ABSTRACT

Title of Dissertation:	MOTHER-CHILD AND FATHER-CHILD "SERVE AND RETURN" INTERACTIONS AT 9 MONTHS: ASSOCIATIONS WITH CHILDREN'S LANGUAGE SKILLS AT 18, 24, AND 30 MONTHS
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Infants learn language through the back-and-forth interactions with their parents where they "serve" by vocalizing, gesturing, or looking and parents "return" in a temporally and semantically contingent way. My dissertation focuses on these "serve and return" (SR) interactions between 9-month-old infants and their mothers and fathers (n = 296 parents and 148 infants) from ethnically and socioeconomically diverse backgrounds by examining the variability in SR interactions explained by maternal and paternal psychological distress, the association between SR interactions and children's language skills at 18, 24, and 30 months, and the moderation effect of maternal and paternal SR interactions on language outcomes. Psychological distress was indicated by parent-reported depressive symptoms, parenting stress, and role overload, and SR interactions were transcribed and coded from video-taped parent-child toy play activities during home visits. I report three major findings. First, neither maternal nor paternal psychological distress was significantly associated with and SR interactions at 9 months, controlling for demographic factors. Second, fathers who responded to their child's serves more promptly and mothers who provided more semantically relevant responses had children with higher receptive and expressive language skills, respectively, at 18 and 30 months. Third, fathers' semantically relevant responses were negatively associated with children's receptive language skills at 24 months; however, this main effect was moderated by mothers' semantically relevant responses. Understanding how mothers and fathers engage in temporally and semantically contingent social interactions with their children during the first year, especially among families from diverse backgrounds, would enable programs and policies to more effectively promote early language development and reduce gaps in school readiness.

MOTHER-CHILD AND FATHER-CHILD "SERVE AND RETURN" INTERACTIONS AT 9 MONTHS: ASSOCIATIONS WITH CHILDREN'S LANGUAGE SKILLS AT 18, 24, AND 30 MONTHS

by

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Chapter 1: Introduction

Statement of the Problem

The development of receptive and expressive language skills during the early years has important implications for children's wellbeing and achievement later on (Gibson et al., 2021; LoRe et al., 2018). Comprehending and producing language are foundational skills that enable children to communicate, interact with others, regulate their behaviors, and follow instructions (Kaushanskaya et al., 2017; Mulvey & Jenkins, 2021). Compared to their peers whose language development is on track, children who have trouble either comprehending or producing language during the early years are more likely to exhibit difficulties in school, such as delays in reading and math skills and behavior problems (Kastner et al., 2001; Matte-Landry et al., 2020; Walker et al., 1994). Poor school performance, in turn, may lead to undesirable educational outcomes in the long term, such as low rates of high school completion and college attendance (Magnuson et al., 2016).

The first years of children's lives are critical for learning sounds and words and acquiring communication skills because the brain is particularly susceptible to environmental input during that period (National Scientific Council on the Developing Child, 2007; Shonkoff & Phillips, 2000; Werker & Hensch, 2015). Although multiple factors, such as children's physical and cognitive abilities, gender, and exposure to two or more languages, matter for language development during the early years (e.g., Adani & Cepanec, 2019; Davidse et al., 2011; Hoff, 2018; Hoff et al., 2014; Iverson, 2010; Umek et al., 2008), a robust body of research suggests that caregiver-child interactions are one of the most significant contributors to the development of early language skills (e.g., Curtin et al., 2021; Hirsh-Pasek et al., 2015; Malin et al., 2014;

Romeo et al., 2018; Rowe, 2012; Shneidman & Woodward, 2016). According to the bioecological and sociocultural perspectives (Bronfenbrenner & Morris, 2006; Vygotsky, 1978), children learn the sounds, words, grammar, and pragmatics of a language through proximal interactions with more advanced social partners in the microsystem (e.g., home, childcare). By talking with children during everyday activities, caregivers not only scaffold children's language learning through these interactions but also transmit culturally appropriate ways to communicate with others. In this dissertation, I specifically focus on children's interactions with their parents because parents have the most proximal influence on early development and are significant contributors even when children's experiences from other types of childcare are accounted for (Cabrera et al., 2020; Duncan et al., 2019; Hirsh-Pasek & Burchinal, 2006).

Extensive research indicates that parent-child interactions of higher quality are strongly beneficial for children (e.g., Blackwell et al., 2015; Curtin et al., 2021; Elmlinger et al., 2022; Golinkoff et al., 2015; Hirsh-Pasek et al., 2015). Specifically, the moment-to-moment reciprocal interactions between parents and children during the early years, also known as "serve and return," (SR; Shonkoff & Bales, 2011), are hypothesized to be critical for early language learning and cognitive competence (National Academies of Sciences, Engineering, and Medicine, 2016; National Scientific Council on the Developing Child, 2004). SR captures parents communicating *with* the child not just *to* the child and represents the ideal that sensitive parents should respect the child's will and agency and allow the child to take the lead during interactions (Fisher et al., 2016; Harvard University Center on the Developing Child, n.d.; Keller et al., 2018). During SR interactions, children learn language through the back-and-forth communication with their parents where they "serve" by vocalizing, gesturing, looking, or making facial expressions, and parents verbally respond ("return") in a prompt (i.e., temporally contingent) and relevant (i.e., semantically contingent) way. These interactions enable children to map the words they hear to the objects they are focusing on at the moment (i.e., word-to-world mapping) and help them learn to take turns in communication and associate intention with social behaviors (Shneidman & Woodward, 2016; Tamis-LeMonda et al., 2014).

SR interactions during children's first two years are positively associated with language outcomes later on (Benassi et al., 2018; Donnelly & Kidd, 2021; Elmlinger et al., 2019; Gros-Louis et al., 2014; McGillion et al., 2013). However, the literature on SR has some limitations. First, the majority of the studies on SR interactions and their impact on language development are based on homogenous samples—White, English-speaking families from middle socioeconomic status (SES)—and little is known about how often parents and children from other SES, ethnic, and racial groups engage in SR interactions and whether their SR interactions are linked to early language development (Ramírez, 2022; Shimpi et al., 2012). The handful of studies that included families from non-White, non-English-speaking, or low-SES backgrounds have demonstrated mixed results in the association between SR interactions and early language skills (e.g., Guttentag et al., 2014; Ma et al., 2021; Shimpi et al., 2012). Therefore, by examining how parents and children in families from diverse backgrounds engage in SR interactions, my study aims to add new and important evidence to support the concept of SR and its contribution to language development in ethnically and racially heterogenous, lower-income samples.

Second, conceptually, there is a large variability in what is considered a "prompt" return from parents to impact early language learning. Some studies found that returns within 2 s of child serves are related to language skills, whereas others found 5 s to be significant (Gros-Louis et al., 2014; Lopez et al., 2020; McGillion et al., 2017; Miller & Lossia, 2013; Paavola, Kunnari, Moilanen, et al., 2005; Tamis-LeMonda et al., 2001). Meanwhile, studies that describe the temporal contingency of maternal responses indicate that mothers' contingent behaviors occur within 1 or 3 s of their child's bids for attention (Keller et al., 1999; Van Egeren et al., 2001). Thus, more research is needed to understand how promptly parents respond to their child, especially in parents from diverse backgrounds. To address this issue, I use a continuous measure of the temporal contingency of parent returns to more inclusively capture SR interactions in a diverse sample.

Third, all the studies have focused on interactions with one parent, mostly mothers, and this is a salient omission given that in two-parent families children are engaged with both parents in meaningful interactions that help them learn language (e.g., Cabrera et al., 2017, 2020; Leech et al., 2013; Malin et al., 2014; Pancsofar & Vernon-Feagans, 2010). Furthermore, theoretically, I expect that mother-child and father-child interactions are interdependent and may moderate each other's influence on the child (Cox & Paley, 1997, 2003). Therefore, parents' influence is both unique and interactive, that is, mothers and fathers jointly support early development. Not including fathers may also overestimate the effect of mothers on child development.

Fourth, the current literature has not explored the factors that may explain the variability in SR interactions. An important determinant of parenting quality is parents' psychological wellbeing. The parenting process model (Belsky, 1984; Taraban & Shaw, 2018) posits that parenting is shaped, in part, by parental psychological wellbeing, which, in turn, indirectly shapes child outcomes. Parents who exhibit psychological distress, such as depressive symptoms and parenting stress (Brody & Flor, 1997; Brookman et al., 2020), may be less able to immediately notice and responding to their children's bids for attention (Hummel et al., 2016). Furthermore, parenting is particularly susceptible to the negative impact of psychological distress during infancy (Letourneau et al., 2013), a critical period for children to establish healthy relationships and foundational skills. Although past research has identified psychological distress as a risk factor for positive parenting, most of the evidence is based on the link between maternal depression and the overall quantity (e.g., frequency of learning activities) and quality (e.g., warmth, sensitivity) of parenting (Coyne et al., 2007; Paulson et al., 2009; Weisleder et al., 2019). Very few studies have examined psychological distress of fathers or its relation to the moment-to-moment reciprocal interactions between parent and child, such as SR interactions. Therefore, I intend to examine whether mothers' *and* fathers' psychological distress are associated with SR interactions with their children during the first year to better understand the sources of variability in SR interactions.

The Current Study

Guided by the bioecological and sociocultural perspectives and building upon the existing research on SR interactions, my study aims to examine: (1) how mothers and fathers from diverse SES, ethnic, and racial backgrounds engage in SR interactions with their children at 9 months, a point of time when joint attention skills and first words begin to emerge (Akhtar & Gernsbacher, 2007; Carpenter et al., 1998; Schneider et al., 2015); (2) whether maternal and paternal psychological distress explains the variability in parents' SR interactions with their children; (3) whether maternal and paternal SR interactions are associated with the language development of children at 18, 24, and 30 months when important language milestones occur (e.g., word spurt at 18 months; Hoff, 2014) and significant differences in language abilities are observed (Cabrera, Malin, et al., 2017; Fernald et al., 2013); and, (4) whether there are moderation effects between maternal and paternal SR interactions on children's language skills.

I use data from a NIH-funded randomized controlled trial (RCT) longitudinal parenting intervention study, Baby Books 2 Project (BB2; Cabrera & Reich, 2017; McKee et al., 2021), to examine whether maternal and paternal psychological distress relates to SR interactions at 9 months and the associations between mothers' and fathers' SR interactions with their children at 9 months and children's receptive and expressive language skills at 18, 24, and 30 months. Specifically, I ask the following research questions:

Research Question 1: Are maternal and paternal psychological distress—depressive symptoms, parenting stress, and role overload—concurrently associated with mother-child and father-child SR interactions at 9 months, controlling for important covariates?

Hypothesis 1: Mothers and fathers who report higher levels of psychological distress at 9 months will engage in fewer SR interactions with their children at 9 months than parents who report lower levels of psychological distress, controlling for important covariates.

Research Question 2: Are maternal and paternal SR interactions at 9 months associated with children's receptive and expressive language skills at 18, 24, and 30 months, controlling for important covariates?

Hypothesis 2: Mothers and fathers who engage in more SR interactions with their children at 9 months will have children with higher receptive and expressive language scores at 18, 24, and 30 months than parents who engage in fewer SR interactions, controlling for important covariates.

Research Question 3: Are the associations between one parent's SR interactions at 9 months and children's receptive and expressive language skills at 18, 24, and 30 months moderated by the other parent's SR interactions?

Hypothesis 3a: The *positive* association between one parent's *high* SR interactions at 9 months and children's receptive and expressive language skills at 18, 24, and 30 months will be *stronger* when the other parent also engages in *high* SR interactions at 9 months (accumulative advantage hypothesis).

Hypothesis 3b: The *negative* association between one parent's *low* SR interactions at 9 months and children's receptive and expressive language skills at 18, 24, and 30 months will be *weaker* when the other parent engages in *high* SR interactions at 9 months (compensatory hypothesis).

Contributions to the Field

This study makes important contributions to the current knowledge of parent-child interactions and language development at the conceptual, methodological, and empirical levels. At the conceptual level, this study extends the previous findings on SR interactions and language development on White, middle-class families to families who are **diverse** in ethnic and racial makeup, nativity status, language use, household income, and parental education. By examining the relation between parental psychological distress and SR interactions, this study also highlights the **variability** in the quality of parent-child interactions in underprivileged families (about half of the sample earned less than $40,000, almost 80% did not have a college degree, and more than 70% were Hispanic). Including families from diverse backgrounds could help researchers identify the types of parent-child interactions that promote early language development while accounting for differences in parents' and children's demographic characteristics and is an important step toward building programs and policies to more effectively **reduce language gaps** during the first years of life.

At the empirical level, this study **accounts for both maternal and paternal** SR interactions to analyze their unique contribution to children's language outcomes by including maternal and paternal SR interactions simultaneously in the model. This study also examines the mechanism through which maternal and paternal SR interactions relate to language skills by testing the **moderation** effect of these two variables. This approach emphasizes the importance of including both parents in studies of child development.

At the methodological level, this study provides a micro-level **coding scheme** to capture both the temporal and semantic contingency of SR interactions using observed parent-child interactions at home.

Chapter 2: Review of the Literature

Children communicate with their parents long before they are able to understand and use words. Through looks, gestures, and babbling, infants send signals (i.e., “serves”) about their interests and desires to parents. Every time parents respond to (i.e., “returns”) these signals by promptly sharing infants’ eye gaze, labeling the toy that infants point at, and imitating the sounds infants make, they are helping infants learn words, produce language, and communicate with others (Reed et al., 2016; Shneidman & Woodward, 2016; Tamis-LeMonda et al., 2014). However, some parents may be less likely than others to engage in these SR interactions to facilitate early language learning. An important factor theorized to influence parenting is parental psychological distress (e.g., depressive symptoms, parenting stress; Belsky, 1984; Taraban & Shaw, 2018), which has been linked to lower quantity and quality of parenting (e.g., frequency of learning activities at home, conversational turns, positive affect, sensitivity) during early childhood (Brookman et al., 2020; Chu & Lee, 2019; Fentz et al., 2021; Letourneau et al., 2013; Marchetti et al., 2020; J. Zhang et al., 2022).

In this review, I synthesize two literatures: one on the association between parental psychological distress and parenting from birth to age 3 and the other on the association between SR interactions during the first three years of children’s life and language development. I focus on the first three years of children’s life because experiences during this period are crucial for building the neural networks for language and have a long-term impact on children’s language skills (Duncan et al., 2019; Gilkerson et al., 2018; Jeong et al., 2021; National Scientific Council on the Developing Child, 2007). Because there is scarce evidence on whether parental psychological distress relates to SR interactions, I review studies that broadly examine the relation between parental psychological distress and the quantity and quality of parenting, such as home learning environment (e.g., frequency of book reading), parenting practices (e.g., discipline), parenting quality (e.g., warmth, sensitivity), and specific features of parent-child interactions (e.g., parental language input, conversational turns). I organize this review in the following way: (1) discuss the theoretical frameworks that conceptualize parent-child interactions as foundational for language learning; (2) describe how SR interactions have been defined and measured in the literature; (3) evaluate the empirical evidence on the importance of SR interactions for early language development; (4) evaluate the empirical evidence on the relation between parental psychological distress and parenting; and (5) summarize the limitations in the current literatures.

Theoretical Frameworks

Several theoretical frameworks have been delineated to understand the development of language, from the nativist view that children are born with the ability to process a universal set of grammatical rules (Chomsky, 1959) to the interactionist view that environmental input is key for language development (Vygotsky, 1978; Snow, 2014). In this review, I focus on the interactionist view of language development because evidence over the past few decades consistently indicates that children's postnatal experiences in their environments are a strong predictor of language outcomes (e.g., Hart & Risley, 1995; Hoff, 2003; Rowe, 2012; Snow, 2014). I discuss two theoretical frameworks that highlight the fundamental role of parent-child interactions in shaping language development during the early years: the bioecological model (Bronfenbrenner, 1977; Bronfenbrenner & Morris, 2006) and the sociocultural theory (Vygotsky, 1978).

Bronfenbrenner's bioecological theory outlines the ways in which proximal and distal environments at different levels of the larger ecological system interdependently influence the development of the child. In his original model, *ecological systems theory* (Bronfenbrenner, 1977), Bronfenbrenner focused heavily on the environments surrounding the child; later, he modified the model to incorporate the genetic and biological characteristics of the child as contributors to development, hence the *bioecological model* (Bronfenbrenner & Ceci, 1994). The child is situated at the center of this model, with their most proximal environment (i.e., the microsystem) having the most direct influence on their development. The microsystem often consists of a child's experiences at home, childcare, and school during early childhood. For infants, their interactions and relationships with caregivers (e.g., parents, relatives, childcare providers) are the primary sources through which they acquire the necessary skills to navigate the world (Bronfenbrenner, 1977; Bronfenbrenner & Morris, 2006). Moreover, early development is also influenced by interactions between microsystems, known as the mesosystem. For example, the positive association between cognitive stimulation (e.g., frequency of book reading) provided by mothers at age 2 and children's reading and math skills at age 4 is stronger when children also receive high levels of cognitive stimulation at childcare (Cabrera et al., 2020). Lastly, this theory includes broader contexts, such as SES and culture (i.e., the exosystem), which exert an indirect influence on development through the proximal environment (Bronfenbrenner & Morris, 2006). For example, low-SES parents on average use less infant-directed speech and, in turn, have children with smaller vocabularies (Rowe, 2008).

Vygotsky's (1978) sociocultural theory zooms in on the interactions between caregivers and children within the microsystem. It posits that language is a tool through which parents transmit culturally appropriate knowledge to children and children communicate their thoughts and intentions to others (Vygotsky, 1978). A key element of this theory is the Zone of Proximal Development (ZPD; Vygotsky, 1978). ZPD refers to the idea that learning is best supported when more advanced social partners (e.g., caregivers, teachers) help children achieve new abilities that children would otherwise be unable to obtain independently. This process through which parents meet children where they are at and provide just enough guidance for them to advance developmentally is called scaffolding. During the early years, parents scaffold language development by providing prompt and relevant feedback to children (Masek, McMillan, et al., 2021); for example, when children point to a ball ("serve"), parents can label the ball and talk about how they can play with the ball while demonstrating the actions ("return"). Through these SR interactions, children internalize more advanced knowledge and skills (e.g., the round rubber toy is called a ball and they can bounce it and roll it) and become able to apply them independently in other situations. SR interactions are particularly important during infancy when children have limited cognitive abilities and need more stimulation and regulation from the environment (Kuhl, 2007; Masek et al., 2021; Rowe & Snow, 2020; Sameroff, 2010).

Together, the bioecological model and the sociocultural theory emphasize the importance of parent-child interactions for supporting language development during infancy. But they also differ from each other in some aspects. The bioecological model highlights the interdependence between the child's social contexts and conceptualizes an indirect path from distal factors (e.g., SES) to proximal factors (e.g., parent-child interactions) to the child's developmental outcomes. This model does not specify a particular aspect of parent-child interactions, whereas the sociocultural theory points out that cognitively stimulating interactions between parents and children drive early development. The sociocultural theory stresses that children learn through socially constructed and culturally appropriate activities with more knowledgeable partners and focuses on the impact of parental input on children. These theories can be tested, for example, by assessing the direct path between parent-child interactions and children's language skills and by assessing the indirect path from a broader context (e.g., SES) to parent-child interactions and then to children's language skills.

