06	2.63	0.02	0.982	[-5.22, 5.34]
Med/High complexity × Condition	1.54	5.48	0.28	0.780	[-9.43, 12.51]
Scaf rate × Med/High complexity × Condition	0.03	8.24	0.00	0.997	[-16.47, 16.53]

Note. CMA = Child Math Assessment. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction with semi-structured condition (reference = free play). The three-way interaction term tests whether complexity level moderates the scaffolding rate–outcome association differently by condition. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table H3

Full Model Output for Scaffolding Rate × Complexity × Condition Predicting PALM (RQ 4.2)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**8.42**	**1.40**	**5.99**	**<.001**	**[5.58, 11.25]**
Scaffolding rate	-2.78	2.71	-1.02	0.312	[-8.28, 2.72]
Low complexity rate	3.75	2.82	1.33	0.192	[-1.98, 9.48]
Condition (semi-structured)	2.17	1.40	1.56	0.128	[-0.65, 5.00]
Age	0.06	0.05	1.19	0.239	[-0.04, 0.17]
Sex (female)	-0.40	0.51	-0.78	0.438	[-1.41, 0.62]
Race/ethnicity (ref = White)					
Asian	0.14	0.78	0.18	0.860	[-1.42, 1.70]
Black/African American	1.38	0.94	1.47	0.144	[-0.48, 3.25]
Hispanic/Latino	0.30	0.69	0.43	0.666	[-1.07, 1.66]
Multiracial/Other	0.89	0.76	1.17	0.246	[-0.63, 2.40]
Other/Multiracial	-0.29	3.97	-0.07	0.944	[-9.66, 9.08]
Parent education	-0.13	0.14	-0.94	0.349	[-0.40, 0.14]
PVT	**0.64**	**0.24**	**2.66**	**0.009**	**[0.16, 1.12]**
Baseline PALM	**0.47**	**0.11**	**4.37**	**<.001**	**[0.26, 0.69]**
Scaf rate × Low complexity	-0.43	3.74	-0.12	0.908	[-7.93, 7.07]
Scaf rate × Condition	3.38	2.84	1.19	0.242	[-2.37, 9.12]
Low complexity × Condition	-3.28	3.12	-1.05	0.299	[-9.57, 3.02]
Scaf rate × Low complexity × Condition	-2.17	4.44	-0.49	0.627	[-11.05, 6.72]
Medium/High complexity model					
Intercept	**8.67**	**1.72**	**5.05**	**<.001**	**[5.21, 12.14]**
Scaffolding rate	-3.43	3.41	-1.00	0.321	[-10.32, 3.46]
Medium/High complexity rate	6.69	7.54	0.89	0.380	[-8.53, 21.90]
Condition (semi-structured)	2.60	1.52	1.72	0.091	[-0.43, 5.64]
Age	0.09	0.05	1.72	0.091	[-0.01, 0.19]
Sex (female)	-0.38	0.56	-0.67	0.502	[-1.49, 0.73]
Race/ethnicity (ref = White)					
Asian	0.40	0.81	0.50	0.622	[-1.21, 2.02]
Black/African American	1.57	0.98	1.61	0.112	[-0.37, 3.51]
Hispanic/Latino	0.57	0.74	0.78	0.440	[-0.90, 2.04]
Multiracial/Other	0.73	0.75	0.97	0.336	[-0.77, 2.23]
Other/Multiracial	-0.02	3.95	-0.00	0.997	[-9.66, 9.62]
Parent education	-0.07	0.17	-0.42	0.678	[-0.41, 0.27]
PVT	**0.64**	**0.24**	**2.71**	**0.008**	**[0.17, 1.12]**
Baseline PALM	**0.48**	**0.09**	**5.09**	**<.001**	**[0.29, 0.67]**
Scaf rate × Med/High complexity	5.38	12.83	0.42	0.677	[-20.52, 31.27]

Table H3. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Scaf rate × Condition	5.32	3.49	1.52	0.133	[-1.67, 12.30]
Med/High complexity × Condition	-9.45	7.86	-1.20	0.233	[-25.14, 6.24]
Scaf rate × Med/High complexity × Condition	-12.83	13.50	-0.95	0.347	[-40.02, 14.37]

