

THE IMPACT OF POVERTY ON INFANT DEVELOPMENT: A
MICROANALYTIC STUDY OF THE MEDIATING ROLE OF PARENT-
CHILD INTERACTION DURING PRETENSE

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Abstract

THE IMPACT OF POVERTY ON INFANT DEVELOPMENT: A MICROANALYTIC STUDY OF THE MEDIATING ROLE OF PARENT- CHILD INTERACTION DURING PRETENSE

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Research suggests that poverty impacts cognitive development early, as an economic achievement gap is evident prior to entry into primary school. This study examined 95 low- and middle-income parent-child dyads micro-analytically to test for income related differences in patterns of parent-child interaction during a standardized pretend play task. Sequential analysis suggested differences in parent-child contingency, with middle-income dyads evidencing stronger contingency relationships between parent and child behavior. Importantly, sequential analysis also showed that middle-income infants spend significantly more time in mutual pretend play with parents than low-income 12-month-olds. A full test of the mediation model using a micro-level measure of parent-child interaction as a mediator yielded insignificant results.

BIOGRAPHICAL SKETCH

Erika Blackburn received her Bachelor's degree in Psychology and French from Bowdoin College, Brunswick, Maine in 1992 where she was a John Brown Russworm Scholar, a James Bowdoin Scholar and a Dunlap Travel Scholar.

In 1997, Erika received a Master's Degree from Cornell University in Ithaca, New York, under the guidance of C. Cybele Raver, Ph.D. She was an active contributor to Raver's lab in social and emotional development and received a SUNY Fellowship and National Science Foundation Fellowship to support her pre-doctoral scholarship. Following graduation, she worked as a policy and evaluation researcher in education and early childhood education, and directed a program designed to teach New York City high school students applied social science research.

In 2010, Erika returned to Cornell University to work with Marianella Casasola in her infant lab, and to develop a dissertation project under her guidance. She received a Provost Diversity Fellowship to support her work on income differences in early development. In 2013-2014, she received a Consortium Diversity Fellowship to work as a Visiting Assistant Professor at Mount Holyoke College in South Hadley, Massachusetts.

Dedication

This dissertation is dedicated to my generous parents, Kathy and Willie Blackburn for all of their support; my spirited children Alizah, Jaizah and Carlos for keeping me “rejuvenated” (adoption rocks!); Mommy Keli, Mommy Biz, Johanna Husband, Vanessa Adel and Beth Adel for listening and helping me be the best parent I could muster while dividing time between parenting and graduate school; Cristian, Kasiem and Cooper (who sometimes call me Mommy Erika) for reminding me of the important things in life, such as chocolate covered bananas, laughter and ninjas; and the incredibly brilliant, beautiful and resourceful Keanne Henry for being my inspiration, my cheerleader and my rock.

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Chapter One

Introduction

While the negative effects of poverty on cognitive abilities and academic achievement during childhood have been extensively studied, the literature relating to the impact of poverty on the developing cognitive abilities of infants and toddlers is scant. Although there is evidence to suggest that the effects of poverty on development can manifest as early as the first few years of life, the mechanisms underpinning such early effects remain unclear. Research with older children suggests that the relationship between economic disadvantage and cognitive development is mediated by qualitative features of the parent's interaction style, such as parental warmth. Using measures of receptive language and an inhibitory control component of executive function as outcomes, the present study seeks to contribute to the literature on the influence of poverty on early cognitive development. A key objective of the study is to examine whether expected links between poverty and language development and executive function, respectively, are explained by patterns of parent-infant interaction. The current study expands upon previous research in this area by using a more comprehensive approach to studying interaction through the use of micro-analytic coding and sequential analysis. Furthermore, the findings from this study may have important implications for the design of interventions targeted at enhancing the quality of parent-child interactions

and, in turn, improving cognitive development among economically disadvantaged infants and toddlers.

On a theoretical level, this research is guided in large part by Bronfenbrenner's bioecological model (Bronfenbrenner & Morris, 1987). In this work, I consider the four important components of the model: proximal process, person, context and time. According to the bioecological model, bi-directional proximal processes have a strong influence on development; such influence varies as a function of the context in which development occurs and the characteristics of the individuals under study. In the present study, the bi-directional and dynamic features of mother-child interaction are considered. Age characteristics of the person are taken into account through the cross-sectional comparison of two groups of infants: 12-month- and 24-month olds. The developmental context is taking into account through the comparison of two socioeconomically different groups: low- and middle-income parent-child dyads. Finally, sequential analysis brings time into focus at the micro-level, enabling a refined analysis of the dynamic interplay in behavioral sequences over the period of play.

In addition to drawing upon the bioecological model, the present study also draws upon several other theoretical frameworks; these frameworks are social-cognitive theories, Vygotsky (1978)'s theory of social development, and Piaget's (1969) theory of cognitive development. Parent-infant and parent-toddler interactions are studied in the context of a standardized pretend play task. Interactions involving pretense are

rich in complex positive affective communication and reciprocal gazes and behaviors (Nishida & Lillard, 2007) important for the important for the cognitive development of infants and toddlers (Valentino *et al.* 2011). Thus, pretend play represents an ideal context for studying 12- and 24-month old children.

A key theoretical contribution of the present study is that interaction is operationalized dyadically, according to specific, coordinated micro-level parent-child behaviors that lead into and maintain bouts of pretend play; these behaviors may differ according to socioeconomic status and mediate the relationship between economic disadvantage and cognitive outcomes. This micro-level focus is important for three reasons: First, when studying group differences, observer bias is minimized using moment-to-moment codes; second, micro-level codes permit a consideration of the contributions of each individual—parent as well as child—to the interaction; and, third, the micro-level codes hold better potential for applying findings to improve the parent-infant and parent-toddler interactions and developmental outcomes.