Definitions and Measurement of SR Interactions

Researchers have used several terms to define the moment-to-moment reciprocal interactions between parents and children, such as *responsiveness* and *contingent responses*, which refer to a *prompt* (close in time) change in parents' behavior that is *contingent* (in response to children's behavior) and *appropriate* (meaningful for children's behavior) in the context of children's verbal and verbal acts (e.g., touch or manipulate a toy, eye gaze, gestures, and vocalizations; Baumwell et al., 1997; Benassi et al., 2018; Choi et al., 2020; Tamis-LeMonda et al., 2001, 2014). *SR interactions* can be used as an umbrella term to represent all these types of parent-child interactions featured by their temporal and semantic contingency.

Admittedly, there are other measures, such as *sensitivity*, that capture parents' attuned and adequate reactions to children's signals using a global rating scale. Although these measures have been found to similarly predict children's language outcomes (e.g., Attig & Weinert, 2020; Bruce et al., 2022; Elsabbagh et al., 2013; Leigh et al., 2011; Murray et al., 2016), they assess the overall quality of parent-child interactions rather than the moment-to-moment (i.e., micro-level coding) exchanges between parents and children and are not able to assess the temporal link between children's signals and parents' responses. Compared to global rating, micro-level coding is able to provide more details about the variability in SR interactions in regard to how soon parents respond to children's serves and how often their responses are about what children attend to. In this review, I only focus on studies that measured SR interactions at the micro level.

SR interactions are often assessed as parent responses (usually the first response) that occur within a specified time window (e.g., 2, 3, or 5 seconds) following every child act (e.g., look to toy, look to parent, gestures, vocalizations) and are semantically relevant for the child act (e.g., labeling the toy the child looks to, imitating the child's vocalization). Most studies adopt a 2 or 5 s time window to distinguish parents' temporally contingent from non-temporally contingent responses (e.g., Baumwell et al., 1997; Benassi et al., 2018; Goldstein & Schwade, 2008; Miller & Lossia, 2013; Paavola et al., 2005; Shimpi et al., 2012; Tamis-LeMonda et al., 2001). For example, Gros-Louis and colleagues (2014) coded mothers' "contingent responses" within 2 s following infants' vocalizations and categorized these responses based on their functions, such as acknowledgements, naming, imitations or expansions (Gros-Louis et al., 2014). McGillion and colleagues (2013) coded "temporal contingency" and "semantic contingency" and defined the former as maternal responses within 2 s following an infant vocalization and the latter as mothers talking about objects/activities under infants' attention in the 2 s window preceding mothers' utterance (McGillion et al., 2013).

In one of their earliest studies, Baumwell, Tamis-LeMonda, and Bornstein (1997) coded "maternal verbal sensitivity" as a positive and meaningful change in mothers' verbal behavior occurring within 5 s following an infant vocal or exploratory act (Baumwell et al., 1997). Later, this group of researchers expanded the coding scheme (renamed as "maternal responsiveness") by categorizing maternal responses based on the type of infant acts (e.g., responses to infant bids/looks to mother, responses to infant vocalizations) and the function of the responses (e.g., imitation, questions, description; Tamis-LeMonda et al., 2001).

Other studies that code parents' responses within 5 s focus on the conversational turns between children and parents. Conversational turn counts (CTCs) are primarily measured by the Language Environment Analysis device (LENA), which collects day-long audio recordings of the language children are exposed to (e.g., Gilkerson et al., 2018; Greenwood et al., 2011; Lopez et al., 2020). LENA defines CTCs as the number of alternations between an adult and the target child (or vice versa) within a 5 s time window; in other words, if one speaker takes longer than 5 s to respond to the other speaker, then there is no conversational turn. It is important to note that this method does not account for the relevance of adults' responses to children (e.g., the adult and child may not be talking about the same thing during the conversational turn) and only include "returns" to children's vocalizations but not nonverbal acts. Moreover, some evidence suggests that this automated measure of CTCs demonstrates low reliability with manually coded CTCs (Busch et al., 2018; Cristia et al., 2021; Marchman et al., 2021). Nonetheless, compared to the manual coding of SR interactions mentioned above, CTCs calculated by LENA are able to provide a comprehensive profile of the back-and-forth communication between adults (not just parents) and children during children's entire waking time (not just a brief session of parent-child interaction) without demanding a considerable amount of time and resources spent in transcribing video recordings and processing transcribed data.

A few studies have used a 1 or 3 s time window to assess SR interactions (e.g., Ashtari et al., 2020; Fagan & Doveikis, 2017; Goldstein et al., 2003) and a handful of studies have measured the temporal aspect of mothers' responses in other ways, such as responses during the child act or within the same 10 s interval as the child act (Coates & Lewis, 1984; Gros-Louis & Miller, 2018; Wu & Gros-Louis, 2014), thus allowing a longer period for mothers to respond and consequently yielding a higher count of SR interactions.

In addition to coding SR interactions during naturalistic parent-child interactions, some studies have manipulated mothers' responses to infants through experiments with random assignment to illuminate the causal relation between temporally contingent responses and language skills (e.g., Goldstein et al., 2003; Miller & Lossia, 2013). In these experiments, researchers instruct mothers to either respond contingently to each of their infants' vocalizations/gestures (i.e., contingent condition) or non-contingently with the same type and number of responses (i.e., yoked condition). For example, Goldstein and colleagues (2003) randomly assigned mothers to the contingent condition (CC), in which mothers responded immediately to their 8-month-olds' vocalizations by smiling at, moving closer to, and touching infants. Mothers who were randomly assigned to the yoked condition (YC) were cued by a researcher about when to respond based on the timing of the responses from CC mothers. This manipulation made sure that YC mothers' responses were not temporally contingent to their infants' vocalizations but provided the same level of stimulation as the responses from CC mothers. A few other studies modified this experimental paradigm by allowing mothers to speak to infants freely, say infants' names, or by instructing mothers to only respond to a proportion of infants' vocalizations (Goldstein & Schwade, 2008; Miller, 2014; Miller & Lossia, 2013).

To summarize, there is a large variability in how studies operationalize SR interactions as they differ in the duration of the time windows used to assess the promptness of parents' responses and in the types of infant acts (verbal or nonverbal) that are considered as serves to parents. These methodological variations may produce inconsistent estimation of SR interactions across studies and render it challenging to draw conclusions about the specific features of parent-child interactions that matter for early language learning. Although experimental evidence has the potential to inform causal relations between SR interactions and children's language development, the existing experimental studies have only manipulated mothers' responses to infants' vocalizations, but not infants' nonverbal behaviors, and have only measured concurrent relations between mothers' responses and infants' language skills (e.g., vocal production during the interaction, mother-reported vocabulary measured at the same time as the interaction), thus making the direction of the relation unclear. Moreover, the majority of the studies observed SR interactions during short sessions (5 to 30 minutes) of parent-child toy play and less is known about how parents and children engage in SR interactions during other common activities for infants and toddlers, such as bath time, mealtime, and book reading.

Contribution of SR Interactions to Early Language Development

A body of the literature assessing mothers' returns *within 2 s* following infants' serves have demonstrated significant associations between SR interactions and infants' phonological and vocabulary skills. For example, in an experiment, Goldstein and Schwade (2008) found that when 9-month-old infants were provided with contingent verbal and nonverbal feedback (e.g., smiles, touches, vowel and consonant-vowel sounds) by their mothers within 2 s after their babbling, they produced 10% more vocalizations during the interaction that were phonologically similar to the sounds they heard in their mothers' feedback compared to infants who did not receive contingent responses (Goldstein & Schwade, 2008). Other studies utilizing a similar experimental design with 9- to 12-month-olds in White, middle-SES, English-speaking families also showed that infants produced more vocalizations in total and more vocalizations mimicking the phonological features of their mothers' speech during the interaction when receiving contingent responses within 2 s compared to receiving non-contingent responses (e.g., Elmlinger et al., 2019; Gros-Louis & Miller, 2018; Miller, 2014; Miller & Lossia, 2013). Moreover, longitudinal evidence from an experimental study with a sample of nine primarily White, middle-SES families indicates that mothers' contingent responses within 2 s following infants' vocalizations from 8 to 14 months is strongly correlated ($r = .77$) with children's vocabulary production measured with the MacArthur-Bates Communicative Development Inventory (MB-CDI) at 15 months (Gros-Louis et al., 2014). Altogether, these experimental findings reveal that parents' prompt (in this case, within 2 s) returns to infants' babbling may simultaneously help infants learn and use phonologically mature sounds, but such evidence does not speak to whether parents' prompt and relevant returns to infants' nonverbal serves support early language development and are insufficient for understanding the longitudinal relation between SR interactions and children's language skills.

Two correlational studies that examined the longitudinal relation between SR interactions within 2 s (considering parents' returns to both verbal and nonverbal serves) and child language however, showed inconsistent results. Using a sample of 46 mother-child dyads from White, middle-SES, English-speaking families in the U.K., McGillion and colleagues (2013) found that maternal responses that were temporally linked (i.e., within 2 s) to infants' vocalizations *while* being semantically relevant to infants' attention (e.g., talking about the toy the infant was looking at) at 9.5 months predicted children's expressive vocabulary on MB-CDI at 18 months. This association demonstrated a medium effect size ($\beta = .34$) after controlling for maternal education and vocabulary diversity. It is also important to note that temporally or semantically contingent responses *alone* were not significantly associated with children's vocabulary (McGillion et al., 2013). In contrast, a study with Black, low-SES mothers and their children did not find support for a significant longitudinal association between SR interactions and child language. Shimpi and colleagues (2012) reported nonsignificant correlations between maternal prompt (i.e., within 2 s) and relevant responses to infants' verbal and nonverbal acts from 1 to 18 months and children's vocal production (i.e., number of word tokens and types produced during the interaction) at 18 and 24 months (Shimpi et al., 2012). Such discrepancy between the two studies may be attributed to sample difference as McGillion et al. (2013) included more privileged families than Shimpi et al. (2012) and age difference as the latter included newborns starting at 1 month. More evidence with families from diverse backgrounds and children at different ages is needed to better understand the relation between SR interactions and early language development.

Another body of the literature measuring mothers' returns *within 5 s* following infants' serves also consistently shows that SR interactions are beneficial for early language development (e.g., Baumwell et al., 1997; Bornstein et al., 1999; Paavola et al., 2005; Tamis-LeMonda et al., 2001). For example, Tamis-LeMonda and colleagues (2001) measured maternal responses that occurred within 5 s following an infant act (e.g., play, vocalization, look) and were relevant and appropriate for the act (e.g., description of an object, imitation of child's vocalization) in a sample of 40 White, middle-SES, English-speaking families. They found that infants who engaged in more SR interactions with their mothers at 9 and 13 months achieved language milestones (e.g., 50 words in production, combining words) earlier than infants who engaged in fewer SR interactions, while accounting for infants cognitive and language abilities (Tamis-LeMonda et al., 2001). Among the different types of maternal responses tested in the study, mothers' descriptions (e.g., that's a ball), affirmations (e.g., good job), play prompts (e.g., why don't you feed the doll), and imitations of infants' vocalizations within a 5 s time window are particularly beneficial for language learning during infancy (Tamis-LeMonda et al., 2001).

Adopting the measure developed by Baumwell, Bornstein, Tamis-LeMonda, and colleagues (Baumwell et al., 1997; Bornstein et al., 1999; Bornstein & Tamis-Lemonda, 1997; Tamis-LeMonda et al., 2001), Paavola and colleagues replicated the positive link between SR interactions and early language development with small samples of middle-SES, Finnish-speaking families. They found that mothers' prompt (i.e., within 5 s) and appropriate responses to infants' exploratory and vocal behaviors at 10 months were associated with infants' word production and vocabulary at 12 months (Paavola, Kunnari, & Moilanen, 2005; Paavola, Kunnari, Moilanen, et al., 2005). In addition, two studies with large samples of low-SES, English-speaking families in Australia indicate that maternal imitations of infants' vocalizations and responsive yes/no questions (e.g., when the infant takes a drink, mother asks "are you thirsty?") within a 5 s time window at 12 months have a longitudinal impact on infants' word production at 24 months and language skills (e.g., expressive vocabulary, word structure) at 36 months, respectively (Smith et al., 2018, 2019).

Lastly, findings on CTCs calculated by LENA, which assess the conversational turns between parents and children within 5 s, suggest that the more CTCs children experience at home, the better their language skills, demonstrating small to medium effects across SES, age (from newborns to 3-year-olds), and linguistic (e.g., English, Swedish, Mandarin) groups (Brookman et al., 2020; Donnelly & Kidd, 2021; Dwyer et al., 2019; Gilkerson et al., 2018; Sundqvist et al., 2021; Swanson et al., 2019; Y. Zhang et al., 2015). For example, in a longitudinal study with 146 families from low, middle, and high SES, Gilkerson and colleagues found that CTCs measured at 18 to 24 months accounted for 14% to 27% of the variance in children's verbal comprehension and receptive and expressive vocabulary scores 10 years later, controlling for SES (Gilkerson et al., 2018). In another study with longitudinal data at six time points from White, high-SES families, Donnelly and colleagues (2021) reported a significant association between the growth of CTCs and the growth of vocabulary from 9 to 24 months, controlling for parental education (Donnelly & Kidd, 2021). These findings converge to show that conversational turns may facilitate early language development both in the short and long term and for children from diverse backgrounds.

Overall, these findings offer empirical support that parents' verbal input that is both temporally and semantically contingent is beneficial for children to learn words and communication, demonstrating small to medium effect sizes. Most evidence on maternal responses within a 2 s time window is experimental but concurrent, while the majority of the results regarding a 5 s time window is longitudinal but correlational. However, most of the findings were based on mother-child dyads from White, middle-SES, English-speaking families and do not capture infants' total home experiences that include interactions with both mothers and fathers and hence may overestimate maternal effects.

Contribution of Parental Psychological Distress to Parent-Child Interactions

According to the process model of the determinants of parenting (Belsky, 1984), parenting is directly influenced by multiple factors including characteristics of the individual parent, such as psychological wellbeing. Of all these factors, parents' psychological wellbeing might be the most important especially in the early years. Parents who are cognitively mature and psychologically healthy are the most able to provide nurturant care to children, which fosters optimal child development (Belsky, 1984). More specifically, a recent model, which expands from Belsky's model, highlights parental depression as a key determinant of parenting, because a large body of research has shown that maternal depression is linked to negative parenting (e.g., neglect and harsh discipline) and low levels of positive parenting (e.g., warmth, responsiveness; Lovejoy et al., 2000; Taraban & Shaw, 2018). These models also indicate that parental psychological distress may shape early development by influencing parenting practices and behaviors. In this section, I review studies that examine the association between parental psychological distress and parenting.

Substantial evidence, mostly based on mothers, has revealed the adverse effect of psychological distress, measured as *depressive symptoms* and/or *clinical depression* (both referred as depression from now on), on the quantity and quality of parenting. Specifically, parental depression is associated with more corporal punishment and disciplinary practices, less cognitive stimulation (e.g., reading activities), less responsive and more withdrawn parenting, fewer words and back-and-forth conversations with children during interactions, and fewer affective and informative features in speech to children (Carter et al., 2001; Chung et al., 2004; Field, 2010; Herrera et al., 2004; Kiernan & Huerta, 2008; Paulson et al., 2009; Stein et al., 2008). For example, in a sample of 128 primarily White, middle-SES mothers, Coyne and colleagues (2007) found that mothers who reported more depressive symptoms on the Center for Epidemiological Studies Depression (CES-D) Scale (e.g., I felt sad) noticed and reacted to their children less, viewed them more negatively, and displayed lower levels of sensitive parenting during interactions with their 30-month-olds at home (Coyne et al., 2007). A study with a national sample in the UK showed that maternal depression reported at 9 months was negatively associated with their reading activities (e.g., frequency of reading to child) and positive relationships with child (e.g., child seeks comfort from mother, mother in tune with child's feelings) at age 3 (Kiernan & Huerta, 2008). Likewise, another study with a large sample of mothers from diverse backgrounds in the UK found that self-reported maternal depression at 10 months was associated with less positive caregiving (e.g., maternal responsivity, opportunities for cognitive stimulation) at 10 months (Stein et al., 2008).

Considering paternal depression, Paulson and colleagues (2009) found in a subsample of the Early Childhood Longitudinal Study–Birth Cohort (ECLS-B) that mothers' and fathers' depressive symptoms reported at 9 months were negatively associated with the frequency of their reading to children at 9 and 24 months, controlling for important demographic characteristics (e.g., parent race, age, education). This finding is consistent with past research that reveals similar associations between paternal depression and parenting as found with maternal depression (Wilson & Durbin, 2010). Another study that also used the ECLS-B data demonstrated that nonresident fathers who reported depressive symptoms at 9 months also reported being less involved (e.g., spending less time and less affection and delight) with their infants at 9 months, controlling for parent race and work conditions (Paulson et al., 2011).

Moreover, studies that include both mothers and fathers indicate a partner effect of depression on parenting, although the direction (from mother to father or vice versa) of the effect is unclear. Chu and Lee (2019) demonstrated in a large sample of Korean families that paternal psychological distress at age 3 was related to maternal psychological distress, which in turn was related to paternal caregiving quality (e.g., plays and talks with child) and quantity (e.g., hours spent on caregiving) at age 3, suggesting associations between fathers' psychological distress and parenting mediated by mothers' psychological distress (Chu & Lee, 2019). In contrast, a study with 80 Chilean families revealed a mediation by fathers' parenting. Muzard and colleagues (2021) found that paternal sensitivity observed during parent-child interactions mediated the relation between maternal depressive symptoms and sensitivity during toddlerhood (Muzard et al., 2021). Additionally, in a large sample of middle-SES Danish families, Fentz and colleagues (2021) showed that prenatal maternal depressive symptoms were associated with own depressive symptoms 10 months after childbirth, which was then associated with father-child attachment 19 months after child birth (Fentz et al., 2021). Overall, these findings shed light on the spillover effect between mother and father within a family and the importance of including both parents to understand the link between parental psychological distress and parenting.

Parental psychological distress is not only related to the overall quality of parenting but also the contingent responses of parents during interactions. Hummel and colleagues (2016), using a sample of primarily White, middle-SES mothers, found that mothers who reported no/low and moderate/high depressive symptoms on CES-D displayed similar levels of warmth and positive affect when interacting with their children at 24 months, but the positive affect of mothers with moderate/high depressive symptoms was not contingent to the positive affect of their children (Hummel et al., 2016). Thus, even though depressed mothers may express adequate levels of positive emotions, they may struggle with responding to their children in a contingent and appropriate manner.