Note. PALM = Preschool Mathematical Language Assessment. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction with semi-structured condition (reference = free play). The three-way interaction term tests whether complexity level moderates the scaffolding rate–outcome association differently by condition. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table H4

Full Model Output for Scaffolding Rate × Complexity × Condition Predicting Numeral ID (RQ 4.2)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**5.85**	**0.90**	**6.49**	**<.001**	**[4.02, 7.67]**
Scaffolding rate	-2.33	2.00	-1.16	0.252	[-6.40, 1.73]
Low complexity rate	-1.12	1.76	-0.64	0.528	[-4.68, 2.44]
Condition (semi-structured)	-0.20	0.93	-0.22	0.830	[-2.07, 1.67]
Age	-0.04	0.04	-1.04	0.300	[-0.13, 0.04]
Sex (female)	0.08	0.41	0.19	0.847	[-0.74, 0.90]
Race/ethnicity (ref = White)					
Asian	-0.07	0.50	-0.14	0.893	[-1.07, 0.93]
Black/African American	-0.27	0.78	-0.34	0.735	[-1.83, 1.29]
Hispanic/Latino	-0.77	0.69	-1.11	0.273	[-2.15, 0.62]
Multiracial/Other	0.14	0.40	0.35	0.726	[-0.65, 0.93]
Other/Multiracial	0.33	2.92	0.11	0.915	[-7.82, 8.48]
Parent education	-0.12	0.12	-1.00	0.324	[-0.36, 0.12]
PVT	0.13	0.13	1.04	0.300	[-0.12, 0.39]
Baseline Numeral ID	**0.85**	**0.10**	**8.25**	**<.001**	**[0.65, 1.06]**
Scaf rate × Low complexity	2.29	2.53	0.91	0.372	[-2.86, 7.45]
Scaf rate × Condition	2.83	2.31	1.23	0.226	[-1.81, 7.48]
Low complexity × Condition	1.29	2.21	0.58	0.562	[-3.12, 5.69]
Scaf rate × Low complexity × Condition	-4.79	3.57	-1.34	0.185	[-11.93, 2.35]
Medium/High complexity model					

Table H4. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Intercept	**5.26**	**1.34**	**3.94**	**<.001**	**[2.52, 8.00]**
Scaffolding rate	-2.88	2.75	-1.04	0.305	[-8.50, 2.75]
Medium/High complexity rate	0.37	5.53	0.07	0.947	[-10.87, 11.61]
Condition (semi-structured)	0.27	1.26	0.21	0.835	[-2.32, 2.85]
Age	-0.04	0.04	-0.85	0.399	[-0.12, 0.05]
Sex (female)	0.14	0.45	0.31	0.759	[-0.75, 1.03]
Race/ethnicity (ref = White)					
Asian	0.01	0.54	0.02	0.983	[-1.08, 1.11]
Black/African American	-0.23	0.79	-0.29	0.774	[-1.80, 1.34]
Hispanic/Latino	-0.85	0.67	-1.27	0.210	[-2.20, 0.50]
Multiracial/Other	0.16	0.39	0.42	0.678	[-0.61, 0.93]
Other/Multiracial	0.61	3.00	0.20	0.847	[-7.23, 8.45]
Parent education	-0.11	0.13	-0.88	0.383	[-0.37, 0.15]
PVT	0.13	0.13	0.99	0.323	[-0.13, 0.39]
Baseline Numeral ID	**0.85**	**0.11**	**7.78**	**<.001**	**[0.63, 1.07]**
Scaf rate × Med/High complexity	6.33	8.21	0.77	0.449	[-10.70, 23.37]
Scaf rate × Condition	2.43	3.24	0.75	0.459	[-4.13, 8.99]
Med/High complexity × Condition	-0.99	6.15	-0.16	0.872	[-13.49, 11.50]
Scaf rate × Med/High complexity × Condition	-5.33	10.18	-0.52	0.603	[-25.88, 15.22]