The selection of receptive language and inhibitory control as outcome variables is justified on the basis of both theory and research: First, there is a great deal of conceptual overlap between the skills that underlie pretend play and the outcome measures of interest (Lillard, 2001); second, the ability to engage in pretend play with a social partner emerges as language and executive function abilities begin to develop which can be as early as 12 months of age (Diamond & Goldman-Rakic, 1989);

finally, executive function and receptive vocabulary development are among those specific, early developing cognitive skills that are negatively correlated with income status (Noble *et al.*, 2005; Farah *et al.*, 2006), and are linked to both parent-child interaction and cognitive and achievement outcomes later in development (Blair & Diamond, 2008; Cartwright, 2012; Craig, Connor, & Washington, 2003; Magnuson & Duncan, 2006; Magnuson & Duncan, 2006; National Institute of Child Health and Human Development [NICHD] Early Child Care Research Network, 2005; O'Neill, Pearce, & Pick, 2004; Scarborough, 2001; Stevenson & Newman, 1986; Storch & Whitehurst, 2002;). Importantly, inhibitory control may also be part of the foundation for the development of effective strategies for coping with stress (Compas, 1987; Compas, 2006; Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001; Muraven & Baumeister, 2000). Thus, receptive language and the inhibitory control aspects of executive function are measured and compared across income groups; differences in dynamic, dyadic features of interaction during pretend play are expected to mediate the relationship between income status and language and executive functioning.

Chapter Two

Literature Review

This chapter presents a synthesis of theory and research findings relevant to the impact of poverty on early cognitive development. The aim of the chapter is to set the present research in context and to justify the chosen theoretical and empirical approach. The review begins by discussing theory and research concerning the role of economic disadvantage in early development, focusing on language and cognitive development generally, and receptive language and executive function specifically. This then leads on to a review of the evidence suggesting that much of the influence of socioeconomic status upon cognitive development can be explained by patterns of parent-child interaction; this argument is supported largely with evidence from research involving older children, although there is an emerging literature to suggest a similar link in early development. Next, I present my rationale for focusing on interaction during a standard pretend play task; specifically, it is argued that pretense is a form of high quality interaction that stimulates high levels of positive affect and dyadic reciprocity. I also present evidence to suggest that the ability to engage in pretense early in development is correlated with both outcomes of interest (language and executive function). Finally, the advantages of using micro-analytic coding and sequential analysis methods are outlined, and the chapter ends with the specific research questions that the research is designed to address.

Poverty Risk and Cognitive Development

Childhood poverty presents a significant risk to healthy development, with cognitive domains being most affected (Bradley & Corwyn, 2002). Compared to their more advantaged counterparts, children growing up in poverty are significantly more likely to experience deficits in a variety of cognitive abilities, including reading, math, and IQ, as well indicators of academic achievement such as drop-out and graduation rates (Duncan, 2012; Feinstein, 2003; Guo, 1998; Liaw & Brooks-Gunn, 1994; Noble, Farah & McCandliss, 2006; Ratcliffe & McKernan, 2010). Early poverty is a significant risk factor: Infants born into poverty tend to remain in poverty for an average of 8 years (Bane & Ellwood, 1986), and, due to poverty's chronicity and/or possible cascading effects, the developmental risks associated with poverty are more profound the more time spent in poverty (Allhusen *et al.* 2005; Evans & Kim, 2007; Evans & Kim, 2012; Guo, 1998; Korenman, Miller, & Sjaastad, 1995; Najman *et al.* 2009). However, we do not know with certainty how early these adverse developmental consequences of poverty begin.

In an effort to arrive at a better understanding of poverty's early influence on development, researchers have recently switched attention from investigating global indices of cognition to investigating the specific cognitive abilities affected by poverty in early development (Hackman & Farah, 2006; Hackman, Farah, & Meaney, 2010; Noble, McCandliss & Farah, 2007). Of these specific cognitive abilities, language and

executive function skills are particularly susceptible to the impacts of poverty (Noble *et al.*, 2005). The effects of poverty (measured as standard deviations of separation between low and middle income groups) on measures of specific cognitive abilities are presented in Figure 1. Language skill is typically assessed through receptive and/or productive vocabularies (Fenson, *et al.*, 2000). Executive functions are effortful, top-down goal-directed cognitive processes and are comprised of working memory, inhibitory control, and flexibility in attention (for a review, see Diamond, 2013). In a study comparing the cognitive performance of low- and middle-income kindergartners on a full battery of neurocognitive assessments, language and executive function skills were among the cognitive abilities identified as most impacted by economic disadvantage (Noble *et al.*, 2005).

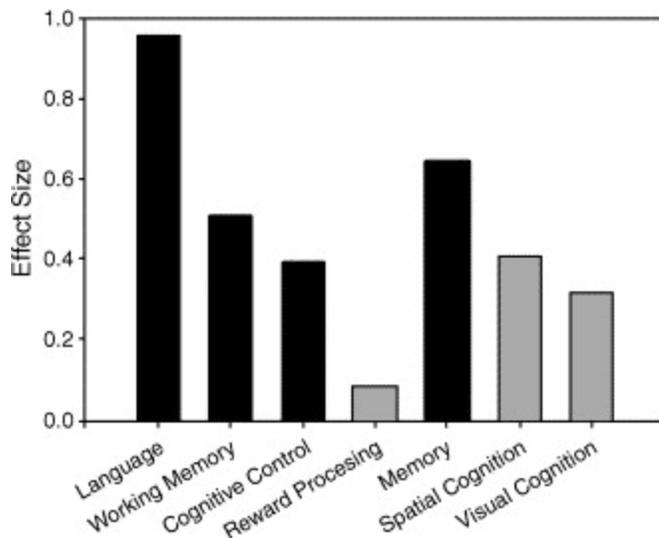


Figure 1: Effect sizes of income differences (Farah et al, 2006).