Furthermore, parenting stress and role overload have also been used, although less commonly, as indicators for parental psychological distress during infancy. Different from depression, which assesses individual emotional status and feelings, *parenting stress* (e.g., my child rarely does things for me that make me feel good) centers around feelings about parent-child relationships and *role overload* (e.g., I do not ever seem to have time for myself) represents individual perceptions of being overwhelmed by partaking multiple social roles (e.g., parent, spouse, breadwinner, etc.; Canfield et al., 2020; Lau et al., 2022; Weisleder et al., 2019), thus revealing important aspects of parental psychological distress not necessarily captured by depression. For example, Weisleder and colleagues (2019) found in a large sample of low-income mothers that mothers who reported higher levels of parenting stress at 6 months engaged their children less frequently in learning activities at 36 months (Weisleder et al., 2019). A study with first-time mothers in Hong Kong demonstrated that self-reported prenatal role overload was indirectly associated with maternal responsiveness at 9 months through self-reported depressive symptoms at 4 months (Lau et al., 2022). Therefore, parenting stress and role overload may be similarly linked to parenting as found with parental depression and should be included to better capture parental psychological distress.

Gaps in the Literature

Despite the robust results on the importance of SR interactions for early language development, researchers need to take caution in interpretation because this literature is limited in its generalizability. The majority of the literature on SR interactions is focused on White, middle-SES, English-speaking families and there is little known on how parents who are low-income and less educated, ethnic and racial minority, or speak non-English languages engage in SR interactions with their children and whether these SR interactions, as defined by the prototypical behaviors observed with Western families, facilitate children's language skills. The lack of inclusion for diverse samples may perpetuate the idea that SR interactions are supposed to look like what have been measured with Western families (Keller et al., 2018). As García Coll and colleagues (1996) emphasized, the development of minority children is situated in a set of dynamic contexts that present unique challenges and strengths (García Coll et al., 1996). Therefore, a literature that centers around historically advantaged groups may overlook the adaptive ways that parents from other socioeconomic and cultural backgrounds interact with their children and could impose predicament on the development of minority children when programs and policies attempt to "standardize" parenting solely based on what are found to be helpful in more privileged families.

Second, the exclusion of fathers in this literature is problematic. During the past two decades, a growing body of research has shown that fathers exert unique impact on children's language development, even after controlling for mothers' contribution and important demographic characteristics (e.g., Cabrera et al., 2017, 2020; Malin et al., 2014; Pancsofar &

Vernon-Feagans, 2010). In this case, research on SR interactions is falling behind on understanding how fathers respond to children's bids for attention and its link to early language development. Studies that only include mothers draw an incomplete picture of the learning environment children experience during their early years, and because fathers tend to use more challenging language with children than mothers (e.g., more wh-questions, more syntactically complex utterances; Cutler & Palkovitz, 2020; Rowe et al., 2004, 2017), it is possible that mothers and fathers may have different communicative goals with their children and engage in SR interactions in different ways.

Third, an important caveat in the literature on SR interactions is that studies differ from each other in how they measure SR interactions, thus making it implausible to compare across studies. Discrepancies especially exist in the time windows used to define prompt responses, with most studies adopting 2 or 5 s (e.g., Elmlinger et al., 2019; Fagan & Doveikis, 2017; Goldstein et al., 2003; Miller, 2014; Tamis-LeMonda et al., 2001) and other studies using multiple different intervals. Although these short time windows have been consistently linked with language outcomes, they can be arbitrary and constraining for families who live in cultures where dyadic and distal (e.g., face-to-face, verbal exchanges and object stimulation) interactions between parent and children are not the norm (Keller et al., 2018). Additionally, it can be difficult to translate these time windows into parenting practices; for example, telling parents to respond within 2 s when their child babbles. Therefore, measuring the temporal contingency of parent returns as a continuous variable may be a more inclusive way to capture how soon parents respond to their children, especially in diverse samples.

Lastly, very few studies haven assessed whether parental psychological distress, in both mothers and fathers, explains the variability in the moment-to-moment reciprocal parent-child interactions. Extant literature on the relation between psychological distress and parenting also focuses on depression and overlooks other sources of stress faced by parents that may come from maintaining positive relationships with their children (e.g., parenting stress) and maneuvering different responsibilities (e.g., role overload). Therefore, the field may benefit from more research on multiple aspects of psychological distress in both parents and their influence on micro-level parent-child interactions.

Considering these limitations, my study examines the main and moderation effects of maternal and paternal SR interactions on children's language skills in a sample of families from diverse SES and ethnic backgrounds. It also explores the relation between maternal and paternal psychological distress, represented by three aspects (i.e., depressive symptoms, parenting stress, and role overload), and SR interactions to understand the variability in SR interactions.

Chapter 3: Methods

Data Source

Data for this study were drawn from the BB2 project, an NIH-funded longitudinal bilingual (English and Spanish) parenting intervention in which educational information about typical child development and effective parenting practices were embedded in baby books (Cabrera & Reich, 2017; McKee et al., 2021). The BB2 project included N=420 first-time biological mothers and fathers (N=210 children/families) who were cohabiting with each other and the child at enrollment. If parents separated over the course of the BB2 project, each parent was still eligible to remain in the study and was followed individually for subsequent data collection activities. Other eligibility criteria included being literate at or above first-grade level in English or Spanish and having household incomes below $75,000 at enrollment. BB2 uses a randomized controlled trial (RCT) design that includes four conditions: (1) families receive BB2 intervention books for both parents (i.e., mothers receive the "mommy" books and fathers receive the "daddy" books) at 9, 12, 15, 18, and 24 months; (2) families receive BB2 intervention books only for mothers at each time point; (3) families receive BB2 intervention books only for fathers at each time point; and (4) families receive commercially available English-Spanish bilingual books (e.g., Big Dog…Little Dog) at each time point (i.e., control condition). The BB2 intervention books are English-Spanish bilingual and are equivalent in storyline and content for mothers and fathers, except that the titles and main characters of the books for mothers are mothers (e.g., "Mommy's Growing Baby") and those of the books for fathers are fathers (e.g., "Daddy's Growing Baby"). The BB2 project has been approved by the Institutional Review Board at the University of Maryland (protocol number 714055).

Study Sample

This study includes n=296 parents (148 mothers and 148 fathers) and their children who had valid data for SR interactions at 9 months and did not have developmental delays or disabilities[1]. Comparing families included in my study (n=296) to those excluded but were in the full BB2 sample (n=124), chi-square tests and independent samples t-tests showed that the two groups did not differ significantly in child gender, parent education, parent ethnicity/race, parent marital status, parent nativity status, parent employment status, parent age, study site, non-parental childcare arrangement, or child language skills at 9 months. However, the two groups differed significantly in household income, parent language spoken to the child, and BB2 intervention condition. Specifically, parents who reported higher household income, speaking English or Spanish to their child, and were assigned to the control group were more likely to be included in my study compared to parents who reported lower household income, speaking a language other than English or Spanish to their child, and were assigned to the intervention group. Therefore, the two samples are not comparable in these aspects and the findings from my study is not generalizable to the full BB2 sample.

Table 1 shows the demographic characteristics of the study sample. The majority of mothers and fathers (76% and 73%) self-identified as Hispanic, followed by non-Hispanic African American (11% and 10%), non-Hispanic White (7% and 8%), and other ethnic and racial groups (e.g., Asian, multiracial; 6% and 9%). More than twice as many fathers (24%) than mothers (10%) reported less than a high school education and almost twice as many mothers (25%) than fathers (14%) reported a 4-year degree or above. More than 90% fathers reported

[1] During the proposal, I and the committee members agreed on a sample size of 300 parents (150 children). However, two children were reported by their parents to receive speech therapy for language delays at later waves and thus were not included in my sample.

currently working for pay at 9 months, whereas less than half of the mothers reported so. More than half of the mothers and fathers were born outside the U.S. About 60% of children lived in households where parents reported speaking only English or Spanish to them and 38% lived in households where parents reported speaking two or more languages to them. About half of the parents reported annual household incomes at or below $40,000, which is 200% of the federal poverty line for a family in 2017 at the time BB2 started enrolling parents (U.S. Department of Health and Human Services, 2017). Half of the children in the sample were boys.

Procedure

Mothers and fathers were recruited by English monolingual and English-Spanish bilingual researchers at community centers, physician offices, childcare centers, farmers' markets, public parks, and health clinics for the Special Supplement Nutrition Program for Women, Infants, and Children (WIC) in southern California (UCI site) and the Washington, D.C. metro area (UMD site). Families were told that the project was aimed at understanding how reading to babies helps them learn. BB2 consists of eight waves of data collection occurring when children were 9-, 12-, 15-, 18-, 21-, 24-, 30-, and between 37- and 47-months-old through a series of home visits, phone calls, online surveys. Families were randomized to one of the four intervention conditions before the 9-month data collection. Due to COVID-19, the last wave of data collection (i.e., Wave 8) was conducted exclusively through phone calls, online surveys, and Zoom, a virtual meeting platform. Data for this study are based on the home visits at 9, 18, 24, and 30 months conducted by me, other graduate students in the lab, and trained post baccalaureate research staff.

During the home visit at 9 months, mothers and fathers were videotaped during four types of semi-structured interactions with their child (i.e., book reading, play without toys, play with toys, and cleanup). The order of mother-child and father-child interactions was randomly assigned at 9 months and counterbalanced for subsequence waves of home visits (i.e., 18, 24, and 30 months). For this study, I used the toy play activity, in which parents were given two bags, one at a time, containing age-appropriate toys (e.g., shape sorter, plastic food toys) to play with their child for 10 minutes. Parents were asked to sit on a mat with the child and act naturally as if we were not present and were encouraged to interact with their child in whatever language they felt comfortable with. During the visit, mothers and fathers were also interviewed in their preferred language (English, Spanish, or both) about family and child demographic characteristics and their psychological wellbeing. During the visits at 18, 24, and 30months, a trained researcher (English-Spanish bilingual researchers for children in Spanish-speaking families) assessed children's language skills after their interactions with mother and father. At the end of each visit, parents were compensated in cash and given the books based on their assigned condition.

Measures

Children's Language Skills at 18, 24, and 30 Months

Along with other graduate students and trained research staff, I assessed children's receptive and expressive language skills at 18, 24, and 30 months using the Preschool Language Scale, 4th edition (PLS-4; Zimmerman et al., 2002). PLS has been validated in a nationally representative sample that was stratified based on parent education, geographic region, and race described by the 2000 Census and provides age-appropriate standardized scores for children's receptive, expressive, and total language skills (Zimmerman et al., 2002). PLS has strong psychometric properties including test-retest stability coefficients that ranged from .82 to .95 for receptive and expressive scores and internal consistency reliability coefficients from .66 to .96 in the standardization sample (Zimmerman et al., 2002).

Our research team administered the PLS-4 assessment during home visits in either English or Spanish after consulting with parents about the child's preferred language use. For children whose parents reported them to understand/speak only Spanish *or* only English, the assessment was conducted in that language. For children whose parents reported them to understand/speak both English *and* Spanish, parents determined which language was more appropriate to use for the assessment, and if the child did not answer an item correctly in the preferred language, we assessed the item in the other language to capture the child's conceptual knowledge regardless of language (Anaya et al., 2016; Byers-Heinlein & Lew-Williams, 2013; Marchman et al., 2010). Although English and Spanish versions of the assessment are standardized based on different populations, they are designed to be functionally equivalent and the items under age 3 are mostly identical in both versions.

Among the 148 children in my sample, n=145 (98%), 102 (69%), and 61 (41%) had valid receptive or expressive language scores at 18, 24, and 30 months, respectively. Missing data in language scores were mostly due to parents withdrawn from the BB2 project, not participating in data collection at the wave, or home visits not being conducted due to COVID-19. Of the children who had valid language scores, n=81 (56%), 59 (58%), and 39 (64%) were assessed in the English PLS-4 and n=65 (45%), 44 (43%), and 23 (34%) in the Spanish PLS-4 at 18, 24, and 30 months, respectively. For my analysis, I used children's standardized receptive and expressive scores at each time point. Independent samples t-tests revealed no significant differences between English and Spanish standardized receptive or expressive scores at the three time points.

Parental Psychological Distress at 9 Months

I used three indicators of parental psychological distress: maternal and paternal depressive symptoms, parenting stress, and role overload. These aspects of psychological wellbeing have been strongly connected to parenting behaviors (Carter et al., 2001; Chung et al., 2004; Field, 2010; Herrera et al., 2004; Kiernan & Huerta, 2008; Paulson et al., 2009; Stein et al., 2008). I used these three indicators to represent the latent construct of psychological distress rather than including them individually because psychological distress is a multifaceted trait that was not directly observed in the study and because I am not interested in the relations between the individual indicators and SR interactions. Maternal and paternal *depressive symptoms* were measured using a self-report 10-item survey: the Center for Epidemiologic Studies Depression Scale Short Form (CESD-SF; Kohout et al., 1993). Parents indicated how often in the past week they felt the same way as indicated by each item (e.g., "I felt depressed." "I was happy.") on a 4-point scale: 0 = rarely or never, 1 = some or a little of the time, 2 = occasionally or a moderate amount of time, and 3 = most or all of the time. For this study, the Cronbach's alpha coefficients for mothers' reports of depressive symptoms was 0.76 and for fathers 0.71. The sum ratings of total items with two reverse coded were used for analysis; the higher the score, the more depressive symptoms reported by parents.

Mothers and fathers reported their *parenting stress* using the Parenting Stress scale, which consists of 18 items (e.g., I am happy in my role as a parent) rated from 1 = strongly disagree to 5 = strongly agree (Berry & Jones, 1995). Internal consistency measured as Cronbach's alpha for this study was 0.80 for mothers and 0.81 for fathers. The average ratings of total items with eight items reverse coded were used for analysis; the higher the score, the more parenting stress reported by parents.

Maternal and paternal *role overload* was measured through self-report on the Role Overload scale (Thiagarajan et al., 2006). This measure consists of 6 items where parents rated how often they felt overwhelmed (e.g., I cannot ever seem to catch up) on a 5-point scale from 1 = strongly disagree to 5 = strongly agree. For this study, the Cronbach's alpha coefficients for mother reports was 0.78 and for father reports was 0.80. The average ratings of total items were used for analysis; the higher the score, the more role overload reported by parents.

"Serve and Return" Interactions at 9 Months

SR interactions were coded from the videotaped parent-child toy play activities at 9 months. The coding process included three steps: (1) my team and I first transcribed child vocalizations and parent speech from the video; (2) we then coded child nonverbal behaviors from the video; (3) at last we coded parent speech as responses to child vocalizations or nonverbal behaviors.

Transcription. I trained native English- and/or Spanish-speaking undergraduate research assistants to transcribe videotaped parent-child toy play activities in Datavyu (Gilmore et al., 2016) using the standardized format dictated by Codes for the Analysis of Human Language (CHAT), which is available through the Child Language Exchange System (CHILDES; MacWhinney, 2000). For parents, transcription was conducted at the utterance level (i.e., a conversational unit), followed by a pause of 1 second or more, ending with a terminal intonation contour, or having a complete grammatical structure (Ratner & Brundage, 2020). For infants, vocalizations of all durations were transcribed and a new vocalization was credited if there was a change in the vocalization or a pause of 1 s or more (Bornstein et al., 1992). Transcribers were required to achieve 90% agreement with me (the lead transcriber) on timing, content, and segmentation of utterances/vocalizations during the training process. Each transcript was checked by a second transcriber to ensure accuracy.

Coding. I developed the coding scheme for SR interactions based on the definition of SR by the Harvard Center on the Developing Child (n.d.) and the existing literature that captures the temporal and semantic contingency of parent responses at a micro level (e.g., Tamis-LeMonda et al., 2001; McGillion et al., 2013). According to the definition by the Harvard University Center on the Developing Child (n.d.), the key components of SR include: (1) noticing what the child is attending to, (2) following in by letting the child know you are seeing the same thing, (3) naming the child's actions and interests, (4) encouraging turn-taking by giving the child time to respond, and (5) knowing when the child is ready to end the activity or switch to another. In this study, I focused on the first three components which reflect the parent's ability to notice and tune in to the child's interest and provide meaningful information for the child to learn about his/her interest.

In my coding scheme, both communicative (i.e., vocalizations, gestures) and non-communicative (e.g., looking at a toy, manipulating a toy) behaviors of the child were coded as "serves," because these behaviors are frequent during the first year of children's life and are closely monitored and responded to by caregivers (Bornstein & Manian, 2013). Each SR interaction began with the child's serve, regardless of whether the child spontaneously initiated the behavior or not. In some cases, the child's serve (e.g., looking to a toy) may be a response to the parent previously drawing the child's attention to the toy. We counted those child behaviors as serves because they still signaled the child's attention and provided an opportunity for the parent to respond.

Child Verbal and Nonverbal Serves. Child *verbal serves* included non-distress vocalizations (i.e., excluded vegetative sounds such as coughing, sneezing). Child *nonverbal serves* included eye gaze (e.g., looking at an object), reaching for and touching an object, gestures, and manipulation of an object (with hands or mouth) and were coded every time the child shifted attention from one object/activity to another (McGillion et al., 2013). For example, if the child was first playing with the toy car and then looked to the ball, this attention shift was coded as a nonverbal serve signaling to the parent the child's interest in the ball. Brief looks that lasted less than 1 s were not coded. The start and end time of child verbal serves (i.e., when the child began and stopped vocalizing) and nonverbal serves (i.e., when the child began attending to an object/activity and shifted attention to a different object/activity or became nonattentive) were coded in milliseconds.

***Parent Returns to Verbal and Nonverbal Serves*.** Maternal and paternal returns to child verbal and nonverbal serves were coded at the utterance level and were coded along two dimensions: how promptly parents responded to the child (i.e., temporal contingency) and whether their response provided relevant information about the object/activity the child was attending to (i.e., semantic contingency). The start time of parents' returns (i.e., the start of the utterance) was coded in milliseconds. Parent returns to verbal and nonverbal serves were coded in separate paths and a return was counted twice if following a verbal and a nonverbal serve that occurred concurrently. I took a more generous approach in coding parent returns because parents could be responding to both verbal and nonverbal behaviors of the child and it is possible for the child to link the response to both behaviors. Figure 1a and 1b provide schematics for the coding scheme.

Based on previous coding schemes in the literature (Benassi et al., 2018; Gros-Louis & Miller, 2018; McGillion et al., 2013; Tamis-LeMonda et al., 2001), *parent returns to child verbal serves (i.e., verbal returns)* included the *first* utterance that occurred after the *end* of a child verbal serve. If the child had two consecutive verbal serves and the parent only responded after the second serve, the first serve was coded as not receiving a return and the second serve was coded as receiving a return. Because infants just begin to babble at 9 months (Hoff, 2014) and the infants in my sample rarely said words during the interaction, most of the time it was not possible to determine whether parent returns were semantically relevant to what infants attempted to say when they vocalized. Therefore, semantic contingency was not coded for parent verbal returns. I calculated two variables for parent verbal returns: (1) *verbal return proportion* (i.e., the proportion of child verbal serves followed by at least one parent return) to represent how much parents responded to their children's verbal serves while accounting for differences in children's volubility and (2) *verbal return time* (i.e., how many seconds between the end of each child verbal serve and the start of each parent first verbal return and then averaged across the verbal returns) to represent the temporal contingency.