Note. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction with semi-structured condition (reference = free play). The three-way interaction term tests whether complexity level moderates the scaffolding rate–outcome association differently by condition. Bold rows indicate $p < .05$. CI = confidence interval for *b.*

Table H5

Full Model Output for Scaffolding Rate × Complexity × Condition Predicting Cardinality (RQ 4.2)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**3.22**	**0.75**	**4.31**	**<.001**	**[1.72, 4.73]**
Scaffolding rate	-0.09	1.59	-0.06	0.953	[-3.28, 3.09]
Low complexity rate	-1.71	1.29	-1.33	0.191	[-4.30, 0.89]
Condition (semi-structured)	-0.30	0.67	-0.45	0.656	[-1.65, 1.04]

Table H5. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Age	0.03	0.03	0.83	0.408	[-0.04, 0.09]
Sex (female)	-0.11	0.26	-0.44	0.663	[-0.62, 0.40]
Race/ethnicity (ref = White)					
Asian	0.74	0.55	1.35	0.182	[-0.36, 1.85]
Black/African American	0.02	0.55	0.03	0.975	[-1.08, 1.11]
Hispanic/Latino	0.07	0.59	0.12	0.901	[-1.10, 1.25]
Multiracial/Other	0.54	0.45	1.19	0.236	[-0.36, 1.44]
Other/Multiracial	1.44	1.93	0.75	0.477	[-3.03, 5.91]
Parent education	-0.00	0.10	-0.04	0.967	[-0.20, 0.19]
PVT	0.16	0.09	1.77	0.081	[-0.02, 0.34]
Baseline Cardinality	**0.55**	**0.11**	**5.07**	**<.001**	**[0.33, 0.76]**
Scaf rate × Low complexity	2.03	1.91	1.06	0.291	[-1.79, 5.86]
Scaf rate × Condition	1.49	1.62	0.92	0.363	[-1.76, 4.74]
Low complexity × Condition	1.70	1.53	1.11	0.273	[-1.38, 4.77]
Scaf rate × Low complexity × Condition	**-4.90**	**2.35**	**-2.08**	**0.041**	**[-9.59, -0.21]**
Medium/High complexity model					
Intercept	2.42	1.25	1.94	0.058	[-0.09, 4.93]
Scaffolding rate	-0.68	2.70	-0.25	0.801	[-6.07, 4.71]
Medium/High complexity rate	0.77	5.22	0.15	0.884	[-9.69, 11.22]
Condition (semi-structured)	0.60	1.15	0.52	0.603	[-1.71, 2.91]
Age	0.03	0.03	0.96	0.340	[-0.03, 0.09]
Sex (female)	-0.15	0.29	-0.52	0.601	[-0.74, 0.43]
Race/ethnicity (ref = White)					
Asian	0.85	0.59	1.43	0.157	[-0.33, 2.03]
Black/African American	0.05	0.58	0.08	0.939	[-1.12, 1.21]
Hispanic/Latino	0.05	0.58	0.08	0.934	[-1.11, 1.20]
Multiracial/Other	0.59	0.44	1.35	0.180	[-0.28, 1.47]
Other/Multiracial	1.52	2.01	0.76	0.471	[-3.08, 6.12]
Parent education	-0.02	0.11	-0.16	0.876	[-0.23, 0.20]
PVT	**0.20**	**0.10**	**2.08**	**0.041**	**[0.01, 0.39]**
Baseline Cardinality	**0.50**	**0.11**	**4.49**	**<.001**	**[0.28, 0.72]**
Scaf rate × Med/High complexity	3.73	7.44	0.50	0.617	[-11.10, 18.57]
Scaf rate × Condition	2.13	2.81	0.76	0.452	[-3.50, 7.76]
Med/High complexity × Condition	-1.69	5.92	-0.29	0.777	[-13.56, 10.19]
Scaf rate × Med/High complexity × Condition	-8.64	8.19	-1.06	0.295	[-24.96, 7.67]