Neuroscientific evidence has highlighted the neural mechanisms underpinning the effect of poverty on specific aspects of early cognitive development. Tomalski *et al.* (2013) found that socioeconomic disadvantage in 6-9 month olds was associated with lower frontal gamma power activity. In prior research, low frontal gamma power activity among 16, 24 and 36 month olds predicted deficits in language skills and the inhibitory control and attention shifting skills of executive function at ages 4 and 5 years (Gou, Choudhury & Benasich, 2011). In a study of preschool children, low-socioeconomic status predicted delayed brain development in the prefrontal cortex region of the brain, a region associated with executive functions (Otero, 1997).

Physiological research linking stress hormone levels and executive function abilities in preschool-aged children suggests that poverty has a profound impact on infant stress

physiology and subsequent performance on executive function tasks (Blair, *et al.*, 2011; Blair, Granger, & Razza, 2005; Davis, Bruce, & Gunnar, 2002).

During the first two years of life—the developmental period under study in the current research—both language and executive function skills are emerging. With regard to language, Fenson and colleagues (1994) used a cross-sectional design in a study of 8- and 30-month old infants to examine the age-related norms for the acquisition of productive and receptive vocabularies. Fenson and colleagues found that vocabulary acquisition typically begins around 9 months for comprehension and 12-13 months for word production. By 12 months, infants have begun to develop a phonological and semantic receptive lexicon of words without reliance on contextual cues (Feldman *et al.*, 2000; Vihman, dePaolis, Nakai & Halle, 2004). Between 12 and 24 months, vocabulary acquisition accelerates, and children progress from understanding and speaking a handful of words to having a substantial receptive and productive vocabulary (Fenson, Dale, Reznick, Bates, & Thal, 1994). In this time period, there are significant individual differences in receptive vocabulary development (Fenson *et al.*, 2000; Huttenlocker *et al.*, 1991). Although research on the emergence of executive function is scant, there is some evidence to suggest that rudimentary aspects of executive function also emerge in the first year of life, typically between 8 and 12 months of age (for review, see Diamond, 2013; Diamond, 2002; Hughes, 2011). Assessments of children’s performance on the “A-not B”—a task designed to

measure these effortful, goal-directed cognitive processes in infancy—have revealed that executive functions begin to emerge as early as 9 months of age (see Diamond, 2013). In this research, after learning to search for an object in one location, infants must inhibit that learned response and shift to searching in a new location. This shift requires both cognitive control of attention and working memory, such that attention is shifted to the location of the object in the new location, and working memory also shifts to remember the object is hidden in a new location. Prior to 12 months, infants cannot reliably inhibit the prepotent response to search in the new location (Hughes, 2011).

To date, most of the research on income differences in vocabulary knowledge has been limited to studies of children of preschool age or older; only a handful of studies have examined vocabulary development in infancy, and these have predominantly focused on productive vocabulary development. Findings from this research show that income has a negative impact on productive vocabulary development. Furey (2011) found that at 16 months, the gap between low- and middle-income infants in vocabulary production was an average of 54 words; that gap increased to 147 words by the age of 18 months. Another study found similar results across a larger age range: In this research, 16 to 30 month-old infants and toddlers from low-income families also had lower productive vocabulary scores (based on parent reports), compared to middle and high-income infants and toddlers (Arriaga, Fenson, Cronan, & Pethick,

1998). Low-income infants continue to lag behind in vocabulary production over development into the second year of life (Hoff, 2003), with the difference between low- and middle-income groups reaching a gap the equivalent of 6-months by 24 months of age (Fernald, Marchman & Weisleder, 2013). Despite evidence that productive and receptive vocabularies are linked in development, income differences in receptive vocabulary development have been less widely studied. Recognizing and understanding words precedes the ability to speak the same words (Fenson, *et al.*, 1993; Fernald, Perfors & Marchman, 2006). Furthermore, infants who are more efficient in receptive vocabulary skill at 2 years also tend to have better trajectories in productive vocabulary growth as toddlers (Fernald, Perfors & Marchman, 2006). Therefore, receptive vocabulary development may be of particular relevance in the study of the development of language in the first two years of life. In one study of income-based differences in receptive vocabulary over development, proxy measures of low socioeconomic status (education level and health insurance) were paradoxically correlated with *better* receptive vocabulary scores for 12- and 14-month old infants (Feldman *et al.*, 1993). This finding could be due to lack of precision in measuring socioeconomic disadvantage, as research with older children suggests that differences in receptive vocabulary are present prior to 24 months of age. Longitudinal research with 24 and 36 month old low-income infants suggests that those from families with greater social risk may start with smaller receptive vocabularies and build their receptive vocabularies at slower rates than low-income children from families with

lower social risk (Morisset, Barnard, Greenberg, Booth, & Spieker, 1990; Fernald, Marchman & Weisleder, 2013). A separate economically diverse study of 36 month olds also found income differences in receptive language development, with low-income children scoring lower on receptive vocabulary measures (Farkas & Beron, 2004). More research is needed using direct measures of income status to examine the possible impact of economic disadvantage on receptive vocabulary development in the first two years of life.

Whereas previous research on differences in receptive vocabulary development and executive function between low- and middle-income children has predominantly focused upon children of pre-school age and older, the present study aimed to examine these differences in 12- and 24-month old infants. Receptive vocabulary will be measured by parental report using the MacArthur Communicative Development Inventory (MCDI: Fenson *et al.*, 2000). Scores on the MCDI correlate well with language scales from other cognitive assessments and analyses of naturally occurring language among low-income 2 year olds, and predict PPVT receptive vocabulary scores at age 3 (Pan, Rowe, Spier & Tamis-LeMonda, 2003). The MCDI has also been used in research with low-income infants and toddlers (Furey, 2011). As in prior research on productive vocabularies of older children, it is anticipated that receptive language performance scores will be lower in low-income infants and toddlers compared to middle-income infants and toddlers.