To measure *parent returns to child nonverbal serves (i.e., nonverbal returns)*, I coded *every* maternal and paternal utterance that occurred after the *start* of a child nonverbal serve and before the *end* of the serve. In other words, a child nonverbal serve was coded as not receiving a return if the parent did not produce any utterance between the start and the end of the serve. Parent utterances that occurred while the child was not attending to any toys/activities were not coded as returns. Next, each nonverbal return was coded based on whether the utterance provided semantically relevant information about the object/activity the child was attending to, such as labeling and describing the object/activity (That's a ball. You see stars on it?), giving play prompts specific to the object/activity (e.g., Throw it to me), and connecting the object/activity to the child (e.g., [referring to the baby doll] it's just as small as you). I calculated three variables for parent nonverbal returns: (1) *nonverbal return proportion* (i.e., the proportion of child nonverbal serves followed by at least one parent return) to represent how much parents responded to their children's nonverbal serves while accounting for differences in children's behaviors; (2) *nonverbal return time* (i.e., how many seconds between the start of each child nonverbal serve and the start of each *first* parent nonverbal return and then averaged across the nonverbal returns) to represent temporal contingency; and (3) *relevant returns* (i.e., the proportion of parent returns that were semantically relevant to the child's focus) to represent semantic contingency.

The extant literature has examined parents' responses to children's vocalizations separately from responses to nonverbal behaviors because vocal exchanges or turn-taking is an essential feature of human communication and provides the basis for the acquisition of language and social interactions (Bornstein et al., 2015; Fagan & Doveikis, 2019; Goldstein & Schwade, 2008; Gros-Louis et al., 2006). However, in my study, vocalizations and nonverbal behaviors were regarded equally as serves that trigger returns from parents and thus parent verbal and nonverbal returns were analyzed together in terms of their associations with language development. Therefore, I calculated two composite variables for return proportions and return time: (1) the average between verbal and nonverbal return proportions to represent parents' overall rate of return regardless of the type of child serves (from now on, *return proportion*) and (2) the average between verbal and nonverbal return time to represent parents' overall temporal contingency regardless of the type of child serves (from now on, *return time*). Because parents' semantic contingency (i.e., relevant returns) was only measured for nonverbal returns, I included this variable on its own.

Reliability. I and trained native English- and/or Spanish-speaking undergraduate research assistants coded child nonverbal serves and parent verbal and nonverbal returns in Datavyu (Gilmore et al., 2016). Coders were required to achieve 90% agreement with me (the lead coder) on the timing and content of serves and returns during the training process. Reliable coders also went through reliability checks with me (approximately every 3.5 months) and only continued with independent coding when they re-demonstrated reliability. A random selection of 20% of the independently coded videos were double coded. Intercoder agreement was 80% for child nonverbal serves, 89% for parent nonverbal returns, and 97% for parent verbal returns. Cohen's kappa ranged between 0.74 and 0.91, indicating acceptable agreement (McHugh, 2012).

Covariates

To isolate the associations between maternal and paternal psychological distress and SR interactions at 9 months (RQ1) and between maternal and paternal SR interactions at 9 months and children's language skills at 18, 24, and 30 months (RQ2 and 3), I included theoretically and conceptually relevant covariates at the study design level (i.e., BB2 intervention condition and study site), the family/parent level (i.e., parent ethnicity, parent education, parent nativity status, globally rated parent responsiveness, parenting stress[2], and child attendance in non-parental care), and the child level (i.e., child gender, child language exposure, child temperament, and child language skills at 9 months.

At the study design level, I controlled for the *BB2 intervention condition* (0 = control group; 1 = intervention group) because children in the intervention and control group may show

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[2] Parenting stress was an indicator for the latent variable of psychological distress in RQ1 and was a covariate in RQ2 and 3.

mean-level differences in their language skills at 18, 24, and 30 months as a result of receiving the BB2 intervention. However, because conditions were randomly assigned to families at 9 months, I did not expect intervention condition to be associated with variables measured at 9 months and thus did not include it as a covariate for RQ1. I also controlled for *site* (1 = UMD; 2 = UCI) to account for potential differences in participant characteristics and data collection between the two sites.

At the family/parent level, I controlled for several variables. First, I controlled for *maternal and paternal education* because it has been consistently associated with children's early language skills and quality of parent-child interactions (e.g., Barnes & Puccioni, 2017; Cabrera et al., 2011; Huttenlocher et al., 2010; Magnuson et al., 2009; Rowe, 2008). In my study, mothers and fathers self-reported their highest level of education at 9 months (1 = less than high school; 2 = high school; 3 = some college; 4 = 4-year degree or higher). Second, I controlled for *maternal and paternal nativity status* (0 = born outside U.S.; 1 = born in the U.S.) because, compared to native-born parents, foreign-born parents tend to be less educated and experience more economic disadvantages, which have been linked to quality of parenting and child outcomes (Cabrera, Chen et al., 2022; García Coll et al., 1996; Han, 2008). Third, I controlled for *maternal and paternal ethnicity* (1 = Hispanic/Latino of any race; 0=non-Hispanic of any race) for RQ1, because it is related to the quality of parent-child interactions (Luo & Tamis-LeMonda, 2019; Prevoo & Tamis-LeMonda, 2017). Fourth, I controlled for the overall level of *maternal and paternal responsiveness* for RQ2 and 3, which has been found to benefit children's language skills (e.g., Attig & Weinert, 2020; Corkin et al., 2021; Landry et al., 2006). Responsiveness was coded on a 1-5 scale from videotaped toy play activities at 9 months using the Qualitative Ratings for Parent-Child Interaction coding system (Cox & Crnic, 2003). Lastly, I controlled for child attendance in *non-parental childcare* (0 = no; 1 = yes), because it has been linked to the quality of parent-child interactions and children's developmental outcomes (Bernal, 2008; Connell & Prinz, 2002; Duncan et al., 2019).

At the child level, I controlled for *child gender* (0 = boy; 1 = girl) because parents may interact differently with their sons versus daughters and boys and girls show differences in language skills (Adani & Cepanec, 2019; Cabrera, Malin, et al., 2017; Siqveland et al., 2022; Umek et al., 2008). Because children with different temperament may elicit different input from parents and display different language abilities (Conture et al., 2013; Padilla & Ryan, 2019), I also controlled for *child temperament*, which was measured using maternal report on the EAS Temperament subscale of emotionality (Bus & Plomin, 1984; Buss, 1991). The emotionality subscale consists of 5 items (e.g., Child cries easily) rated on a 1 to 5 scale and ratings for the items were summed to create a composite score of emotionality ($\alpha = 0.72$). I also controlled for *child language exposure* (0 = English or Spanish only; 2 = two or more languages) for RQ2 and 3 because exposure to multiple languages is related to early language skills (Quiroz et al., 2010). Lastly, I controlled for children's standardized *total language scores at 9 months* for RQ2 and 3, which were measured using the PLS-4 (Zimmermann et al., 2002).

Analytic Plan

To address my research questions, I conducted a set of path analysis models with latent and observed variables. A path analysis model, also known as a structural equation model (SEM), is a statistical model of hypothesized relationships among a set of latent and/or observed variables. Compared to other statistical methods, such as multivariate regression, path analysis is best suited for this study because it emphasizes the testing of theoretically supported causal structures among both latent and observed variables and allows for the evaluation of individual path or a combination of paths (Ullman & Bentler, 2013). For the first research question regarding the association between parental psychological distress and SR interactions, I modeled psychological distress as a latent variable because even though it was not measured directly in the study, it was the ultimate goal of the study (Kline, 1991; Mueller & Hancock, 2019). Using a latent factor rather than measured variables also enables me to test the true effect of a latent (not directly observed) construct free from measurement error (Streiner, 2006). For the second and research questions, I conducted path analysis with observed variables. I used full information maximum likelihood (FIML) estimation to adjust for missing data and maximum likelihood with robust standard errors (MLR) estimation to account for non-normality in the data.

Model Fit and Effect Sizes

As recommended by Hu and Bentler (1999) and Kline (2016), I used four indices to assess model fit: chi-square test, comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Hu and Bentler's (1999) guidelines recommend a CFI > 0.95, a RMSEA < 0.06, and a SRMR < 0.08 for good fit (Hu & Bentler, 1999). I conducted the models using R (R Core Team, 2020) and the following packages: irr (Gamer et al., 2019), lavaan (Rosseel, 2012), psych (Revelle, 2020), tidyverse (Wickham et al., 2019). For the effect sizes of individual predictors, I used standardized coefficients (i.e., Betas). Acock (2014) considers $\beta < 0.2$ to be weak, $0.2 < \beta < 0.5$ moderate, and $\beta > 0.5$ strong. I also calculated R^2 for each model to indicate the proportion of variance in children's language skills explained by the model.

Chapter 4: Results

Descriptive Statistics

Prior to conducting analyses to test my hypotheses, I conducted descriptive statistics (i.e., mean, SD, range, skewness, kurtosis) on the study variables (including covariates; Table 2). Most of the variables were approximately normally distributed, except for maternal and paternal return time, which showed skewness beyond acceptable levels (i.e., smaller than -2 or greater than 2; Curran et al., 1996; Kim, 2013). To adjust for skewness, we conducted non-parametric tests (i.e., Spearman's correlation) and used the MLR estimation in path analysis models.

On average, mothers and fathers reported low levels of depressive symptoms (*M*=6.02, range= 0-22 and *M*=5.22, range= 0-16, respectively) and low levels of parenting stress on a 5-point scale at 9 months (*M*=1.81, range= 1-3.17 and *M*=1.76, range= 1-2.94, respectively). Mothers and fathers on average reported moderate levels of role overload on a 5-point scale at 9 months (*M*=2.94, range=1-4.67 and *M*=2.74, range=1-5, respectively).

In terms of SR interactions, during the 10-minute toy play activity at 9 months with their mothers and fathers, children on average produced 13 verbal serves (*M*=13.16, range=0-62 and *M*=12.50, range=0-124, respectively) and more than 100 nonverbal serves (*M*=107.47, range=44-191 and *M*=103.23, range=31-176, respectively). On average, 87% and 64% of child verbal and nonverbal serves, respectively, were followed by a return from mothers, and 85% and 59% of child verbal and nonverbal serves, respectively, were followed by a return from fathers. Verbal serves on average were returned by mothers at *M*=2.66 s (range=0.18-29.06 s) and fathers at *M*=3.63 s (range=0.37-26.12 s) and nonverbal serves were on average returned by mothers at *M*=1.73 s (range=0.78-4 s) and by fathers at *M*=2.04 s (range=0.55-7.61 s). The distributions of maternal and paternal return time demonstrate that the majority of parent returns occurred within

3 s following the child's serve (Figure 2a and b). This is an important findings given that children on average sustained their attention to each toy/activity for only 6 seconds (*M*=5.51, range=3.06-13.92 and *M*=5.89, range=3.24-13.97, respectively for mothers and fathers), thus giving parents only a brief amount of time to notice their attention and respond. Furthermore, about a fourth of maternal and paternal nonverbal returns were semantically relevant (*M*=0.25, range=0.06-0.53 and *M*=0.22, range=0-0.49, respectively).

Regarding children's receptive skills at 18, 24, and 30 months, 37% (n=52), 55% (n=55), and 35% (n=19) of the children scored 1 SD (SD=15) below the normative mean, respectively (Zimmerman et al., 2009). For expressive language skills at 18 and 24 months, 7% (n=11), 31% (n=31), and 33% (n=19) scored 1 SD below the normative mean at 18, 24, and 30 months, respectively.

Bivariate Correlations

Table 3 presents Pearson and Spearman (for skewed variables) correlations among the continuous study variables. There were no significant correlations between the indicators of maternal and paternal psychological distress (i.e., depressive symptoms, parenting stress, and role overload) and SR variables and no significant correlations between the SR variables and receptive scores at 18 months. Maternal relevant returns and return time were significant correlated with language scores at 18, 24, and 30 months, while paternal return time was significantly correlated with receptive scores at 24 months.

In addition, there were significant correlations among the SR variables, especially between parent return time and return proportion ($\rho = -0.60$, $p > 0.0001$ for mothers and fathers). These correlations indicate that there may be collinearity between the two variables and that including both in the analysis may cause large standard errors and biased estimation of their coefficients. Conceptually, it makes sense that parents who respond faster to their child serves may also respond to a larger proportion of the serves, as both variables reflect an underlying ability of the parent to be attentive and responsive to the child's behaviors. Given that parent return time is a clearer measure of temporal contingency, which is a key component of SR interactions, I included return time and not return proportion in the analysis to avoid multicollinearity.

Confirmatory Factor Analysis

I conducted a confirmatory factor analysis (CFA) of the latent maternal and paternal psychological distress variables indicated by maternal and paternal depressive symptoms, maternal and paternal parenting stress, and maternal and paternal role overload measured at 9 months. Loadings for maternal and paternal depressive symptoms were set to 1 to appropriately scale the factors. The error terms of maternal and paternal variables corresponding to the same construct (e.g., maternal depressive symptoms and paternal depressive symptoms) were allowed to covary. Overall, the model demonstrated good fit: $\chi^2(df = 5) = 3.21$, $p = 0.67$; CFI= 1.00; RMSEA= 0.00 (90% CI [.00 – 0.09]); and SRMR= 0.02. Each of the three indicators loaded adequately onto the factor in the expected direction: depressive symptoms at 0.58 for mothers and 0.66 for fathers, parenting stress at 0.82 for mothers and 0.75 for fathers, and role overload at 0.68 for mothers and 0.78 for fathers (the loadings listed are standardized loadings).

Because I am interested in examining the association between the latent factor of psychological distress and SR interactions rather than the individual loadings of the indicators, I then conducted another model constraining the loadings to be equal between maternal and paternal indicators. The constrained model (Figure 3) also demonstrated good fit: $\chi^2(df = 7) = 4.65$, $p = 0.72$; CFI= 1.00; RMSEA= 0.00 (90% CI [.00 – 0.08]); and SRMR= 0.03. The standardized loadings of the indicators were similar to those in the unconstrained model: depressive symptoms at 0.58 for mothers and 0.66 for fathers, parenting stress at 0.79 for mothers and 0.77 for fathers, and role overload at 0.72 for mothers and 0.75 for fathers. An analysis of variance test revealed no significant difference between the unconstrained and the constrained models (difference in χ^2 = 1.35, p=0.51). Therefore, to obtain more degrees of freedom, I adopted the constrained model when assessing the associations between psychological distress and SR interactions.

Path Analysis Models

I conducted a path analysis model to assess the hypothesized the main effect**s** of maternal and paternal psychological distress (latent) on SR interactions (observed) at 9 months (Model 1). I also conducted three path analysis models to assess the hypothesized main and moderation effects of maternal and paternal SR interactions (observed) at 9 months and children's language skills (observed) at 18, 24, and 30 months (Models 2-4).

Main Effect of Psychological Distress on SR Interactions

Model 1 (Figure 4) included the latent maternal and paternal psychological distress as exogenous variables, maternal and paternal return time and relevant returns as endogenous variables, and covariates (i.e., maternal and paternal nativity status, education, ethnicity, child temperament, attendance in non-parental childcare, gender, and site). The error terms of the covariates and of the latent maternal and paternal psychological distress were allowed to covary. The error terms of the latent variables and of the SR variables were allowed to covary among themselves. The main effect model testing the associations between psychological distress and SR interactions demonstrated good fit: $\chi^2(df=77) = 77.56$, $p = 0.46$; CFI= 1.00; RMSEA= 0.00 (90% CI [0.00 – 0.04]); and SRMR= 0.04. This model explained 17% and 16% of the variance in maternal and paternal relevant returns and 13% and 5% of the variance in maternal and paternal return time. Neither latent maternal nor paternal psychological distress was significantly associated with SR interactions, after controlling for the covariates (Table 4).

Main and Moderation Effects of SR Interactions on Language Outcomes

Models 2-4 included maternal and paternal return time (i.e., temporal contingency), relevant returns (i.e., semantic contingency), and their interaction terms (i.e., moderation) as exogenous variables, children's receptive and expressive language skills as endogenous variables, and covariates (i.e., maternal and paternal parenting stress, nativity status, education, responsiveness, child attendance in non-parental childcare, language exposure, temperament, gender, language skills at 9 months, study site, and intervention condition). To test moderation effects, I first mean-centered maternal and paternal return time and relevant returns and then calculated the product of the mean-centered maternal and paternal variables (i.e., mother mean-centered return time x father mean-centered return time, mother mean-centered relevant returns x father mean-centered relevant returns). I allowed the error terms of the covariates, of maternal and paternal SR variables, and of receptive and expressive language skills to covary among themselves. I also allowed the error terms of the covariates and of the SR variables to covary with each other.

Model 2 (Figure 5) testing the *main* and *moderation* effects of SR interactions at 9 months on language outcomes at *18 months* demonstrated good fit: $\chi^2(df = 38) = 47.32$, $p = 0.14$; CFI= 0.99; RMSEA= 0.03 (90% CI [0.00 – 0.07]); and SRMR= 0.03. This model explained 16.4% and 24.0% of the variance in receptive scores and expressive scores, respectively. Controlling for the covariates, paternal return time and maternal relevant turns at 9 months were significantly associated with children's receptive ($\beta = -0.22$, p = 0.049) and expressive scores at

18 months (β = 0.18, p = 0.03), respectively. None of the interaction terms showed significant associations with language outcomes at 18 months (Table 5).

Model 3 (Figure 6) testing the *main* and *moderation* effects of SR interactions at 9 months on language outcomes at *24 months* also demonstrated good fit: $\chi^2(df=38) = 47.02$, p = 0.15; CFI= 0.99; RMSEA= 0.03 (90% CI [0.00 – 0.07]); and SRMR= 0.03. This model explained 32.8% and 38.4% of the variance in receptive and expressive scores, respectively. Controlling for the covariates, paternal relevant returns at 9 months were significantly associated with children's receptive scores at 24 months (β = -0.19, p = 0.01; Table 5).

The moderation between maternal and paternal relevant returns showed a significant association with receptive scores at 24 months (β = 0.18, p = 0.005; Figure 8). I investigated the moderation effects in two ways because, theoretically, I expected that either parent would moderate the behavior of the other. To test this, I first conducted simple slopes analysis treating paternal relevant returns as the moderator (mother relevant returns x paternal relevant returns) but found no significant association between maternal relevant returns and receptive scores at low, average, or high levels of paternal relevant returns. I then conducted simple slopes analysis to test whether maternal relevant returns moderated the association between paternal relevant returns and receptive scores. I found significant negative associations between paternal relevant returns and receptive scores at low (1 SD below the mean) and average (mean) levels of maternal relevant returns (B= -0.69, SE=0.22, t= -3.11, p=0.004; B= -0.37, SE=0.15, t= -2.49, p=0.02), but not at high (1 SD above the mean) level of maternal relevant returns. This indicates that fathers' relevant returns only had a negative effect on children's receptive scores at 24 months when mothers' relevant returns were low or average.