Note. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction with semi-structured condition (reference = free play). The three-way interaction term tests whether complexity level moderates the scaffolding rate–outcome association differently by condition. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table H6

Full Model Output for Scaffolding Rate × Complexity × Condition Predicting TOSA (RQ 4.2)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**60.93**	**5.93**	**10.27**	**<.001**	**[48.92, 72.94]**
Scaffolding rate	-1.32	10.88	-0.12	0.904	[-23.53, 20.90]
Low complexity rate	-1.58	10.51	-0.15	0.881	[-22.66, 19.50]
Condition (semi-structured)	4.52	5.84	0.77	0.443	[-7.25, 16.29]
Age	0.15	0.22	0.68	0.498	[-0.29, 0.59]
Sex (female)	-3.64	2.12	-1.72	0.089	[-7.84, 0.57]
Race/ethnicity (ref = White)					
Asian	-1.33	3.21	-0.42	0.679	[-7.74, 5.07]
Black/African American	1.59	4.82	0.33	0.742	[-8.00, 11.19]
Hispanic/Latino	1.58	3.84	0.41	0.682	[-6.07, 9.23]
Multiracial/Other	3.63	4.04	0.90	0.373	[-4.47, 11.73]
Other/Multiracial	1.51	12.74	0.12	0.909	[-28.23, 31.25]
Parent education	-0.87	0.65	-1.34	0.185	[-2.15, 0.42]
PVT	-0.33	0.68	-0.48	0.631	[-1.68, 1.02]
Baseline TOSA	**0.54**	**0.11**	**4.75**	**<.001**	**[0.31, 0.76]**
Scaf rate × Low complexity	-4.80	13.81	-0.35	0.730	[-32.54, 22.95]
Scaf rate × Condition	4.78	11.87	0.40	0.690	[-19.33, 28.88]
Low complexity × Condition	-2.98	12.89	-0.23	0.818	[-28.70, 22.75]
Scaf rate × Low complexity × Condition	-12.97	18.40	-0.70	0.484	[-49.80, 23.86]
Medium/High complexity model					
Intercept	**60.01**	**7.62**	**7.88**	**<.001**	**[44.25, 75.76]**
Scaffolding rate	-3.76	14.46	-0.26	0.797	[-33.56, 26.04]
Medium/High complexity rate	-6.12	34.26	-0.18	0.859	[-75.72, 63.48]
Condition (semi-structured)	6.00	6.84	0.88	0.387	[-7.92, 19.92]
Age	0.22	0.23	0.95	0.345	[-0.24, 0.67]
Sex (female)	-3.41	2.40	-1.42	0.159	[-8.17, 1.36]
Race/ethnicity (ref = White)					
Asian	-0.40	3.45	-0.12	0.908	[-7.32, 6.52]
Black/African American	2.22	4.80	0.46	0.645	[-7.33, 11.77]

Table H6. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Hispanic/Latino	2.54	3.85	0.66	0.512	[-5.16, 10.24]
Multiracial/Other	3.40	4.44	0.77	0.447	[-5.48, 12.27]
Other/Multiracial	1.03	12.46	0.08	0.937	[-28.57, 30.62]
Parent education	-1.04	0.72	-1.44	0.155	[-2.49, 0.41]
PVT	-0.26	0.71	-0.36	0.719	[-1.68, 1.16]
Baseline TOSA	**0.58**	**0.11**	**5.28**	**<.001**	**[0.36, 0.80]**
Scaf rate × Med/High complexity	2.13	43.65	0.05	0.961	[-86.48, 90.74]
Scaf rate × Condition	6.29	14.60	0.43	0.669	[-23.39, 35.97]
Med/High complexity × Condition	-15.31	37.29	-0.41	0.683	[-90.35, 59.74]
Scaf rate × Med/High complexity × Condition	-17.44	48.57	-0.36	0.721	[-115.17, 80.30]

Note. TOSA = Test of Spatial Ability. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction with semi-structured condition (reference = free play). The three-way interaction term tests whether complexity level moderates the scaffolding rate–outcome association differently by condition. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table H7