Empirical studies on the impact of socioeconomic disadvantage upon executive functions in early development have clearly demonstrated that poverty is associated with lower executive function scores among preschoolers and older children (Lipina, *et al.*, 2013; Bernier, *et al.*, 2012; Farah, *et al.*, 2006; Noble, McCandliss, & Farah, 2007; Marcovitch & Zelazo, 2009; Mezzacappa, 2004; Rueda, *et al.*, 2004; Stevens, Lauinger & Neville, 2009). In longitudinal research, chronic poverty and financial stress in early infancy are associated with lower executive functioning at 4 years of age (Raver, Blair & Willouby, 2013). Among low-income 7, 15 and 24 month old infants, infant cortisol—a stress hormone that can be elevated in low-income children—predicted executive function skill at the age of 3 (Blair *et al.*, 2011). Researchers are beginning to measure executive functions as cognitive outcomes earlier in development to determine whether or not the deficits found in older children can be identified early—that is, when executive function skills are emerging. In Lipina *et al.* (2005), 6-14 month old infants from low-income communities were tested on the A-not-B task, a task designed to measure emerging executive function abilities (see Diamond, 2013). Relative to infants from non-poor homes, infants from poor homes gave fewer consecutive correct responses and made more errors, including perseverative errors, suggesting challenges associated with inhibiting proponent responses. In a study of low-income toddlers, Hughes and Ensor (2005) found that higher amounts of social disadvantage predicted lower executive function scores at the age of 2 years.

The evidence reviewed above suggests that economic deprivation is a risk factor for impaired executive function, and that the impacts of poverty may be apparent in infancy; however, as with the vocabulary development research reviewed earlier, the majority of the existing research on the relationship between poverty and executive function has been carried out on children of pre-school age and older; these studies have also predominantly taken only indirect measures of income status (for example, education attainment or use of health insurance). In order to arrive at more definitive conclusions concerning the relationship between poverty and executive function abilities, further research involving younger age groups and using direct measures of income status is required. This is an important objective of the present study.

Measures of executive function in early development typically present infants and toddlers with an object to search for, requiring that they are able to mentally represent possible object locations; when they make an error upon searching, they need to make corrections by inhibiting their previous incorrect response and, while keeping that location in mind, shift to choose a new location in future searches (Marcovitch & Zelazo, 2009). In research examining income group differences in executive function among young children, two tasks have been used: *Spin the Pots* and *Hide the Pots*; the first of these is designed for research with toddlers and the latter for research with infants (Hughes & Esnor, 2005). Therefore, in the current study, *Spin the Pots* and *Hide the Pots* will be used to measure executive function. As in previous research with older

children, it is anticipated that the executive function performance scores of low-income infants and toddlers will be lower than the scores of middle-income infants and toddlers.

The mediating role of parent-infant interaction

Despite the clear relevance of parent-child interactions for developmental outcomes among infants and toddlers, the specific ways in which parent-child interactions impact upon child development are not well understood. The parent-child relationship is central to the concept of attachment (Ainsworth, 1979; Berlin & Cassidy, 2000), and provides a reinforcing context for learning and emotional support (Ainsworth, 1979; Pearson, *et al.*, 2011; Tamis-LeMonda, *et al.*, 2001). Parent-child interactions in early development also provide an important context for sharing meaning through language and nonverbal communication (Bloom, 2000; Kochanska, 1997; Stern, 1985; Tomasello & Ferrar, 1986). Findings from observational studies show that low-income mothers and their children have globally less positive interaction than middle-income mothers and their children, regardless of the child's developmental stage (Belsky, *et al.*, 2007; Burchinal, Vernon-Feagans & Cox, 2008); McLoyd, 1998; Morriset, Barnard, Greenberg, Booth, & Spieker, 1990; Pearson, *et al.*, 2011). Furthermore, positive parent-child interaction is a factor that, despite economic risk, moderates the relationship between economic hardship and developmental risks among low-income and other high-risk dyads. Positive parent-

child interaction reduces the negative impact of economic hardship upon cognitive development in low income and other high-risk dyads (Chazan-Cohen, *et al.*, 2009; Lugo-Gil & Tamis-LeMonda 2008; McLoyd, 1990; Ryan, Fauth & Brooks-Gunn, 2006). Thus, poverty might impact cognitive development through its impact on the quality of parent-child interaction (Pianta & Egeland, 1990; Shaw & Vondra, 1995; McLeod & Shanahan, 1993; Watson, *et al.*, 1996; Lugo-Gil and Tamis-LeMonda 2008, Guo & Harris, 2002). Relatively few studies have included measures of poverty, cognition, and parent-child interactions in a single model; thus, the potentially mediating role of parent-child interaction quality in the relationship between poverty and cognitive development has received scant research attention. Nevertheless, findings from the many studies that have looked at poverty, parent-child interaction, and socioemotional outcomes in a single model suggest that parent-child interaction does mediate the relationship between poverty and socioemotional outcomes (Donnellan, 2007; Grant et al, 2003). Furthermore, much of our knowledge about the relationship between poverty and parent-infant interaction and between parent-infant interaction and infant cognitive outcomes is based on macro-level measures of interaction derived from global rating scales or composite measures. Most of these measures ignore or preclude analysis of the contribution of the child to the interaction. In the review of the parent-child interaction literature that follows, evidence is presented to show that among middle-class families, parent-child interaction that is characterized by dyadic reciprocity and positive emotion expression

is less likely to occur in families experiencing economic disadvantage; there is also evidence to suggest that such positive parent-child interactions may predict better cognitive outcomes generally, and enhanced vocabulary and executive function skills specifically. Key gaps in the literature and methodological and conceptual limitations in published research are also identified.