Lastly, Model 4 (Figure 7) testing the *main* and *moderation* effects of SR interactions at 9 months on language outcomes at *30 months* again demonstrated good fit: $\chi^2(df = 38) = 46.94$, $p = 0.15$; CFI= 0.99; RMSEA= 0.03 (90% CI [0.00 – 0.07]); and SRMR= 0.03. This model explained 70.3% and 53.0% of the variance in receptive and expressive scores at 30 months, respectively. Controlling for the covariates, paternal return time and maternal relevant returns at 9 months were significantly associated with children's receptive ($\beta = -0.33$, p = 0.001) and expressive scores at 30 months ($\beta = 0.24$, p = 0.02). None of the interaction terms showed significant associations with language outcomes at 30 months (Table 5).

Supplemental Analyses

Respecify Language Outcomes. Given the different associations between each aspect of SR interactions and language scores (i.e., return time associated with receptive scores while relevant returns associated with expressive scores), which were not specifically hypothesized and were difficult to interpret, I conducted two sets of supplemental analyses. For the first set of analyses, I modelled a direct path from receptive to expressive scores instead of allowing their error terms to covary (Models S1 – S3), because theoretically children develop comprehension skills before expression skills. In this case, I modelled a direct path from each SR variable to receptive scores but not to expressive scores (i.e., SR interactions were associated with expressive scores *through* receptive scores) and other components in the model remained the same as in Models 2 – 4. For the second set, I used standardized total language scores as endogenous variables instead of receptive and expressive scores (Models S4 – 6) and other components in the model remained the same as in Models 2 – 4.

Model S1 (Table S1) testing the main and moderation effects of SR interactions at 9 months on receptive scores and *indirectly on expressive scores at 18 months* demonstrated acceptable fit[3]: $\chi^2(df=44) = 74.47$, $p = 0.003$; CFI= 0.94; RMSEA= 0.06 (90% CI [0.02 – 0.09]); and SRMR= 0.04. This model explained 16.8% and 24.8% of the variance in receptive and expressive scores at 18 months, respectively. Controlling for the covariates, paternal return time at 9 months was significantly associated with children's receptive scores at 18 months (β = -0.24, p = 0.04), which aligns with the finding in the primary model (Model 2).

Model S2 (Table S1) testing the main and moderation effects of SR interactions at 9 months on receptive scores and *indirectly on expressive scores at 24 months* demonstrated good fit: $\chi^2(df=44) = 54.78$, $p = 0.13$; CFI= 0.99; RMSEA= 0.02 (90% CI [0.00 – 0.07]); and SRMR= 0.03. This model explained 32.8% and 58.5% of the variance in receptive and expressive scores at 24 months, respectively. Controlling for the covariates, paternal relevant returns at 9 months were significantly associated with children's receptive scores at 24 months (β = -0.18, p = 0.01). The moderation between maternal and paternal relevant returns also showed a significant association with receptive scores at 24 months (β = 0.18, p = 0.004). Again, these findings align with the findings in the primary model (Model 3).

Model S3 (Table S1) testing the main and moderation effects of SR interactions at 9 months on receptive scores and *indirectly on expressive scores at 30 months* demonstrated good fit: $\chi^2(df=44) = 56.48$, $p = 0.10$; CFI= 0.997; RMSEA= 0.01 (90% CI [0.00 – 0.07]); and SRMR= 0.04. This model explained 69.6% and 53.6% of the variance in receptive and expressive scores at 30 months, respectively. Controlling for the covariates, paternal return time at 9 months was significantly associated with children's receptive scores at 30 months (β = -0.33, p = 0.001), which aligns with the finding in the primary model (Model 4).

[3] Because the chi-square test is statistically significant and the CFI is lower than 0.95, this model did not meet the fit criteria according to Hu and Bentler (1999). However, these indices met other criteria (CFI > 0.90) for acceptable fit; McDonald & Ho, 2002).

Because I did not model direct paths from SR variables to expressive scores in these models, I was not able to test those associations. Furthermore, I did not find significant associations between maternal return time or relevant returns and receptive scores.

Model S4 (Table S2) testing the main and moderation effects of SR interactions at 9 months on *total language scores at 18 months* demonstrated good fit: $\chi^2(df=38) = 47.00$, $p = 0.15$; CFI= 0.99; RMSEA= 0.03 (90% CI [0.00 – 0.07]); and SRMR= 0.03. This model explained 20.2% of the variance in total language scores at 18 months. Controlling for the covariates, I did not find significant associations between SR variables and language scores, which is different from the finding in the primary model (Model 2).

Model S5 (Table S2) testing the main and moderation effects of SR interactions at 9 months on *total language scores at 24 months* demonstrated good fit: $\chi^2(df=38) = 46.99$, $p = 0.15$; CFI= 0.99; RMSEA= 0.03 (90% CI [0.00 – 0.07]); and SRMR= 0.03. This model explained 31.6% of the variance in total language scores at 24 months. Controlling for the covariates, paternal relevant returns at 9 months were significantly associated with children's total language scores at 24 months ($\beta = -0.17$, p = 0.02), but there was no significant moderation effect, which is different from the finding in the primary model (Model 3).

Model S6 (Table S2) testing the main and moderation effects of SR interactions at 9 months on *total language scores at 30 months* demonstrated good fit: $\chi^2(df=38) = 46.95$, $p = 0.15$; CFI= 0.99; RMSEA= 0.03 (90% CI [0.00 – 0.07]); and SRMR= 0.03. This model explained 81.6% of the variance in total language scores at 30 months. Controlling for the covariates, paternal return time at 9 months was significantly associated with children's total language scores at 30 months ($\beta = -0.39$, p = 0.005), which aligns with the finding in the primary model (Model 4). In addition, I found a significant moderation between maternal and paternal return time on total language scores at 30 months (β = 0.39, p = 0.02).

Overall, these results indicate that maternal and paternal SR were not significantly associated with language skills at 18 months, paternal relevant returns were negatively associated with language skills at 24 months, and paternal return time was negatively associated with language skills at 30 months while moderated by maternal return time.

Account for Return Proportions and Word Tokens. The primary models did not control for maternal and paternal return proportions or word tokens due to multicollinearity concerns (Table S3). To examine whether the associations between maternal and paternal return time and relevant returns and language outcomes will change after accounting for the potential effects of return proportions and word tokens on language outcomes, I conducted supplemental analyses including maternal and paternal return proportions, their interaction terms, and word tokens (Models S7 – 9).

Model S7 (Table S4) testing the main and moderation effects of SR interactions at 9 months on receptive and expressive scores *at 18 months* demonstrated acceptable fit: $\chi^2(df=45)$ = 54.52, p = 0.16; CFI= 0.99; RMSEA= 0.03 (90% CI [0.00 – 0.07]); and SRMR= 0.03. This model explained 21.9% and 27.0% of the variance in receptive and expressive scores at 18 months, respectively. Controlling for the covariates, maternal relevant returns at 9 months were significantly associated with children's expressive scores at 18 months (β = 0.18, p = 0.04).

Model S8 (Table S4) testing the main and moderation effects of SR interactions at 9 months on receptive and expressive scores *at 24 months* demonstrated acceptable fit: $\chi^2(df=45)$ = 54.40, p = 0.16; CFI= 0.99; RMSEA= 0.03 (90% CI [0.00 – 0.07]); and SRMR= 0.03. This model explained 38.7% and 45.6% of the variance in receptive and expressive scores at 24 months, respectively. Controlling for the covariates, paternal relevant returns and maternal return proportion at 9 months were significantly associated with children's receptive and expressive scores, respectively, at 24 months (β = -0.17, p = 0.04; β = 0.27, p = 0.03, respectively). I also found a significant moderation between maternal and paternal relevant returns on receptive scores (β = 0.17, p = 0.01).

Model S9 (Table S4) testing the main and moderation effects of SR interactions at 9 months on receptive and expressive scores *at 30 months* demonstrated acceptable fit: $\chi^2(df = 45) = 54.27$ p = 0.16; CFI= 0.99; RMSEA= 0.03 (90% CI [0.00 – 0.07]); and SRMR= 0.03. This model explained 75.8% and 77.9% of the variance in receptive and expressive scores at 30 months, respectively. Controlling for the covariates, maternal return proportion at 9 months was significantly associated with children's receptive scores at 30 months (β = 0.38, p = 0.005). Maternal relevant returns, return proportion, and paternal return time were significantly associated with children's expressive scores at 30 months (β = 0.30, p = 0.01; β = 0.35, p = 0.002; β = -0.26, p = 0.02, respectively).

Overall, these supplemental results suggest that mothers' and fathers' relevant returns and fathers' return time still play a significant role in shaping language development while the effects of return proportions (i.e., how much of child serves parents returned) and word tokens were accounted for. However, mothers' return proportion also supports language development above and beyond the contribution of return time and relevant returns at 24 and 30 months.

Chapter 5: Discussion

Grounded in bioecological and sociocultural perspectives that parent-child interactions during the early years have the most direct and proximal influence on development (Bronfenbrenner & Morris, 2006; Vygotsky, 1978), my study used a sample of ethnically and socioeconomically diverse families to examine the variability in mothers' and fathers' SR interactions with their child at 9 months and the main and moderation effects of these interactions on language skills at 18, 24, and 30 months. This study addresses significant gaps in the literature regarding how *mothers and fathers* from *diverse backgrounds* engage in moment-to-moment reciprocal interactions with infants and the contribution of these interactions to *early language development*. I report three main findings. First, contrary to my hypothesis, maternal and paternal psychological distress were not concurrently associated with SR interactions at 9 months. Second, as hypothesized, paternal SR interactions (i.e., return time) and maternal SR interactions (i.e., relevant returns) at 9 months were significantly associated with children's receptive and expressive language skills, respectively, at 18 and 30 months. Third, paternal SR interactions (i.e., relevant returns) were negatively associated with receptive scores at 24 months but only at low and average levels of maternal SR interactions (i.e., relevant returns). Overall, these findings emphasize the importance of considering both mother-child and father-child SR interactions during infancy in relation to later language development and suggest that although both mothers and fathers engage in SR interactions in similar ways, they differ in the ways their aspects of SR interactions (i.e., return time and relevant returns) are associated with language learning at different time points in development.

Main Effect of Parental Psychological Distress on SR Interactions

I did not find support for the hypothesized association between psychological distress and SR interactions at 9 months. Past studies that support this association are typically conducted with parents who exhibit high levels of distress (e.g., Chu & Lee, 2019; Paulson et al., 2009). The parents in my sample reported on average low levels of distress, especially for depressive symptoms and parenting stress. Only 10% of mothers and fathers scored above the depression clinical cutoff and they on average scored less than 2 on a 1-5 scale for parenting stress. All the families in my study were two-parent, cohabiting families, over 90% had at least one parent employed, and more than half of the parents had at least a high school diploma. Therefore, this is a relatively high-functioning sample, which may explain the fact that parents, on average, reported low levels of psychological distress.

Although previous research has shown negative associations between parental psychological distress and overall parenting quality (e.g., Coyne et al., 2007; Paulson et al., 2009; Weisleder et al., 2019), this is one of the first studies to examine its association with the quality of parent-child interactions at a micro level (Hummel et al., 2016) and to use multiple indicators (i.e., depressive symptoms, parenting stress, and role overload) of maternal and paternal psychological distress. Furthermore, I assessed the association between psychological distress and SR interactions while controlling for the confounding effects of several covariates (e.g., parents' ethnicity, nativity status, child temperament) that have been found to affect psychological distress and parenting quality (Cabrera, Chen, et al., 2022; Conture et al., 2013; Prevoo & Tamis-LeMonda, 2017). It is also possible that psychological distress at 9 months does not have a concurrent association with SR interactions over and above the contribution of the covariates. More evidence is needed to further understand the association between mothers' and fathers' psychological functioning and their SR interactions with infants.

Main Effects of SR Interactions on Language Outcomes

In my study, the majority of the mothers and fathers responded promptly (within 3 s) when their children vocalized or showed attention to a toy/activity at 9 months, but in just a fourth of their responses, mothers and fathers provided semantically relevant information about what their child was attending to. These findings are consistent with the 3 s time window the field uses to identify parents' contingent responses (Bornstein et al., 1992; Fagan & Doveikis, 2019; Van Egeren et al., 2001) and are remarkable in that parents' responses occurred within the short 6 s window where their children sustained attention on the object of interest. Furthermore, these findings suggest that the parents in this diverse sample are pretty attentive and responsive to their children's serves and thus are getting their children on a positive trajectory of language learning at 9 months.

It is also worth noting that the children in my sample, on average, scored below the normative mean in language skills at all three time points, especially in receptive language skills. Furthermore, almost 40% of the children were "emerging bilinguals," that is, they were exposed to two languages (mostly English and Spanish) from parents at home. Although I measured children's conceptual language skills, it is still possible that the language assessment did not fully capture those children's bilingual skills. These characteristics of my sample are important to consider for the different ways the aspects of SR interactions are associated with children's language outcomes.

As hypothesized, I found that paternal *return time* and maternal *relevant returns*, the two aspects of SR interactions, at 9 months were significantly associated with children's languages outcomes at 18 and 30 months. First, the shorter the paternal return time (i.e., more prompt returns) at 9 months, the higher children's receptive scores at 18 and 30 months. Despite their relatively small effect sizes (standardized coefficients equal -0.22 and -0.33), this is an important new finding suggesting that fathers' prompt responses (average return time was 3 s in my study) support the early learning of receptive language skills. This finding is consistent with previous research with mothers demonstrating the benefits of contingent responses for vocal development and word learning during infancy (e.g., Gros-Louis et al., 2014; McGillion et al., 2017; Rollins, 2003; Tamis-LeMonda et al., 2001). In the case of learning new words, when children hear certain words immediately after they act on a specific toy, from time to time they will associate those words with the toy they play with and thus learn the proper label for the toy.

Furthermore, paternal return time was significantly associated with receptive language skills at 18 and 30 months but not 24 months. This may be attributed to the low receptive scores at 24 months (55% of the children scored 1 SD below the normative mean). For children at that age, the PLS-4 assessment—most of the items at 24 months require children to sit still and listen for instructions from the researcher—may be too burdensome given their less developed executive functioning skills (Moriguchi, 2014). However, maternal return time was not significantly associated with children's language outcomes when the effect of paternal return time was accounted for, suggesting that past studies may have overestimated maternal effects while not including fathers' returns. It is also possible that because the majority of the mothers in my sample responded promptly (85% within 3 s), there may not be enough variability in their return time to detect significant associations with language skills.

Second, when mothers returned to their child's serves in a semantically relevant way (e.g., label or describe the toy/activity in the child's attention) at 9 months, children had better expressive language skills at 18 and 30 months. This finding corroborates previous research that shows positive associations between mothers' appropriate and meaningful responses and infants' vocabulary and language skills (e.g., Baumwell et al., 1997; Benassi et al., 2018; Conway et al., 2018; McGillion et al., 2013; Rollins, 2003). However, these associations only demonstrated small effect sizes (standardized coefficients equal 0.18 and 0.24). It is also important to note that despite mothers' limited amount of semantically relevant returns (only 25% of their returns), children still benefited when mothers provided meaningful information about what they were attending to.

Contrary to my hypothesis, I found a *negative* association between paternal relevant returns and children's receptive scores at 24 months. Although this is inconsistent with previous findings showing a positive association between mothers' semantically relevant returns and children's language skills (e.g., McGillion et al., 2013; Tamis-LeMonda et al., 2001), a possible explanation may lie in the content of fathers' semantically relevant returns. Previous research indicates that fathers tend to use more challenging language (e.g., complex sentences) than mothers with their children (Leech et al., 2013; Rowe et al., 2004). It is possible that fathers may provide information, albeit semantically relevant to children's attention, too complex for 9-month-old infants to comprehend and learn. In my coding scheme, if the child looks to a ball, returns such as "that's a ball" and "that is such a fun toy, the ball is so cool" are both counted as semantically relevant, although the second one provides more information. For example, in one of the father-child interactions I observed, the child was playing with a pretend credit card and the father said "You shouldn't use those. If you don't pay it back, you'll be in debt." Although these responses are semantically relevant to the credit card, a 9-month-old infant may not be able to learn "credit card" from this father's convoluted way of describing it and may even become confused with the additional new word ("debt"). To explore the possibility that fathers are more likely to use challenging language with children than mothers, I compared maternal and paternal token-type ratio (TTR) and mean length of utterance in words (MLU) but did not find significant differences, although on average fathers had slightly higher TTR and MLU (i.e., more diverse and complex language input) than mothers. Therefore, future studies should examine the content of mothers' and fathers' semantically relevant responses to better understand their associations with children's language skills.

Moderation Effect of SR Interactions on Language Outcomes

As hypothesized, I found that maternal and paternal SR interactions (i.e., relevant returns) were jointly associated with children's language outcomes such that the *negative* effect of paternal relevant returns at 9 months on children's receptive language skills at 24 months was *reduced* to nonsignificant when maternal relevant returns were at a high level. In other words, fathers who provided a large proportion of relevant returns at 9 months had children with better receptive language skills at 24 months when mothers also provided a large proportion of relevant returns. However, paternal relevant returns did not moderate the association between maternal relevant returns and language outcomes.

To conclude, these findings indicate that both maternal and paternal SR interactions contribute, independently and interactively, to early language development. An important new finding is that the association between SR interactions and language skills varies depending on the specific aspect of SR interactions, whether the parent is mother or father, and the developmental time point. Specifically, *fathers'*, but not mothers', *prompt responses* to their children at 9 months benefited *receptive,* but not expressive, language skills at 18 and 30 months. *Mothers'*, but not fathers', *semantically relevant responses* to their children at 9 months benefited *expressive*, but not receptive, language skills at 18 and 30 months, whereas fathers' semantically relevant responses were not helpful for receptive language skills at 24 months. Importantly, the significant associations between SR interactions and child language were found in a sample of ethnically and socioeconomically diverse families and still stand when parents' and children's sociodemographic characteristics are accounted for. This study suggests that mothers and fathers influence their child over and above each other and also moderate each other's influence.

Other Findings

Although not hypothesized, an auxiliary finding that is of interest is that the micro-coded SR interactions in my study seem to capture a different construct from the globally rated responsiveness and that the two variables contribute to children's language development over and above each other. Paternal and maternal responsiveness at 9 months was positively associated with receptive scores at 24 months and expressive scores at 30 months, respectively, while the effects of the micro-coded SR interactions were accounted for. However, the micro-coded maternal and paternal SR interactions demonstrated more consistent and stronger associations with both receptive and expressive language skills across the three time points. Past studies have attempted to disentangle contingency and responsiveness as overlapping but different constructs. Keller and colleagues (1999) did not find significant correlations between contingency (micro-coded) and sensitivity (globally rated) in dyadic mother-infant interactions (Keller et al., 1999), whereas Bornstein and Manian (2013) found a nonlinear relation between contingency and sensitive responsiveness such that mothers who demonstrated contingency at too low or too high levels were rated as less responsive or even intrusive. Along with past research, the findings in my study indicate that there is merit in assessing the moment-to-moment reciprocal exchanges between parent and child to better understand how the quality of social interactions facilitates early language learning.