Full Model Output for Scaffolding Rate × Complexity × Condition Predicting DNS (RQ 4.2)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**20.37**	**4.55**	**4.48**	**<.001**	**[11.25, 29.49]**
Scaffolding rate	-3.38	7.77	-0.43	0.666	[-19.08, 12.33]
Low complexity rate	3.99	7.86	0.51	0.614	[-11.72, 19.69]
Condition (semi-structured)	0.69	4.59	0.15	0.880	[-8.50, 9.89]
Age	0.13	0.15	0.88	0.383	[-0.17, 0.44]
Sex (female)	0.36	1.57	0.23	0.821	[-2.76, 3.47]
Race/ethnicity (ref = White)					
Asian	2.63	2.64	1.00	0.321	[-2.64, 7.91]
Black/African American	**6.37**	**2.07**	**3.09**	**0.003**	**[2.26, 10.49]**
Hispanic/Latino	1.04	2.44	0.43	0.671	[-3.81, 5.89]
Multiracial/Other	3.48	2.74	1.27	0.208	[-1.97, 8.94]
Other/Multiracial	7.76	8.62	0.90	0.386	[-11.05, 26.56]
Parent education	-0.50	0.42	-1.20	0.233	[-1.33, 0.33]
PVT	0.31	0.44	0.71	0.482	[-0.57, 1.19]
Baseline DNS	**0.39**	**0.12**	**3.25**	**0.002**	**[0.15, 0.63]**

Table H7. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Scaf rate × Low complexity	2.28	9.15	0.25	0.805	[-16.41, 20.98]
Scaf rate × Condition	6.82	8.52	0.80	0.427	[-10.29, 23.94]
Low complexity × Condition	-3.63	9.22	-0.39	0.695	[-22.03, 14.77]
Scaf rate × Low complexity × Condition	-9.26	11.74	-0.79	0.434	[-32.76, 14.24]
Medium/High complexity model					
Intercept	**17.56**	**4.71**	**3.72**	**0.001**	**[7.84, 27.28]**
Scaffolding rate	-7.87	9.10	-0.86	0.397	[-26.79, 11.06]
Medium/High complexity rate	27.61	20.32	1.36	0.185	[-14.09, 69.30]
Condition (semi-structured)	4.49	4.78	0.94	0.353	[-5.14, 14.11]
Age	0.15	0.16	0.92	0.361	[-0.18, 0.47]
Sex (female)	0.46	1.60	0.29	0.772	[-2.71, 3.64]
Race/ethnicity (ref = White)					
Asian	3.13	2.64	1.18	0.242	[-2.17, 8.42]
Black/African American	**6.80**	**2.14**	**3.18**	**0.002**	**[2.53, 11.06]**
Hispanic/Latino	1.58	2.32	0.68	0.498	[-3.05, 6.22]
Multiracial/Other	3.30	2.80	1.18	0.242	[-2.27, 8.88]
Other/Multiracial	8.45	8.56	0.99	0.343	[-10.17, 27.06]
Parent education	-0.35	0.50	-0.70	0.487	[-1.35, 0.65]
PVT	0.29	0.43	0.67	0.507	[-0.57, 1.15]
Baseline DNS	**0.42**	**0.11**	**3.85**	**<.001**	**[0.20, 0.64]**
Scaf rate × Med/High complexity	8.69	28.55	0.30	0.764	[-50.75, 68.13]
Scaf rate × Condition	13.23	10.41	1.27	0.212	[-7.86, 34.33]
Med/High complexity × Condition	-33.85	23.82	-1.42	0.162	[-81.86, 14.15]
Scaf rate × Med/High complexity × Condition	-23.80	35.00	-0.68	0.500	[-94.50, 46.89]

Note. DNS = Day-Night Stroop. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction with semi-structured condition (reference = free play). The three-way interaction term tests whether complexity level moderates the scaffolding rate–outcome association differently by condition. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table H8