Dyadic Interaction: Theory and Evidence

There are several important theoretical issues to consider in terms of how best to measure and analyze parent-child interaction. There are strong theoretical and empirical bases for operationalizing the nature of parent-child interaction dyadically (for example, with the use of measures of reciprocity or coordinated, mutually contingent and responsive interaction between social partners: Kuczynski, Lollis, & Koguchi, 2003; Deater-Deckard & O'Connor, 2000; Kochanska, 1997; Maccoby, 1999). Also, important distinctions can be made at the level of conceptual analysis (micro- versus macro-) and in the degree to which the interdependence of behavior is taken into account in the measure of parent-infant interaction. Last, analytic procedures that permit an analysis of parent-infant interaction sequences and that may differentiate dyads according to income status would provide a more comprehensive picture of interaction.

Theoretical arguments posit that dyadic reciprocity in parent-infant interaction fosters the development of general cognitive abilities generally, and language and executive

function specifically; however, dyadic reciprocity is believed to occur less frequently in low-income families. Dyadic reciprocity involves sensitivity and temporal contingency from *both* members of the dyad; these characteristics are central to theorists' notions of "optimal social structure" (Dunham & Dunham, 2008) and are regarded as the "bedrock of all social interaction" (Crown, Feldstein, Jasnow, Beebe & Jaffe, 2002). The theoretical rationale for anticipating a relationship between interaction and language is clear: Reciprocal turn-taking in social interaction, including interactions with infant partners, mimics the turn-taking sequences in conversation. Furthermore, contingent communication during synchronous interaction lessens cognitive load and facilitates object-label matching in word learning (Harris & Waugh, 2002). Thus, dyadic reciprocity is expected to support early language acquisition. Early executive function, which is also influenced by early caregiving, may in fact be understood as a product of dyadic reciprocity. Contingent, reciprocal interaction provides a sense of predictability, agency and competence for infants (for review, see Goldberg, Grusec & Jenkins, 1999; Mundy & Newell, 2009; Nadel, Prepin, & Okanda, 2005). As caregivers and infants engage in early face-to-face interaction and, later, joint attention on the surrounding environment, caregivers provide external regulation of infant affect and attention; this, in turn, fosters the infant's development of self-regulatory abilities which are central to the concept of executive control (for review, see Bernier *et al.*, 2012). Family stress theories suggest that dyads living under the well-established stress association with economic hardship may be less able to generate reciprocal

interaction; as a result, the children in these families may be at developmental risk (Conger & Donnellan, 2007).

Empirical evidence shows that reciprocal interaction is optimal for development. When a parent is not responsive to the infant's desire to interact, the infant disengages from the interaction and may also evidence negative moods (Crown et al., 2002; Jaffe, Beebe, Feldstein, Bigelow, MacLean, & MacDonald, 1996; Crown, & Jasnow, 2001; Kaye & Wells, 1980; Murray & Trevarthen, 1985; for review, see Striano & Ried, 2006). Longitudinal research on reciprocal exchanges between parents and children also highlights the bi-directionality of the influence between parents and their children. For example, maternal sensitivity and responsiveness to infant cues at 6-8 weeks of age predicts infant responsiveness to maternal cues at 2 years of age (Kemppinen, *et al.*, 2007). Similarly, parent behavior during interaction is somewhat contingent upon infant behavior, as parents tend to imitate infant behavior (Martin, Mccoby, Baran & Jacklin, 1981; Papousek & Papousek, 1989) and infant emotional expression (Gergely & Watson, 1999; Stern, 1985) during interaction in early development. The effect of *dyadic* reciprocity on development is less well-understood, however, as most of the research has focused only upon how parents respond to child-initiated cues for interaction; individual differences in rates of infant signaling behaviors have been relatively ignored. Several studies with children in general population samples ranging in age from 12 months through early childhood

have demonstrated that a caregiver's ability to respond to the child's cues for interaction is associated with a variety of positive developmental outcomes; these include enhanced overall cognitive abilities (Jaffe, Beebe, Feldstein, Crown, & Jasnow, 2001; Murray, Fiori-Cowley, *et al.*, 1996; Lemelin, Tarabulsy, & Provost, 2006; Klein, Wieder & Greenspan, 1987), earlier timing for first word production, better speech, and better receptive and productive vocabulary skills (Tamis-LeMonda, Bornstein, & Baumwell, 2001; Paavola, Kunnari & Moilanen, 2005; Keown, Woodward & Field, 2001; Tamis-LeMonda, Shannon, Cabrera & Lamb, 2004; LaFrenierre & Dumas, 1992; Leigh, *et al.*, 2011). Klein, Wieder and Greenspan (1987) obtained similar findings in a longitudinal study involving a high socio-demographic risk sample: In this study, interaction quality was assessed using a mediated learning measure (a composite that included reciprocal, sensitive and engaged interaction) and found that, relative to those scoring lower on mediated learning at 12 months, parents scoring higher on mediated learning at 12 months had children with better general cognitive abilities at ages 2-4 years. Joint attention research finds similar relationships between parent-infant reciprocal interaction and receptive vocabulary at 12 months (Markus, Mundy, Morales, Delgado, & Yale, 2000) and productive vocabulary at 18 and 24 months (Carpenter, Nagell & Tomasello, 1998; Saxon, Colombo, Robinson & Frick, 2000).