Limitations and Future Directions

This study has a few limitations. First, the PLS-4 language assessment, despite being more objective than parent-report language measures, was challenging to administer in a home setting, especially with infants. Sometimes a score of 0 for an item may be the result of the child not being compliant to follow the instructions rather than lack of knowledge. Moreover, although the PLS-4 was administered to measure the conceptual knowledge of children exposed to both English and Spanish (i.e., those children received points for answering correctly when the item was administered in either language), the assessment is not originally designed to assess bilingual skills and thus may not be able to capture the full language ability of bilingual children.

Second, due to language limitations of myself and the research team, I was only able to include families whose parent-child interactions were in English and/or Spanish and this is a select sample of parents who agreed to participate in a longitudinal parenting intervention study. The majority of these parents were recruited from WIC centers and many of them were already aware of and utilizing supports and resources and the eligibility requirements of the intervention study (i.e., two-parent families, co-resident at baseline, literate at a first-grade reading level) may have predisposed the sample to meet certain characteristics that could explain why these families reported relatively low levels of psychological distress. Therefore, the findings in my study cannot be generalized to other families.

Third, I only coded a subset of the possible parent and child behaviors during dyadic interactions (i.e., child's attention and vocalizations and parent's speech) because I was particularly interested in how they relate to language development and because these behaviors are prominent and conducive of parent responses during infancy. However, the literature has examined other behaviors (e.g., smiles, touch, physical movements) of parents and children to assess contingent and reciprocal interactions (e.g., Choi et al., 2020; Wu & Gros-Louis, 2014). Therefore, future research should include a wider range of parent and child behaviors to obtain a more comprehensive understanding of SR interactions during the early years.

Lastly, the findings of my study do not warrant causal interpretations of the relation between SR and language skills. Although I included a number of covariates to account for confounding effects, there may still be confounders that the study did not measure. In addition, I measured SR based on a 10-minute videotaped semi-structured parent-child interaction at home, which may not accurately reflect how mothers and fathers interact with their child on a daily basis (e.g., parents may not act naturally because they were being videotaped and were restricted to a specific area for the videotaping) and does not account for other types of interactions (e.g., a triadic interaction among mother, father, and child) that children experience at home. Although videotaped semi-structed activities is a common method in the field of developmental science, it may not represent children's true experiences. Therefore, the findings in my study should be interpreted based on the specific setting where SR was measured and the significant associations between SR and language skills should be regarded as correlational not causal.

Conclusion

Using observational data on parent-child interactions with a longitudinal design, this study tested the main effect of maternal and paternal psychological distress on SR interactions at 9 months and the main and moderation effects of maternal and paternal SR interactions on children's language skills at 18, 24, and 30 months. Overall, this study demonstrates in a sample of families from diverse socioeconomic and ethnic backgrounds that moment-to-moment reciprocal interactions between parents and infants are supportive of early language learning. I found that parental psychological distress was not concurrently associated with SR interactions while important sociodemographic characteristics of the family were accounted for. I also found that the aspects (i.e., prompt returns and semantically relevant returns) of maternal and paternal SR interactions, independently and interactively, contributed to early language skills at different time points. My study adds new evidence to the extant literature on SR by showing that the specific aspects of SR contribute to early language skills longitudinally and in different ways, and mothers and fathers jointly support early language development.

Future research should build upon these findings to assess both maternal and paternal SR interactions with their child and to develop and test the effects of randomized control trial interventions that aim to improve SR with both parents during infancy. This study shows that the parents in a socioeconomically and ethnically diverse sample already respond promptly (within 3 s) to their child but provide few semantically relevant responses. Therefore, programs and policies could put more emphasis on encouraging mothers and fathers to talk more about what their child is attending to at the moment, such as labeling the object, describing its color and shape, or giving specific action prompts (e.g., if the child is interested in the ball, say "throw it to me" or "bounce it"). It is also important for parents to provide input that is age-appropriate and easy for their child to understand, for examples, at 9 months, infants benefit the most from clear, short, and repetitive input (Rowe & Snow, 2020) and parents can label objects, use short sentences, and simple words to help their child learn language.

Tables and Figures

Table 1

Sample Demographic Characteristics

Variable	Family-Level Reports (n = 148)		Mothers (n = 148)		Fathers (n = 148)	
	n	%	n	%	n	%
Race and ethnicity						
Hispanic/Latinx			113	76.4	108	73.0
African American, non-Hispanic			16	10.8	15	10.1
White, non-Hispanic			10	6.8	12	8.1
Other (e.g., Asian, multiracial)			9	6.1	13	8.8
Parent education						
Less than high school			15	10.1	35	23.6
High school			29	19.6	36	24.3
Some college			67	45.3	57	38.5
4-year degree or above			37	25.0	20	13.5
Parent language use with child						
English only			57	38.5	63	42.6
Spanish only			63	42.6	60	40.5
English and Spanish			21	14.2	17	11.5
Other (e.g., French, Mam)			7	4.7	8	5.4
Parent born outside the U.S.			75	50.7	81	54.7
Parent working for pay			61	41.2	136	91.9
Household income						
Below $25,000	40	27.0				
$25,001 to $40,000	37	25.0				
$40,001 to $75,000	60	40.5				
More than $75,000	8	5.4				
Child language exposure						
English only	45	30.4				
Spanish only	45	30.4				
English and Spanish	49	33.1				
Other (e.g., English and French)	7	4.7				
Child is boy	73	49.3				
Child attended nonparental childcare	69	46.6				
BB2 intervention group						
Intervention	107	72.3				
Control	41	27.7				
BB2 data collection site						
UMD	71	48.0				
UCI	77	52.0				

Note. Proportions were calculated based on the analytic sample (n=148 for mothers, fathers, and families) and may not add to 100 due to missing data or rounding.

Table 2

Descriptive Statistics of Primary Study Variables and Covariates

	Mothers (n = 148)			Fathers (n = 148)			Child (n = 148)		
	Mean (SD)	Range	n	Mean (SD)	Range	n	Mean (SD)	Range	n
Depressive symptoms	6.02 (4.48)	0-22	148	5.22 (3.80)	0-16	148			
Parenting stress	1.81 (0.42)	1-3.17	148	1.76 (0.41)	1-2.94	148			
Role overload[a]	2.95 (0.76)	1-4.67	148	2.74 (0.74)	1-5	148			
Globally rated responsiveness	3.35 (0.75)	2-5	148	3.21 (0.78)	2-5	147			
Child verbal serves	13.16 (12.48)	0-62	146	12.50 (13.93)	0-124	145			
Child nonverbal serves	107.47 (28.30)	44-191	146	103.23 (31.81)	31-176	145			
Parent verbal return time (seconds)	2.66 (3.17)	0.18-29.06	136	3.63 (5.02)	0.37-26.12	136			
Parent nonverbal return time[b] (seconds)	1.73 (0.60)	0.78-4.00	146	2.04 (0.98)	0.55-7.61	145			
Parent overall return time[c] (seconds)	2.17 (1.71)	0.72-16.12	146	2.78 (2.63)	0.83-14.43	145			
Parent relevant returns[d] (% nonverbal returns)	0.25 (0.10)	0.06-0.53	146	0.22 (0.10)	0-0.49	145			
Child temperament (12M)							2.26 (0.78)	1-5	143
Total language scores at 9 months							95.64 (9.78)	66-119	148
Receptive scores (18M)							86.94 (11.92)	67-129	139
Expressive scores (18M)							97.85 (9.51)	73-131	145
Receptive scores (24M)							88.03 (16.23)	60-123	100
Expressive scores (24M)							92.37 (12.02)	64-125	101
Receptive scores (30M)							94.09 (19.00)	53-123	54
Expressive scores (30M)							93.25 (13.19)	69-136	57

Note. 12M = 12 months. 18M = 18 months. 24M = 24 months. 30M = 30 months. If not indicated, variable was measured at 9 months.
[a]Significant difference between maternal and paternal role overload ($t=2.76$, $p=0.006$). [b]Significant difference between maternal and paternal nonverbal return time ($V=3388$, $p<0.001$). [c]Significant difference between maternal and paternal return time ($V=3739$, $p=0.005$). [d]Significant difference between maternal and paternal relevant returns ($t=3.46$, $p<0.001$).

Table 3

Bivariate Correlations among Continuous Study Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.
1. M CES-D	--																		
2. F CES-D	**0.28**	--																	
3. M PSS	**0.49**	**0.20**	--																
4. F PSS	**0.25**	**0.48**	**0.35**	--															
5. M RRO	**0.37**	**0.24**	**0.56**	**0.25**	--														
6. F RRO	**0.20**	**0.52**	**0.20**	**0.58**	**0.26**	--													
7. M responsive	-0.03	0.02	-0.04	-0.11	-0.11	-0.03	--												
8. F responsive	0.00	0.00	-0.06	-0.02	0.02	**0.18**	**0.24**	--											
9. M relevant returns	0.09	0.09	-0.07	-0.02	0.02	0.11	0.09	0.07	--										
10. F relevant returns	0.06	0.00	0.02	0.08	0.14	0.08	0.03	-0.03	**0.22**	--									
11. M return time	-0.01	0.04	0.12	0.06	0.15	0.02	**-0.38**	-0.04	-0.05	0.05	--								
12. F return time	-0.05	0.10	0.13	0.12	0.03	0.06	-0.02	**-0.27**	0.02	-0.08	**0.18**	--							
13. Child temperament	**0.20**	0.09	**0.30**	**0.18**	**0.31**	0.00	0.00	-0.01	-0.10	-0.01	0.12	-0.06	--						
14. TL09	-0.01	-0.02	-0.16	**-0.21**	-0.01	-0.05	0.15	**0.17**	0.07	-0.06	**0.20**	-0.07	-0.09	--					
15. AC18	-0.02	-0.07	-0.15	-0.01	**-0.27**	-0.15	0.07	0.13	0.08	0.01	-0.04	-0.09	**-0.18**	0.01	--				
16. EC18	0.13	0.06	-0.04	-0.02	-0.09	0.01	**0.18**	0.10	**0.22**	0.10	**-0.19**	-0.07	**-0.17**	-0.05	**0.39**	--			
17. AC24	-0.04	0.06	-0.17	**-0.22**	-0.16	-0.12	**0.22**	**0.26**	0.15	-0.10	-0.18	**-0.25**	**-0.26**	0.11	**0.37**	**0.25**	--		
18. EC24	0.12	0.02	-0.01	**-0.21**	-0.09	-0.03	**0.35**	**0.27**	0.09	-0.04	**-0.29**	-0.16	-0.13	0.12	**0.34**	**0.22**	**0.67**	**--**	
19. AC30	-0.09	-0.13	-0.17	**-0.37**	-0.09	-0.10	0.21	-0.01	**0.29**	0.07	-0.22	-0.24	**-0.28**	0.18	**0.47**	0.09	**0.65**	**0.56**	--
20. EC30	-0.01	-0.02	0.04	-0.18	0.03	-0.01	**0.28**	0.21	**0.37**	0.10	-0.22	-0.20	-0.13	0.00	**0.51**	**0.40**	**0.73**	**0.71**	**0.64**

Note. Bolded correlations are significant at $p<0.05$. M=mother. F=father. CES-D=depressive symptoms. PSS=parenting stress. RRO=role overload. TL09=child total language skills at 9 months. AC18/24/30= child auditory (receptive) comprehension skills at 18, 24, or 30 months. EC18/24/30= child expressive comprehension skills at 18, 24, or 30 months.

Table 4

Summary of Latent Variable Path Analysis Testing Main Effect of Psychological Distress on SR Interactions at 9 Months (Model 1)

	Mother Relevant Returns (%)		Mother Return Time (seconds)		Father Relevant Returns (%)		Father Return Time (seconds)	
	Beta	*SE*	*Beta*	SE	*Beta*	SE	*Beta*	SE
M distress	0.05	0.36	0.07	0.07	0.08	0.33	-0.11	0.13
F distress	0.03	0.29	0.09	0.06	0.05	0.28	-0.03	0.10
M native-born	**0.19**	1.45	0.01	0.24	**0.19**	1.40	0.02	0.49
F native-born	0.04	1.53	0.11	0.29	0.16	1.43	0.09	0.45
M Hispanic	0.08	0.29	0.11	0.10	**-0.23**	0.30	0.02	0.06
F Hispanic	-0.01	0.27	0.11	0.07	-0.02	0.27	-0.06	0.06
M education	-0.08	0.75	-0.14	0.19	0.03	0.91	-0.10	0.49
F education	**0.22**	0.67	0.05	0.13	0.12	0.81	0.05	0.30
Non-parental childcare	-0.17	1.47	0.05	0.26	-0.07	1.34	0.01	0.61
Child is girl	0.01	1.37	0.08	0.25	0.04	1.31	0.03	0.59
Child temperament	-0.15	0.98	-0.11	0.31	-0.04	1.05	0.02	0.57
UCI site	0.07	1.37	0.07	0.30	0.08	1.32	**-0.15**	0.52

Note. Standardized coefficients are presented. Bolded coefficients are significant at $p<0.05$. M=mother. F=father.

Table 5

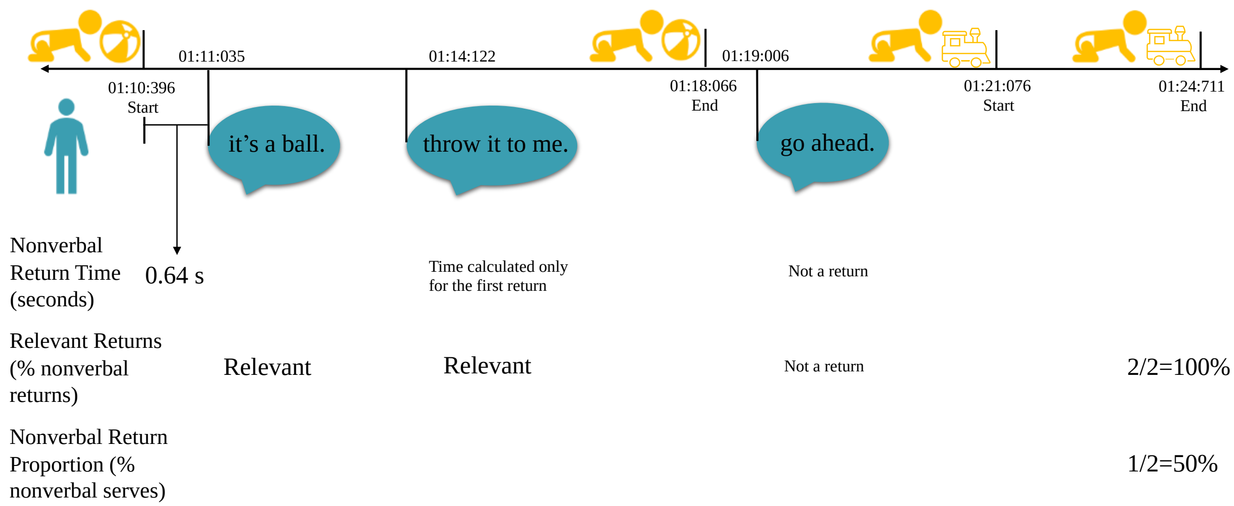
Summary of Path Analyses Testing Main and Moderation Effects of SR Interactions at 9 Months on Language Outcomes at 18, 24, and 30 Months (Models 2-4)

	18 Months				24 Months				30 Months			
	Receptive Scores		Expressive Scores		Receptive Scores		Expressive Scores		Receptive Scores		Expressive Scores	
	Beta	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*
M relevant returns (%)	-0.05	0.12	**0.18**	0.10	0.02	0.18	0.07	0.15	0.06	0.28	**0.24**	0.18
M return time (s)	-0.01	0.06	-0.11	0.04	0.02	0.09	-0.10	0.06	-0.08	0.16	-0.13	0.11
F relevant returns (%)	-0.06	0.11	0.02	0.08	**-0.19**	0.15	-0.07	0.11	0.02	0.30	0.06	0.15
F return time (s)	**-0.22**	0.04	-0.16	0.03	-0.15	0.04	-0.17	0.03	**-0.33**	0.06	-0.26	0.06
M x F relevant returns	0.07	0.12	0.07	0.09	**0.18**	0.14	0.05	0.10	-0.05	0.30	0.01	0.13
M x F return time	0.12	0.08	-0.13	0.07	-0.08	0.19	0.03	0.11	0.37	0.33	0.18	0.16
M native-born	0.08	0.22	-0.15	0.18	0.19	0.37	0.17	0.22	**0.31**	0.54	0.13	0.37
F native-born	-0.12	0.24	0.01	0.17	-0.18	0.36	**-0.23**	0.24	**-0.53**	0.55	**-0.41**	0.34
M education	-0.02	0.10	-0.06	0.10	0.07	0.19	0.03	0.11	0.10	0.20	0.04	0.15
F education	**0.22**	0.09	0.02	0.10	0.10	0.18	0.12	0.11	-0.02	0.22	0.01	0.18
Child temperament	-0.13	0.03	-0.15	0.02	**-0.24**	0.04	-0.12	0.03	-0.04	0.05	0.04	0.03
UCI site	0.08	0.20	0.04	0.15	-0.08	0.32	-0.16	0.24	0.22	0.51	-0.01	0.35
Child bilingual exposure	-0.13	0.20	-0.01	0.15	0.13	0.29	0.08	0.19	-0.01	0.45	**-0.21**	0.29
M responsiveness	0.05	0.15	0.11	0.11	0.09	0.20	0.17	0.14	0.24	0.37	**0.23**	0.20
F responsiveness	0.06	0.15	0.08	0.11	**0.20**	0.19	0.13	0.15	-0.11	0.33	0.01	0.27
Non-parental childcare	-0.03	0.21	0.12	0.16	-0.01	0.33	**0.21**	0.22	0.13	0.43	0.13	0.41
Child is girl	0.10	0.22	0.14	0.16	0.17	0.32	**0.17**	0.20	**0.32**	0.45	**0.29**	0.27
Intervention group	-0.01	0.23	**-0.17**	0.17	-0.07	0.34	0.07	0.24	0.16	0.49	0.07	0.31
M parenting stress	-0.17	0.29	-0.01	0.21	-0.05	0.32	**0.15**	0.21	0.12	0.53	0.18	0.35
F parenting stress	0.09	0.30	0.07	0.22	-0.08	0.41	-0.15	0.24	-0.17	0.76	-0.04	0.47
Language skills at 9 months	-0.01	0.01	-0.07	0.01	0.04	0.02	0.07	0.01	0.18	0.03	0.11	0.02

Note. Standardized coefficients are presented. Bolded coefficients are significant at $p<0.05$. M=mother. F=father.