Full Model Output for Scaffolding Rate × Complexity × Condition Predicting DCCS (RQ 4.2)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**14.25**	**2.21**	**6.45**	**<.001**	**[9.82, 18.69]**
Scaffolding rate	1.19	4.35	0.27	0.786	[-7.57, 9.95]
Low complexity rate	-4.17	4.32	-0.96	0.338	[-12.80, 4.46]
Condition (semi-structured)	-0.65	2.65	-0.25	0.807	[-5.94, 4.64]
Age	0.10	0.11	0.92	0.362	[-0.11, 0.31]
Sex (female)	1.47	0.85	1.74	0.086	[-0.21, 3.15]
Race/ethnicity (ref = White)					
Asian	-0.27	1.67	-0.16	0.870	[-3.59, 3.05]
Black/African American	1.95	2.50	0.78	0.438	[-3.02, 6.91]
Hispanic/Latino	-0.62	1.71	-0.36	0.718	[-4.03, 2.79]
Multiracial/Other	-0.09	1.64	-0.05	0.957	[-3.36, 3.18]
Other/Multiracial	4.03	6.84	0.59	0.571	[-11.46, 19.51]
Parent education	-0.09	0.38	-0.22	0.823	[-0.84, 0.67]
PVT	**0.97**	**0.37**	**2.64**	**0.010**	**[0.24, 1.70]**
Baseline DCCS	**0.42**	**0.10**	**4.06**	**<.001**	**[0.21, 0.62]**
Scaf rate × Low complexity	5.81	5.79	1.00	0.321	[-5.84, 17.47]
Scaf rate × Condition	-0.46	5.32	-0.09	0.931	[-11.10, 10.17]
Low complexity × Condition	0.12	6.42	0.02	0.985	[-12.67, 12.91]
Scaf rate × Low complexity × Condition	-1.32	9.55	-0.14	0.891	[-20.33, 17.70]
Medium/High complexity model					
Intercept	**11.71**	**2.87**	**4.08**	**<.001**	**[5.83, 17.58]**
Scaffolding rate	-1.26	5.94	-0.21	0.833	[-13.29, 10.76]
Medium/High complexity rate	4.33	12.84	0.34	0.737	[-21.66, 30.33]
Condition (semi-structured)	-0.77	2.98	-0.26	0.798	[-6.77, 5.24]
Age	0.09	0.10	0.90	0.372	[-0.11, 0.29]
Sex (female)	**1.94**	**0.93**	**2.10**	**0.039**	**[0.10, 3.79]**
Race/ethnicity (ref = White)					
Asian	-0.27	1.57	-0.17	0.864	[-3.40, 2.86]
Black/African American	2.00	2.47	0.81	0.422	[-2.92, 6.92]
Hispanic/Latino	-0.73	1.57	-0.47	0.643	[-3.87, 2.41]
Multiracial/Other	-0.12	1.65	-0.07	0.942	[-3.41, 3.17]
Other/Multiracial	3.82	6.49	0.59	0.571	[-11.03, 18.67]
Parent education	-0.03	0.41	-0.08	0.936	[-0.85, 0.79]
PVT	**0.90**	**0.42**	**2.13**	**0.036**	**[0.06, 1.74]**
Baseline DCCS	**0.42**	**0.10**	**4.01**	**<.001**	**[0.21, 0.63]**
Scaf rate × Med/High complexity	12.97	17.02	0.76	0.451	[-21.61, 47.54]

Table H8. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Scaf rate × Condition	-2.79	7.70	-0.36	0.718	[-18.18, 12.59]
Med/High complexity × Condition	-4.27	16.41	-0.26	0.796	[-37.16, 28.62]
Scaf rate × Med/High complexity × Condition	12.67	25.79	0.49	0.625	[-38.80, 64.15]

Note. DCCS = Dimensional Card Change Sort. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction with semi-structured condition (reference = free play). The three-way interaction term tests whether complexity level moderates the scaffolding rate–outcome association differently by condition. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table H9