Research on the relationship between dyadic reciprocity in parent-child interaction and executive function skill is scant; however, a study involving infants by Bernier, *et al.* (2010) reported a positive correlation between an indirect measure of parent-led reciprocal interaction—namely, overall parental sensitivity to child cues—and composite measures of executive function. At 18 months, executive function was assessed using downward adaptations of *Spin the Pots* (Hughes & Ensor, 2005) and *Reverse Categorization* (Carlson et al., 2004), namely, the *Hide the Pots* and *Categorization*, a task that teaches children to learn and apply a categorization rule, such as baby animals get sorted together in the “baby box,” and adult animals get sorted into a “mommy box”. At 26 months, the researchers used *Spin the Pots* (Hughes & Ensor, 2005), *Delay of Gratification* (Kochanska, Murray & Harley, 2000) whereby children are asked to wait 5, 10, 15 and then 20 seconds before retrieving a gift under a transparent cover; *Shape Stroop* (Kochanska, Murray & Harley, 2000) in which children are asked to point to each of the small fruits when shown small fruits embedded in larger ones; and *Baby Stroop* (Bernier *et al.*, 2010 adapted from Hughes & Ensor, 2005) in which children are asked to reverse a rule to feed a “mommy” doll with a small spoon and a “baby” doll with a larger spoon. In a low-income sample involving 24-month olds, Raver (1996) found that social contingency during interaction was related to children’s self-regulation, a behavioral construct that overlaps conceptually with the construct of executive function. Experimental research complements these findings by demonstrating that when infants are randomly assigned to treatment groups designed

to improve parent-led dyadic reciprocity, their overall cognitive skill improves relative to the control group, from 6 to 13 months of age (Landry, Smith, & Swank, 2006).

While there is some evidence that infants from lower income families are less globally responsive to their mothers than infants from higher income families (Bornstein, Hendricks, Haynes & Painter, 2007), and that parents from lower income families are less globally sensitive than parents from higher income families (Hirsh-Pasek & Burchinal, 2006), few studies have examined the potential causal pathway from income status using a measure of parent-child dyadic interaction to cognitive development. Of the handful of studies that have examined the mediating role of factors relevant to parent-child dyadic interaction, these have operationalized dyadic interaction in terms of maternal responsiveness. This research has demonstrated that maternal responsiveness mediates the relationship between family poverty and learning outcomes such that poverty is causally associated with less maternal responsiveness which, in turn, is associated with poorer learning outcomes (Guo & Harris 2002; Lugo-Gil & Tamis-LeMonda 2008).

The current study aims to address this gap. Specifically, the present study will investigate the potentially mediating role of behavioral contingencies in parent-child interactions in the relationship between family income and children's cognitive development. In order to capture the interdependent, behavioral contingencies that

show dyadic reciprocity in interaction, the present study will use micro-analytic coding and sequential analytic procedures.

In addition to the theoretical and empirical grounds for using micro-analytic coding, micro-analytic coding is particularly advantageous when analyses involve comparisons of different socio-economic groups. Specifically, since codes are defined by specific behaviors or sequences of behaviors as opposed to holistic ratings of behavior (Bornstein, Suwalsky & Haynes, 2011), micro-level measures are less vulnerable to biases than are macro-level measures. High quality interaction requires cognitive resources such as attentional focus and patience from both members of the dyad; under economic stress, these resources may be compromised for one or both members of the dyad (Bornstein *et al.*, 2007). In the current study, the use of sequential analysis will disambiguate questions related to directionality in interaction and potentially reveal the extent to which income differences in interaction are due to maternal or child interactive behaviors. Finally, micro-analytic coding permits a more fine-grained analysis of interaction in the period under study. Predictions tested via analyses of discrete micro-level behaviors could reveal patterns in interactive behavior not apparent with molar coding; as a result, micro-level analysis has the potential to inform the design of more effective interventions for one or both members of the dyad.

Positive Emotion Expression in interaction: Theory and evidence

There is a long history of theory and research supporting the need to include a dimension of positive emotion in research on parent-infant interaction. Parent expression of positive affect is at its peak during early development (Barry & Kochanska, 2010) and evidence suggests that affectively positive parents create more optimal caregiving environments for their infants than less affectively positive parents (for reviews, see Dix, 1991 and Pearson *et al.*, 2011; Bigelow *et al.*, 2010; Meins, Fernyhough, Fradley & Tuckey, 2001). As such, positive affect is commonly measured in research on mother-infant interaction quality, and there is some support for including affective tone in research examining the impact of economic stress on low-income mother-infant dyads. The rationale for including a measure of shared positive affect in the current study is presented below; this includes an analysis of methodological issues and gaps in the existing research that the present study is designed to address.

Theoretical arguments posit that positive emotion expression may increase the quantity or quality of interaction and, in doing so, support learning outcomes. A more behavioral psychology orientation suggests that infants who experience interactions characterized by more positive emotion expression may develop an orientation towards social interaction that is characterized by approach tendencies, and may be more motivated to, and interested in, engaging in interactions with a parent as a result

(see MacDonald, 1992). Frederickson's (1998) positive psychology theory—the broaden-and-build theory of positive emotions—suggests that positive affect facilitates cognition and enhances learning in young children. Family stress theories (for example, Conger & Donnellan, 2007) suggest that dyads under stress from economic hardship may be less able to generate positive affect in interaction, and the children in these families may be at developmental risk as a result. Together, these theories suggest that, as a result of lost opportunities for shared positive affect in interaction among low-income dyads, the development of cognitive and language skill in children from such families is impaired.