Figure 1a

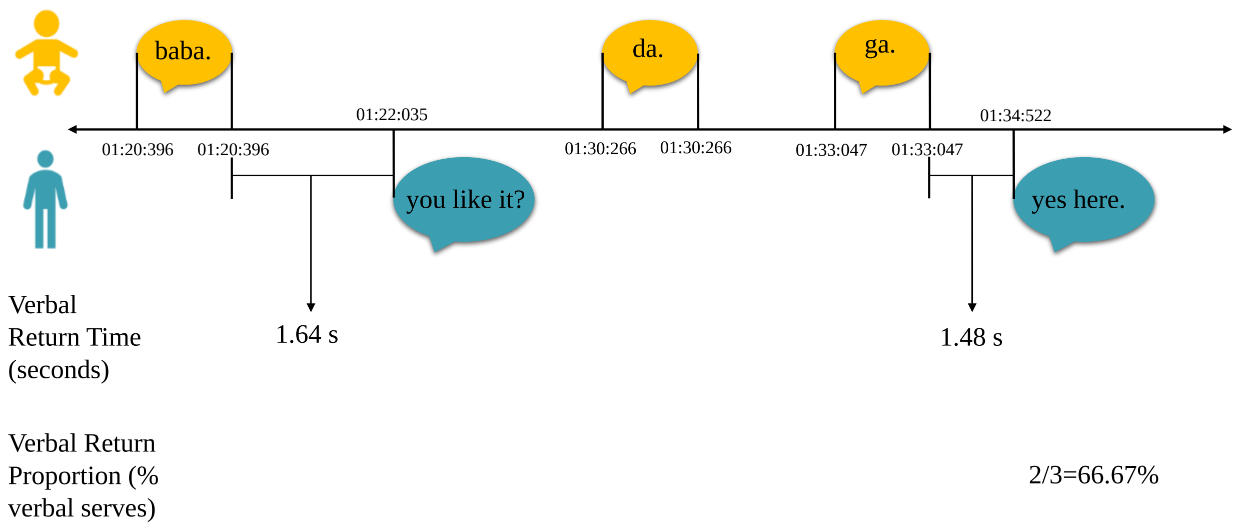
Schematics for SR Interactions Coding (Parent Nonverbal Returns)



Note. In this segment, the child had two nonverbal serves (looking at the ball and looking at the car). The parent provided two returns for the first serve, both of which were semantically relevant, and none for the second serve.

Figure 1b

Schematics for SR Interactions Coding (Parent Verbal Returns)



Note. In this segment, the child had three verbal serves and two of them received parent returns. Parent verbal return time for this segment is the average of the two verbal return times.

Figure 2a

Distribution of <u>Maternal</u> Verbal, Nonverbal, and Overall Return Time (Temporal Contingency)

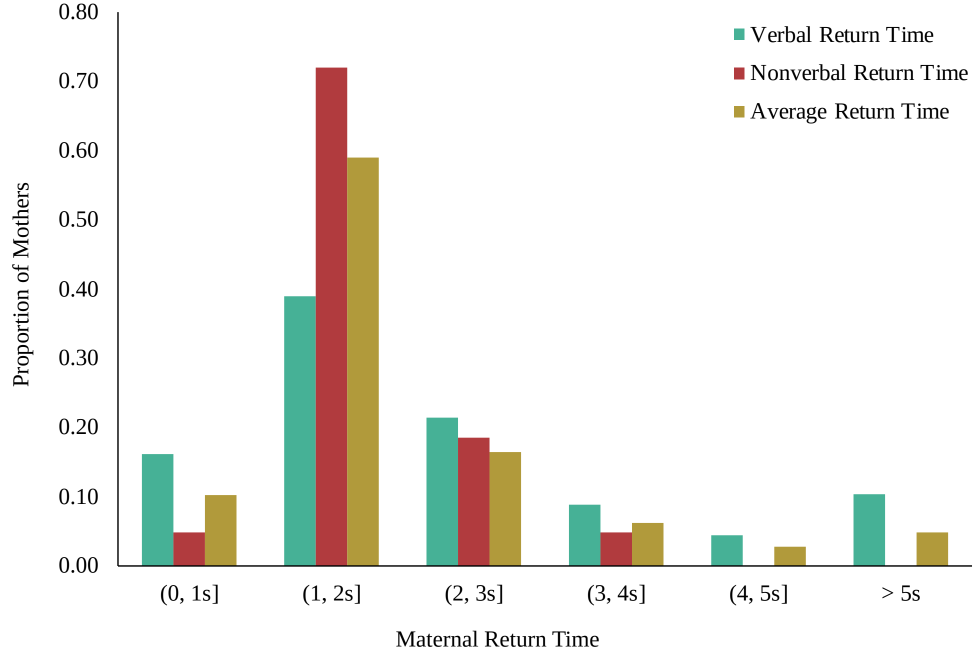


Figure 2b

Distribution of <u>*Paternal*</u> *Verbal, Nonverbal, and Overall Return Time (Temporal Contingency)*

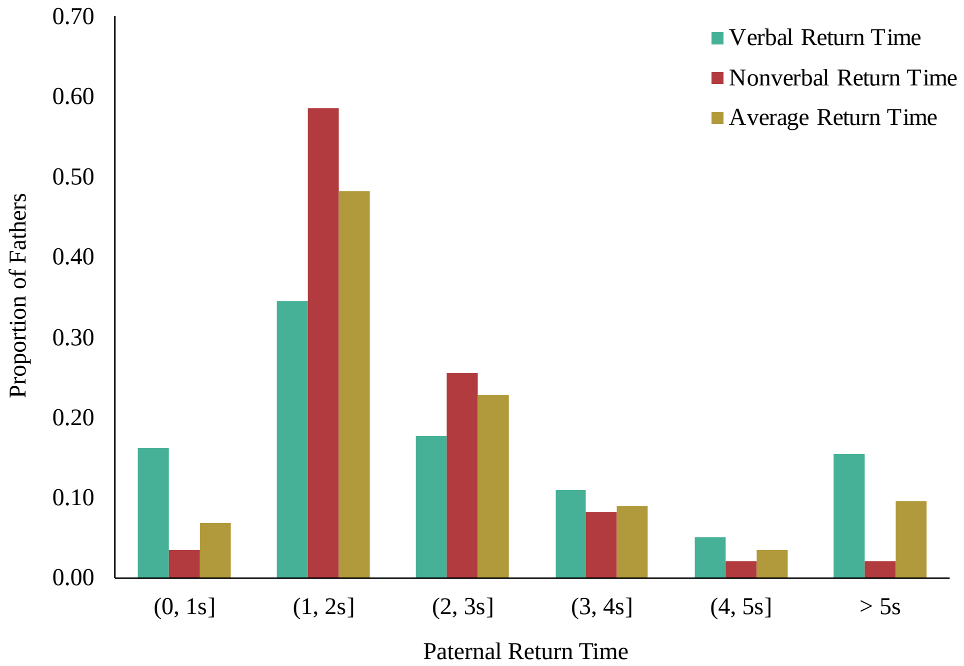
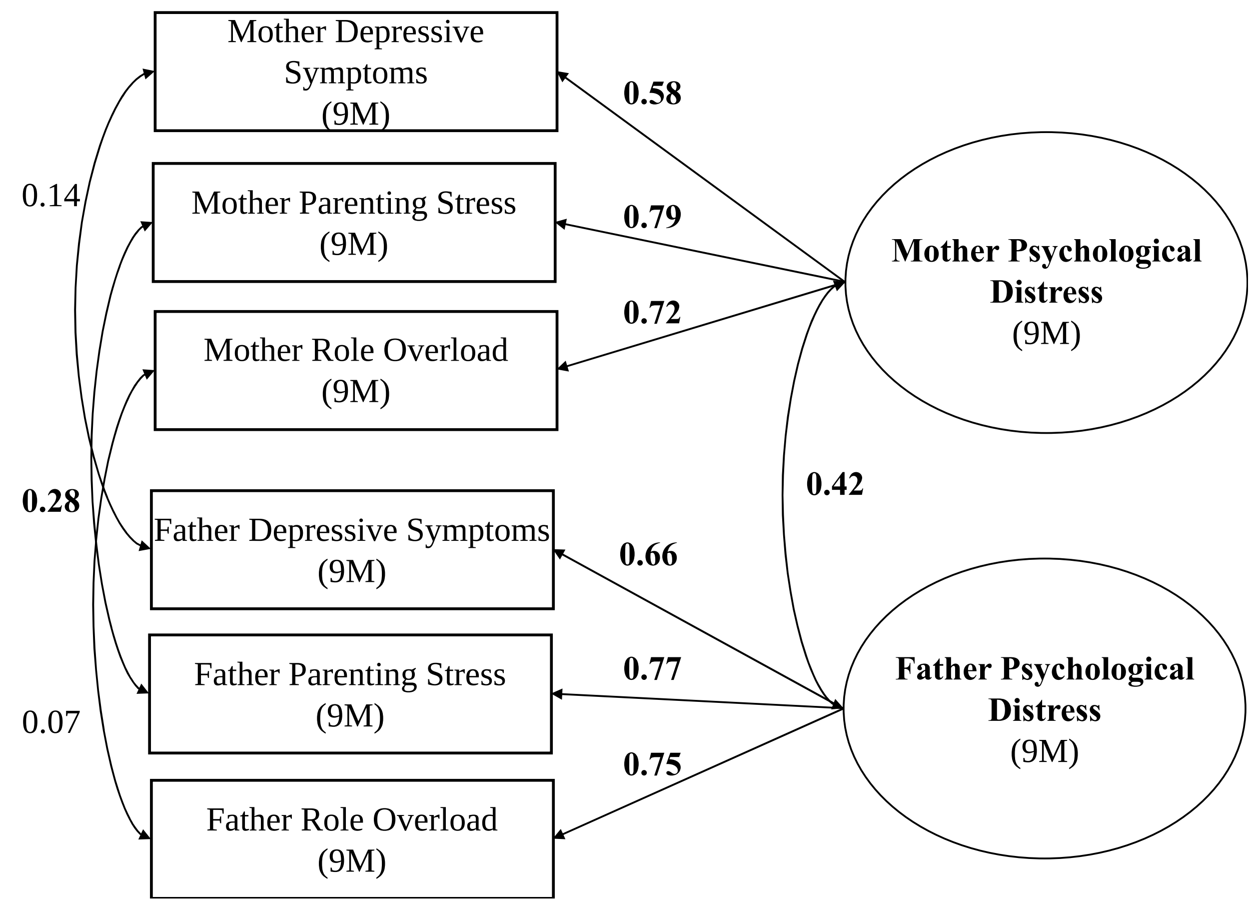


Figure 3

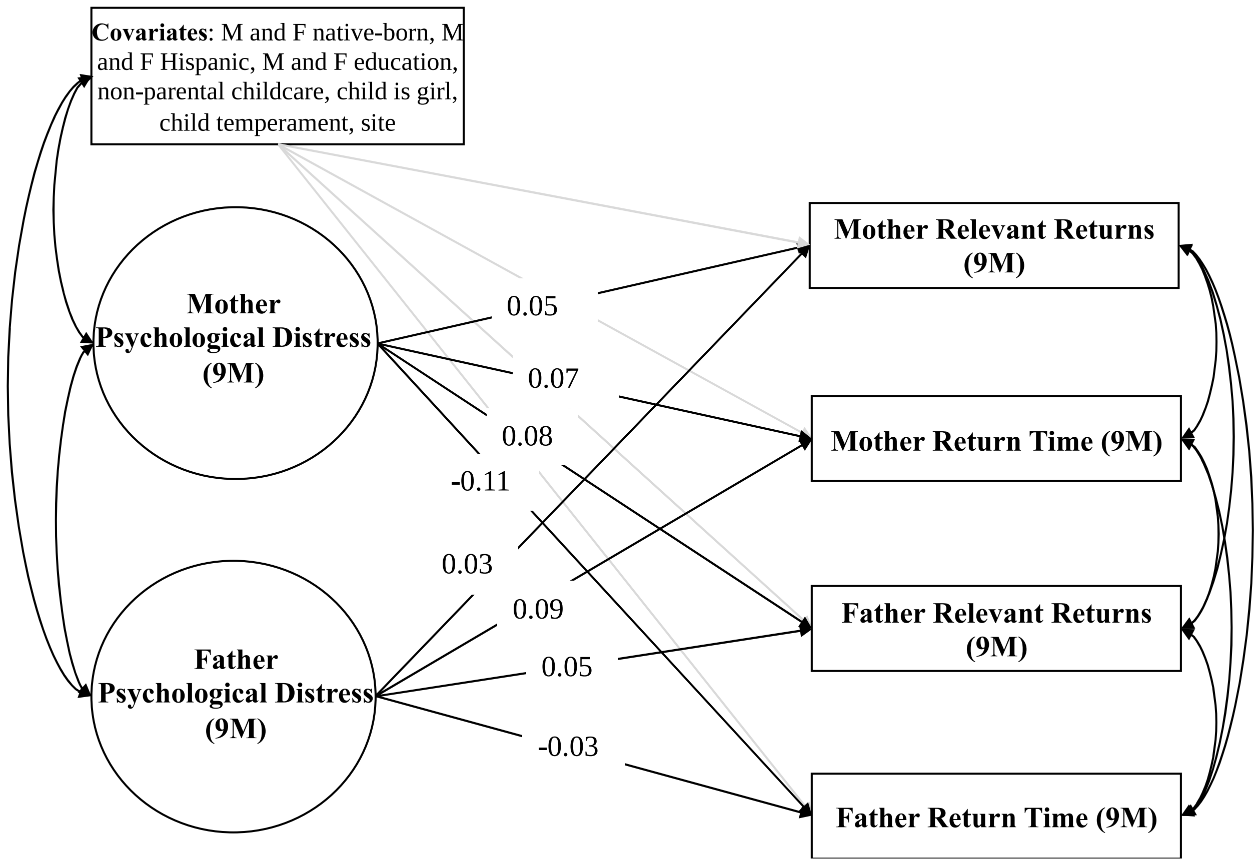
Confirmatory Factor Analysis for Maternal and Paternal Psychological Distress at 9 Months



Note. Bolded coefficients are significant at $p<0.05$.

Figure 4

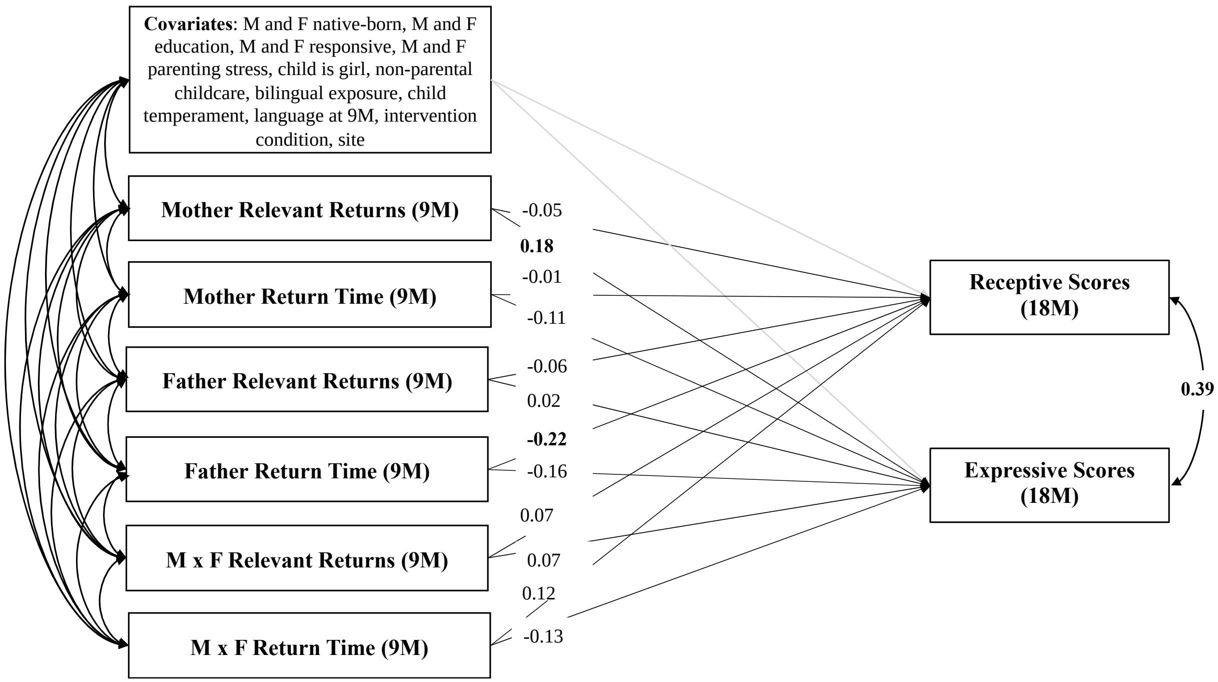
Latent Variable Path Analysis Model Testing Main effects of Maternal and Paternal Psychological Distress on SR Interactions at 9 Months (Model 1)



Note. Black lines are hypothesized direct paths and grey lines are not hypothesized direct paths. Bolded coefficients are significant at $p<0.05$. Each covariate was modeled to have a direct path to each SR variable. Covariance coefficients are not shown for visual clarity but are available upon request. Standardized coefficients for covariates are listed in Table 4.

Figure 5

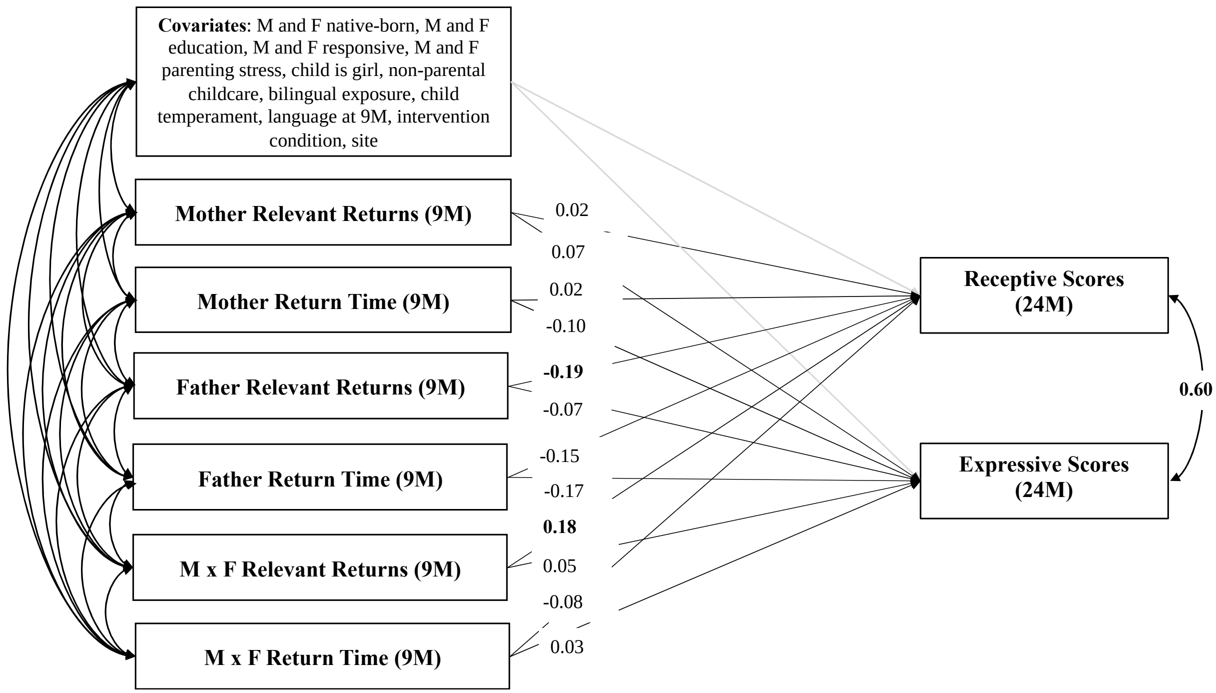
Path Analysis Model Testing Main and Moderation Effects of SR Interactions at 9 Months on Language Outcomes at <u>*18 Months*</u> *(Model 2)*



Note. 9M = 9 months. 18M = 18 months. M=mother. F=father. Black lines are hypothesized direct paths and grey lines are not hypothesized direct paths. Bolded coefficients are significant at p<0.05. Each covariate was modeled to have a direct path to each language outcome. Covariance coefficients are not shown for visual clarity but are available upon request. Standardized coefficients for covariates are listed in Table 5.