Full Model Output for Scaffolding Rate × Complexity × Condition Predicting Tower of Hanoi (RQ 4.2)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**3.67**	**1.05**	**3.49**	**<.001**	**[1.56, 5.77]**
Scaffolding rate	0.73	2.05	0.35	0.724	[-3.39, 4.85]
Low complexity rate	-2.50	1.83	-1.37	0.177	[-6.17, 1.16]
Condition (semi-structured)	-1.13	1.05	-1.08	0.286	[-3.24, 0.97]
Age	-0.01	0.03	-0.44	0.665	[-0.07, 0.04]
Sex (female)	-0.02	0.35	-0.06	0.953	[-0.71, 0.67]
Race/ethnicity (ref = White)					
Asian	-0.29	0.61	-0.47	0.639	[-1.51, 0.93]
Black/African American	0.44	0.58	0.76	0.450	[-0.71, 1.60]
Hispanic/Latino	-0.10	0.52	-0.19	0.853	[-1.13, 0.94]
Multiracial/Other	0.66	0.51	1.30	0.197	[-0.35, 1.67]
Other/Multiracial	-0.03	0.78	-0.04	0.966	[-1.61, 1.54]
Parent education	-0.15	0.12	-1.26	0.212	[-0.38, 0.08]
PVT	**0.39**	**0.08**	**4.93**	**<.001**	**[0.23, 0.55]**
Baseline Tower of Hanoi	0.13	0.09	1.41	0.162	[-0.05, 0.32]
Scaf rate × Low complexity	1.25	2.18	0.57	0.571	[-3.16, 5.66]
Scaf rate × Condition	-0.65	2.14	-0.30	0.764	[-4.95, 3.66]
Low complexity × Condition	0.61	2.09	0.29	0.771	[-3.57, 4.79]
Scaf rate × Low complexity × Condition	-0.12	2.61	-0.05	0.964	[-5.37, 5.13]
Medium/High complexity model					

Table H9. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Intercept	**2.48**	**1.10**	**2.26**	**0.030**	**[0.25, 4.71]**
Scaffolding rate	-0.43	2.37	-0.18	0.857	[-5.25, 4.39]
Medium/High complexity rate	0.61	5.84	0.10	0.918	[-11.12, 12.33]
Condition (semi-structured)	-0.79	1.32	-0.60	0.552	[-3.42, 1.84]
Age	-0.02	0.04	-0.61	0.546	[-0.09, 0.05]
Sex (female)	0.05	0.39	0.12	0.907	[-0.72, 0.81]
Race/ethnicity (ref = White)					
Asian	-0.25	0.63	-0.40	0.692	[-1.51, 1.01]
Black/African American	0.45	0.64	0.70	0.486	[-0.83, 1.72]
Hispanic/Latino	-0.04	0.55	-0.07	0.945	[-1.13, 1.06]
Multiracial/Other	0.71	0.54	1.30	0.198	[-0.38, 1.79]
Other/Multiracial	-0.36	0.88	-0.41	0.686	[-2.12, 1.40]
Parent education	-0.17	0.14	-1.19	0.237	[-0.44, 0.11]
PVT	**0.40**	**0.09**	**4.37**	**<.001**	**[0.22, 0.58]**
Baseline Tower of Hanoi	0.15	0.10	1.48	0.142	[-0.05, 0.34]
Scaf rate × Med/High complexity	1.76	6.84	0.26	0.799	[-12.27, 15.78]
Scaf rate × Condition	-0.14	2.82	-0.05	0.961	[-5.80, 5.53]
Med/High complexity × Condition	-0.57	6.70	-0.09	0.932	[-13.93, 12.79]
Scaf rate × Med/High complexity × Condition	0.20	8.48	0.02	0.982	[-16.90, 17.30]

Note. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction with semi-structured condition (reference = free play). The three-way interaction term tests whether complexity level moderates the scaffolding rate–outcome association differently by condition. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

Table H10

Full Model Output for Scaffolding Rate × Complexity × Condition Predicting HTKS (RQ 4.2)