The above theorizing is supported by empirical evidence suggesting a relationship between infant cognitive development and parental positive expression during interaction, infant positive affect, and mutuality in positive emotion expression during interaction. Most of the published research in this area has focused on positive emotional expression of parents during parent-infant interaction. Longitudinal studies have established positive relationships between emotionally positive parenting during early infancy and the child's general cognitive ability at 18 months (Pearson *et al.*, 2011), and between emotionally positive parenting of 4 year olds and the child's general cognitive performance at the age of 6 (Estrada, Arsenio, Hess, & Holloway, 1987). Furthermore, infant smiling and laughing is positively correlated with the amount of joint engagement, which has been consistently found to predict language

development during the first year of life (Vaughan, *et al.*, 2003). In experimental research designed to elicit positive emotion expression, Kubicek and Emde (2012), found that infants who were early talkers expressed more frequent and more intense positive affect during the experiment than late talkers. Parent-child interaction is also related to more specific indicators of cognitive ability, such as growth in receptive and expressive language in infancy (from 18 to 36 months of age: Pungello, *et al.*, 2009) and toddlerhood (from 2 to 4 years of age: Keown, Woodward & Field, 2001; Tamis-LeMonda, Shannon, Cabrera & Lamb, 2004).

Notwithstanding the above evidence supporting a relationship between infant cognitive development and positive emotion expression during parent-child interaction, little research has examined whether differences in parent-infant interactions explain differences in executive function skill. In a longitudinal study, Bernier, Carlson & Whipple (2012) found that a composite measure of parent-infant interaction quality at 12 months and 15 months predicted executive function abilities at 18 months and 26 months. In a study of low-income dyads, Blair, *et al.* (2011) found that global measures of positive parenting (which included the dimension of positive emotion expression) at 7, 15 and 24 months were related to executive functions at 36 months. Pearson, *et al.* (2011) invited low-, middle- and high-income mothers and their 12-month old infants to share a picture book for 5 minutes; middle and high social status parents were significantly more likely to display affectively warm

and positive behaviors, including tactile behaviors such as touch, during interaction than low-income parents (44%, 43% and 13%, respectively). In interactions, low-income mothers are globally less sensitive (McLoyd, 1998; Morriset, Barnard, Greenberg, Booth, & Spieker, 1990), less warm, more affectively negative (Belsky, *et al.*, 2007) and less positive (Pearson *et al.*, 2011; Burchinal, Vernon-Feagans & Cox, 2008) than their middle-class counterparts. In one notable study measuring positive emotion expression in dyads, Kochanska, Forman and Coy (1999) found that interactive positivity among 14 month olds interacting with their mothers predicted better infant learning performance during an imitation teaching task. Replications of this research are necessary in order to test whether similar findings are obtained when specific language or cognitive ability measures are used. This will be a further important focus of the present study.

Researchers have only recently turned their attention to addressing the possibility that executive function is an outcome of parent-infant interaction. Using a composite measure that included positive regard toward one's toddler at 36 months, Blair, Raver and Berry (2014) found a relationship between early parenting quality and greater gain in executive function at 60 months. Though these studies primarily focused on either infant behaviors or parenting behaviors, rather than dyadic interaction quality, the findings suggest that parent-child dyads living under the stress of economic hardship

may be less able to engage in affectively positive interaction, and the children in these families may be at developmental risk as a result.

A handful of studies have tested mediation models of the role of parent-infant emotion expression in the relationship between dyadic risk status and cognitive development. Pearson, *et al.* (2011) studied low-, middle- and high-income mothers' book reading interactions with their 12-month old infants. Using a composite measure of global positivity in interaction (frequency of parent smiling and affectionate gestures) these researchers found that the relationship between positive interaction and cognitive skill was similar for low- and middle-income dyads: The composite measure of interaction positivity at 12-months predicted general cognitive scores and IQ scores at 18 months and 4 years of age, respectively. Importantly, relative to low-income parents, middle- and high- income parents were significantly more likely to have affectively warm and emotionally positive interactions during book sharing. Similar findings were obtained in a study comparing the positive emotion expression of low-income mothers high in social risk and low-income mothers low in social risk; infants in dyads with greater social risk also had mothers who displayed less emotionally positive maternal engagement, when positive maternal engagement was coded globally. Positivity in interaction at 6 months moderated the relationship between social risk and cognitive skill at 15 months, such that affectively positive parent-infant interaction attenuated the negative impact of economic risk for low-

income dyads (Burchinal, Vernon-Feagans & Cox, 2008). Again, however, research that focuses on one or the other member of the dyad may not reveal the true nature of possible bidirectional influences in interaction. For example, infants who express more positive affect may recruit more positive parental interaction and support; those who express more negative affect may reduce those interactions. Research shows that a difficult temperament during infancy and toddlerhood is associated with harsher or emotionally detached interactions with parents (Patterson, Reid, & Dishion, 1992; Simons, Chao, Conger, & Elder, 2001). Additional research that tests similar mediation models is required; this research should employ more specific cognitive outcome measures and measures that are more sensitive to the dynamics of parent-infant interaction.

To summarize, several gaps remain in the literature regarding the potential mediating role of parent-infant and parent-toddler interaction in the relationship between economic disadvantage and cognitive outcomes. First, as the evidence to date has been gleaned largely from research using general cognitive outcome measures among older children, further research is required using more narrowly specified cognitive outcomes such as receptive vocabulary development and executive control; second, although there is evidence that poverty has a negative impact on parent-infant interaction and specific cognitive outcomes during infancy, few studies have tested whether parent-infant interaction mediates the relationship between poverty and child

cognitive development. Of the few studies that have tested for such mediation, most have used global measures of the quality of interaction with a unidirectional focus, obscuring possible influences of the child and/or parent on the interaction.

Furthermore, rather than utilizing specific measures of cognition that previous research has shown to be related to both poverty and parent-infant interaction in early development, these studies have typically measured general cognitive or language development outcomes, generally with older children. Finally, the affective content, given dyadic reciprocity, may hold particular relevance in the association between poverty and parent-child interaction, and between parent-child interaction and cognitive outcomes.