Figure 6

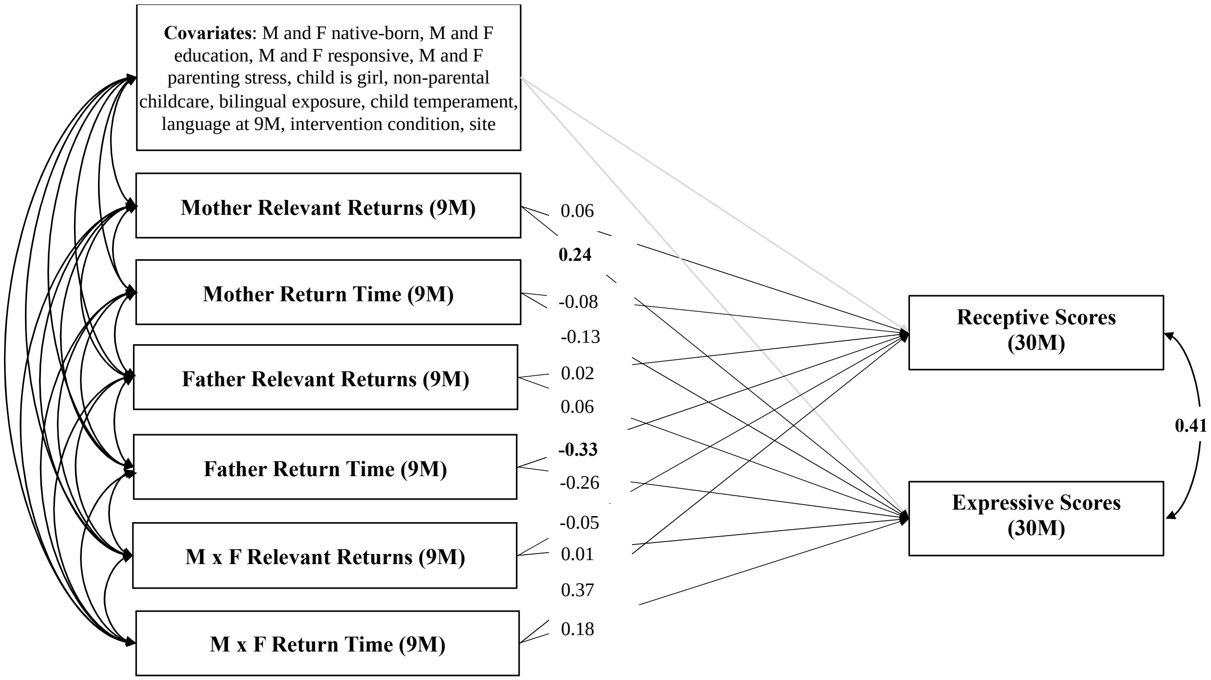
Path Analysis Models Testing Main and Moderation Effects of SR Interactions at 9 Months on Language Outcomes at *24 Months* *(Model 3)*



Note. 9M = 9 months. 24M = 24 months. M=mother. F=father. Black lines are hypothesized direct paths and grey lines are not hypothesized direct paths. Bolded coefficients are significant at $p<0.05$. Each covariate was modeled to have a direct path to each language outcome. Covariance coefficients are not shown for visual clarity but are available upon request. Standardized coefficients for covariates are listed in Table 5.

Figure 7

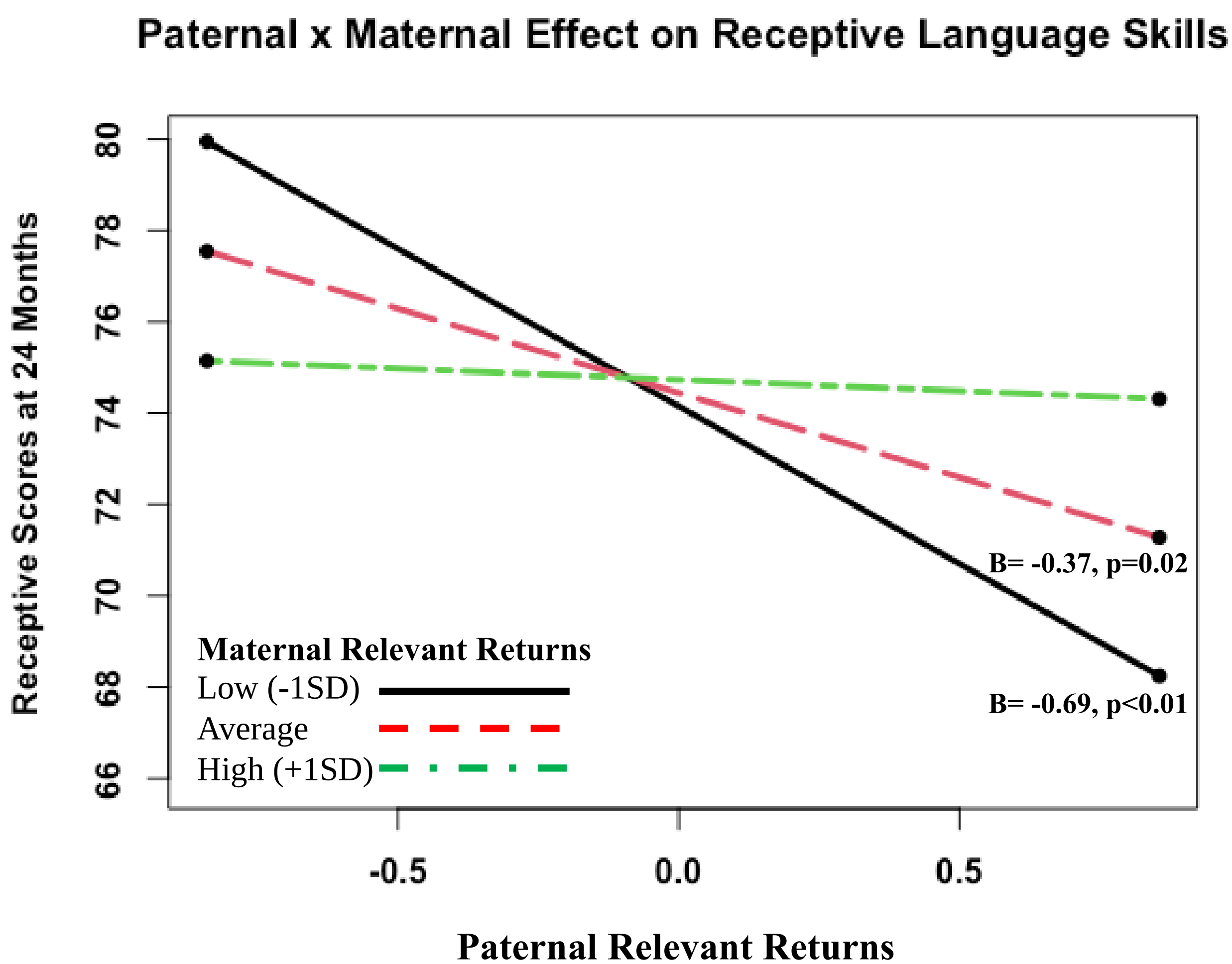
Path Analysis Models Testing Main and Moderation Effects of SR Interactions at 9 Months on Language Outcomes at 30 Months (Model 4)



Note. 9M = 9 months. 24M = 24 months. M=mother. F=father. Black lines are hypothesized direct paths and grey lines are not hypothesized direct paths. Bolded coefficients are significant at p<0.05. Each covariate was modeled to have a direct path to each language outcome. Covariance coefficients are not shown for visual clarity but are available upon request. Standardized coefficients for covariates are listed in Table 5.

Figure 8

Maternal Meaningful Returns Moderating the Effect of Paternal Meaningful Returns at 9 Months on Children's Receptive Language Skills at 24 Months



Supplemental Materials

Table S1

Summary of Supplemental Path Analyses Testing Main and Moderation Effects of SR Interactions at 9 Months on Receptive Scores and Indirectly on Expressive Scores at 18, 24, and 30 Months (Models S1-3)

	18 Months				24 Months				30 Months			
	Receptive Scores		Expressive Scores		Receptive Scores		Expressive Scores		Receptive Scores		Expressive Scores	
	Beta	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*
Receptive scores	--	--	**0.39**	0.06	--	--	**0.57**	0.06	--	--	**0.62**	0.14
M relevant returns (%)	-0.05	0.12	--	--	0.02	0.18	--	--	0.07	0.28	--	--
M return time (s)	0.00	0.06	--	--	0.02	0.09	--	--	-0.07	0.15	--	--
F relevant returns (%)	-0.07	0.11	--	--	**-0.19**	0.15	--	--	0.02	0.27	--	--
F return time (s)	**-0.24**	0.04	--	--	-0.15	0.04	--	--	**-0.33**	0.06	--	--
M x F relevant returns	0.08	0.12	--	--	**0.18**	0.14	--	--	-0.05	0.28	--	--
M x F return time	0.13	0.09	--	--	-0.08	0.19	--	--	0.36	0.32	--	--
M native-born	0.08	0.22	-0.13	0.16	0.19	0.37	0.06	0.15	**0.31**	0.54	-0.01	0.44
F native-born	-0.13	0.24	0.06	0.16	-0.18	0.36	**-0.14**	0.16	**-0.53**	0.55	-0.06	0.53
M education	-0.02	0.10	-0.02	0.10	0.07	0.19	0.02	0.10	0.11	0.20	-0.03	0.14
F education	**0.22**	0.09	-0.01	0.09	0.10	0.18	0.05	0.10	-0.02	0.21	0.09	0.17
Child temperament	-0.14	0.03	0.00	0.03	**-0.24**	0.04	0.01	0.02	-0.04	0.05	0.06	0.03
UCI site	0.07	0.20	0.06	0.14	-0.08	0.32	-0.10	0.17	0.22	0.50	-0.10	0.39
Child bilingual exposure	-0.13	0.20	0.01	0.15	0.13	0.29	0.02	0.18	0.00	0.44	**-0.20**	0.25
M responsiveness	0.05	0.15	**0.16**	0.10	0.09	0.20	**0.16**	0.10	**0.25**	0.34	0.10	0.25
F responsiveness	0.05	0.15	0.08	0.11	**0.20**	0.19	0.03	0.10	-0.12	0.33	0.14	0.22
Non-parental childcare	-0.03	0.21	0.07	0.16	-0.01	0.33	**0.18**	0.16	0.13	0.42	-0.03	0.36

Child is girl	0.10	0.21	0.10	0.15	0.17	0.31	0.08	0.16	**0.32**	0.45	0.09	0.28
Intervention group	-0.01	0.23	**-0.16**	0.17	-0.07	0.34	0.13	0.21	0.15	0.47	-0.04	0.35
M parenting stress	-0.17	0.29	0.02	0.21	-0.05	0.32	**0.17**	0.21	0.11	0.53	0.10	0.31
F parenting stress	0.09	0.30	0.02	0.20	-0.08	0.41	-0.13	0.21	-0.16	0.73	0.00	0.39
Language skills at 9 months	-0.01	0.01	-0.08	0.01	0.04	0.02	0.02	0.01	0.18	0.03	0.00	0.02

Note. Standardized coefficients are presented. Bolded coefficients are significant at $p<0.05$. M=mother. F=father.

Table S2

Summary of Supplemental Path Analyses Testing Main and Moderation Effects of SR Interactions at 9 Months on Total Language Scores at 18, 24, and 30 Months (Models S4-6)

	18 Months		24 Months		30 Months	
	Beta	*SE*	*Beta*	*SE*	*Beta*	*SE*
M relevant returns (%)	0.04	0.10	0.02	0.16	0.07	0.20
M return time (s)	-0.06	0.05	-0.01	0.08	-0.14	0.14
F relevant returns (%)	0.00	0.09	**-0.17**	0.12	0.08	0.20
F return time (s)	-0.22	0.04	-0.18	0.04	**-0.39**	0.08
M x F relevant returns	0.07	0.09	0.11	0.12	-0.04	0.19
M x F return time	0.02	0.07	-0.10	0.16	**0.39**	0.24
M native-born	-0.01	0.19	0.18	0.32	**0.29**	0.35
F native-born	-0.06	0.19	-0.18	0.34	**-0.55**	0.34
M education	-0.05	0.08	0.07	0.15	0.04	0.15
F education	**0.17**	0.08	0.07	0.16	-0.07	0.14
Child temperament	-0.12	0.02	**-0.25**	0.03	-0.04	0.03
UCI site	0.09	0.17	-0.16	0.30	0.09	0.39
Child bilingual exposure	-0.09	0.16	0.07	0.26	-0.10	0.35
M responsiveness	0.09	0.12	0.13	0.18	**0.23**	0.27
F responsiveness	0.10	0.12	0.11	0.20	0.05	0.21
Non-parental childcare	0.02	0.17	0.10	0.29	0.15	0.40
Child is girl	0.16	0.18	0.12	0.29	**0.39**	0.32
Intervention group	-0.10	0.18	-0.03	0.32	**0.13**	0.30
M parenting stress	-0.13	0.24	-0.03	0.31	0.15	0.44
F parenting stress	0.10	0.26	-0.10	0.35	-0.17	0.64
Language skills at 9 months	-0.07	0.01	0.04	0.02	0.17	0.02

Note. Standardized coefficients are presented. Bolded coefficients are significant at $p<0.05$. M=mother. F=father.

Table S3

Zero-order Bivariate Correlations among Maternal and Paternal Return Time, Relevant Returns, Return Proportions, and Word Tokens

	1.	2.	3.	4.	5.	6.	7.
1. M relevant returns	--						
2. F relevant returns	**0.22**	--					
3. M return time	-0.05	0.05	**--**				
4. F return time	0.02	-0.08	**0.18**	--			
5. M return proportion	0.08	-0.06	**-0.60**	-0.10	--		
6. F return proportion	**0.24**	0.09	-0.15	**-0.60**	**0.26**	--	
7. M word tokens	**0.30**	0.05	**-0.60**	**-0.18**	**0.64**	**0.27**	--
8. F word tokens	**0.25**	**0.21**	**-0.18**	**-0.66**	0.15	**0.67**	**0.31**

Note. Bolded correlations are significant at $p<0.05$. M=mother. F=father.

Table S4

Summary of Supplemental Path Analyses Testing Main and Moderation Effects of SR Interactions at 9 Months on Language Outcomes at 18, 24, and 30 Months (Models S7-9)

	18 Months				24 Months				30 Months			
	Receptive Scores		Expressive Scores		Receptive Scores		Expressive Scores		Receptive Scores		Expressive Scores	
	Beta	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*
M relevant returns (%)	-0.07	0.13	**0.18**	0.10	-0.02	0.19	0.05	0.14	0.03	0.21	**0.20**	0.16
M return time (s)	0.09	0.06	-0.04	0.04	0.09	0.07	-0.03	0.05	0.13	0.21	0.10	0.11
M return proportion (%)	0.21	0.08	0.09	0.06	0.09	0.15	**0.27**	0.10	**0.38**	0.19	**0.35**	0.12
F relevant returns (%)	-0.04	0.11	0.03	0.09	**-0.17**	0.15	-0.02	0.12	0.05	0.33	0.02	0.14
F return time (s)	-0.06	0.05	-0.14	0.03	-0.08	0.04	-0.15	0.03	-0.23	0.07	**-0.26**	0.05
F return proportion (%)	-0.19	0.09	-0.18	0.07	-0.04	0.13	0.12	0.09	0.00	0.22	-0.11	0.13
M x F relevant returns	0.05	0.13	0.06	0.09	**0.17**	0.14	0.05	0.10	-0.05	0.27	0.03	0.13
M x F return time	0.11	0.11	-0.16	0.10	-0.17	0.16	0.07	0.11	0.27	0.39	0.16	0.26
M x F return proportion	-0.08	0.30	0.09	0.23	0.01	0.37	0.01	0.38	-0.29	0.87	0.08	0.68
M native-born	0.05	0.21	-0.17	0.18	0.15	0.36	0.14	0.23	0.25	0.56	0.12	0.33
F native-born	-0.19	0.24	-0.04	0.18	-0.19	0.35	**-0.20**	0.23	**-0.53**	0.46	**-0.36**	0.29
M education	-0.02	0.10	-0.05	0.10	0.09	0.19	0.05	0.10	0.10	0.22	0.00	0.13
F education	**0.21**	0.10	0.01	0.10	0.13	0.18	**0.19**	0.11	0.05	0.24	0.03	0.15
Child temperament	-0.11	0.03	-0.13	0.02	**-0.18**	0.04	-0.06	0.03	0.04	0.06	-0.02	0.03
UCI site	0.06	0.20	0.04	0.14	-0.11	0.32	**-0.20**	0.23	0.11	0.63	0.02	0.30
Child bilingual exposure	-0.14	0.21	-0.03	0.16	0.09	0.30	0.06	0.20	0.03	0.46	**-0.34**	0.32
M responsiveness	-0.08	0.18	0.05	0.13	-0.03	0.22	0.07	0.16	0.15	0.36	0.05	0.18
F responsiveness	-0.03	0.17	0.04	0.13	0.16	0.23	0.10	0.17	-0.24	0.39	0.02	0.24
Non-parental childcare	-0.01	0.19	0.13	0.16	-0.02	0.32	**0.17**	0.21	0.12	0.44	**0.21**	0.32
Child is girl	0.11	0.21	0.16	0.16	0.18	0.31	**0.18**	0.20	**0.29**	0.40	**0.34**	0.27
Intervention group	-0.05	0.22	**-0.19**	0.18	-0.07	0.36	0.09	0.26	0.14	0.51	-0.05	0.26

M parenting stress	-0.17	0.28	-0.02	0.22	-0.11	0.35	0.08	0.21	0.11	0.66	0.13	0.30
F parenting stress	0.05	0.28	0.05	0.22	-0.09	0.43	**-0.17**	0.24	-0.24	0.82	0.10	0.39
Language skills at 9 months	0.03	0.01	-0.06	0.01	0.09	0.02	0.14	0.01	**0.29**	0.03	0.18	0.02
M word tokens	0.14	0.07	0.11	0.06	0.16	0.10	0.02	0.06	-0.20	0.20	**0.32**	0.09
F word tokens	0.26	0.06	0.13	0.05	0.07	0.09	-0.12	0.07	0.28	0.15	0.08	0.07

Note. Standardized coefficients are presented. Bolded coefficients are significant at $p<0.05$. M=mother. F=father.

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