Term	*b*	SE	*t*	*p*	95% CI
Low complexity model					
Intercept	**24.66**	**9.12**	**2.70**	**0.011**	**[6.06, 43.25]**
Scaffolding rate	5.93	19.49	0.30	0.763	[-33.85, 45.71]
Low complexity rate	14.62	18.55	0.79	0.437	[-23.25, 52.50]
Condition (semi-structured)	7.59	10.11	0.75	0.458	[-12.89, 28.06]
Age	0.42	0.42	1.01	0.318	[-0.41, 1.26]

Table H10. (continued)

Term	*b*	SE	*t*	*p*	95% CI
Sex (female)	2.78	3.78	0.73	0.466	[-4.77, 10.32]
Race/ethnicity (ref = White)					
Asian	-0.41	7.07	-0.06	0.954	[-14.49, 13.68]
Black/African American	14.80	10.30	1.44	0.154	[-5.68, 35.28]
Hispanic/Latino	-2.51	5.61	-0.45	0.657	[-13.84, 8.82]
Multiracial/Other	-4.47	5.56	-0.80	0.424	[-15.56, 6.63]
Other/Multiracial	4.81	20.05	0.24	0.813	[-36.70, 46.31]
Parent education	-1.06	1.60	-0.66	0.512	[-4.28, 2.17]
PVT	**3.34**	**1.29**	**2.59**	**0.012**	**[0.77, 5.91]**
Baseline HTKS	**0.71**	**0.12**	**5.88**	**<.001**	**[0.47, 0.95]**
Scaf rate × Low complexity	-8.29	29.83	-0.28	0.782	[-68.34, 51.77]
Scaf rate × Condition	-5.11	20.49	-0.25	0.804	[-46.80, 36.57]
Low complexity × Condition	-25.39	21.84	-1.16	0.251	[-69.32, 18.53]
Scaf rate × Low complexity × Condition	-7.96	34.84	-0.23	0.820	[-77.76, 61.84]
Medium/High complexity model					
Intercept	**24.89**	**11.72**	**2.12**	**0.041**	**[1.07, 48.71]**
Scaffolding rate	2.68	25.42	0.11	0.917	[-49.08, 54.43]
Medium/High complexity rate	23.11	60.71	0.38	0.705	[-98.78, 144.99]
Condition (semi-structured)	7.19	10.90	0.66	0.513	[-14.79, 29.17]
Age	0.66	0.42	1.55	0.125	[-0.19, 1.50]
Sex (female)	2.94	4.18	0.70	0.485	[-5.40, 11.28]
Race/ethnicity (ref = White)					
Asian	2.29	6.22	0.37	0.714	[-10.11, 14.69]
Black/African American	17.08	10.49	1.63	0.107	[-3.78, 37.95]
Hispanic/Latino	0.16	5.61	0.03	0.977	[-11.16, 11.48]
Multiracial/Other	-4.73	5.46	-0.87	0.390	[-15.64, 6.18]
Other/Multiracial	4.47	19.04	0.23	0.817	[-35.10, 44.04]
Parent education	-0.90	1.61	-0.56	0.581	[-4.17, 2.37]
PVT	**3.71**	**1.28**	**2.91**	**0.005**	**[1.17, 6.26]**
Baseline HTKS	**0.66**	**0.12**	**5.50**	**<.001**	**[0.42, 0.90]**
Scaf rate × Med/High complexity	10.57	98.39	0.11	0.915	[-188.97, 210.10]
Scaf rate × Condition	2.07	27.90	0.07	0.941	[-54.16, 58.30]
Med/High complexity × Condition	-53.02	62.30	-0.85	0.398	[-177.59, 71.56]
Scaf rate × Med/High complexity × Condition	-48.89	107.69	-0.45	0.652	[-266.08, 168.30]

Note. HTKS = Head-Toes-Knees-Shoulders. PVT = Picture Vocabulary Test. Estimates are pooled across 20 imputed datasets using Rubin's Rules. Models estimated with CR2 cluster-robust standard errors clustered by small group. Race/ethnicity is dummy-coded with White as the reference category. × Condition = interaction with semi-structured condition (reference = free play). The three-way interaction term tests whether complexity level moderates the scaffolding rate–outcome association differently by condition. Bold rows indicate $p < .05$. CI = confidence interval for *b*.

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