Thus, the current study aims to expand upon prior research in this area in several important ways. Receptive vocabulary and executive function abilities will be measured at 12 and 24 months of age, the age around which these abilities are first emerging. The current study also aims to replicate findings from studies conducted among older children on the role of poverty status in explaining individual differences in receptive vocabulary and executive function among younger children. However, this research is also unique in three key ways: First, it uses micro-analytic coding and sequential analytic techniques to operationalize dyadic interaction; second, it examines the interdependent contributions of parent and infant; and, third, it focuses on both contingency and positive emotionality—factors that previous research has identified

as significant features of parent-infant interaction. These differences are expected to distinguish low-income from middle-income dyads and predict differences in specific cognitive skills.

Pretend Play: An Ideal Context for Studying Parent-Infant Interaction

Pretend play is defined as taking an intentionally symbolic “as-if” stance for the purpose of play (see Lilliard, 2012) and is an ideal context in which to examine the impact of income on parent-infant interactions in early development. Pretend play is an important aspect of development in childhood as it facilitates the development of language, executive function, and other cognitive abilities important for social interaction beginning as early as 12 months of age (Diamond & Goldman-Rakic, 1989). Early pretend play (during infancy and toddlerhood) is inherently social in nature. For many children, parents are the first social partners in pretense; parent-infant interaction during pretend play invokes positive affect and reciprocal social exchange, key features of positive interaction that lead to optimal infant and toddler development. There is considerable conceptual overlap between the skills that underlie pretend play and the skills that underlie language, executive function, and other cognitive abilities. Research findings have demonstrated correlations between pretend play behaviors and both cognitive skills generally and language and executive function skills specifically (for review, see Lillard *et al.*, 2012). In summary, there are good grounds for using the context of pretend play interaction for addressing the aims of the present research.

Middle-class parents engage in pretend interactions with their infants when infants are as young as 12 months of age (Farver, 1992; Haight & Miller, 1993; Kavanaugh, Whittington & Cerbone, 1983; Tamis-LeMonda & Bornstein, 1991). As the capacity to understand and join in on pretend play develops, so too do other infant-toddler capacities: The infant starts to engage in joint attention with a social partner, uses affective communication during social referencing to disambiguate social interaction, and can understand the intent of social partners (Lillard, Witherington, & Robinette Friedman & Leslie, 2005; DeLoache, 2000). By the age of two years, middle class children appear to understand and readily engage in independent pretend behaviors. This ability has been established in empirical studies using a variety of tasks. In a study by Harris and Kavanaugh (1993), for example, two year olds joined an adult who pretended to get toys dirty and then pretended to clean them or commented on the need to pretend clean. In Walker-Andrews and Kahana-Kalman (1999), two year olds who viewed adults pretending to bath and dry a doll joined in to pretend to dry a second doll. Reliable performance indicating a robust, explicit understanding of pretend versus real object play may not occur until about 28 months of age; however, by 24 months of age, toddlers are capable of engaging in fairly complex and coordinated social pretend play (Harris & Kavanaugh, 1993; Ma & Lillard, 2006).

In order to facilitate or scaffold the child's understanding of pretend, parents behave differently with their infants and toddlers when they are pretending compared to

when they are not pretending (Nishida & Lillard, 2007). Among the key differences are facial expression and attention directing, and attracting and maintaining behaviors: When pretending an act—compared to not pretending—parents exaggerate smiles and movements, look to the child more, and use more sound effects and different verbal cues (Lillard & Witherington, 2004). Empirical evidence shows that when the parent teases or behaves in other unexpected ways towards the child during these interactions, the child looks to others' emotion expressions for a social reference as to how to behave (Barna & Legerstee, 2005; for review, see Vaish *et al.*, 2008). Such social referencing behaviors are a key component in the development of early social cognition and have been demonstrated in research with middle-class infants of ages as young as 7- and 9-months (Straino & Rochat, 2000); for most infants, these behaviors emerge by the age of 12 months (Carpenter, Nagell & Tomasello, 1998). By 18 months, toddlers can use experimentally-manipulated positive and negative emotional cues about an object to regulate their own behavior towards that object, even when the emotional message is not directed towards them (Repacholi & Meltzoff, 2007). Research involving standard pretend play tasks has shown that middle-class infants at 18 months and their caregivers structure their interaction differently when they pretend compared to when they do not pretend. Specifically, they use contingent and reciprocal social referencing behaviors. During pretend play, parents will initiate pretend, followed by a gaze to the child's face with a smile. Infants then reference the parent's face and respond either by smiling or joining in to pretend with the parent

(Nishida & Lillard, 2007). This structure, composed of contingencies in gaze, smile and pretend behavior, is measured in the current study. Social referencing during pretense is the key measure of dyadic reciprocity; it includes joint gaze, affective sharing, and engagement in continued interaction.

Like language, pretend play requires cognitive ability to mentally represent ideas. Dual representation, or the ability to represent an object as its physical reality and its abstract representation, underpins both pretend play (see Baudonnière *et al.*, 2002; Lillard, 2001; Perner, 1991; Leslie, 1987, 1988, 2002) and language (for review, see DeLoache, 2000). Children who engage in interactions characterized by pretense may therefore be more experienced in manipulating mental representations and, as a result, may be better able to apply this capacity to abilities outside of the domain of pretense, such as language (for review, see Lillard, 2001).

A number of theoretical explanations have been advanced to account for the relationship between executive function and pretend play. The dual representation of ideas that underpins pretend play conceptually overlaps with the ability to inhibit a prepotent response. In pretense, children hold both the literal and abstract meanings of objects or ideas, but respond to symbolic rather than literal meanings during play (DeLoache, 2000). Social cognitive theorists take this argument further by proposing that children are able to understand pretense as a result of a specific cognitive architecture that enables children to process real and imagined information separately;

this mechanism is referred to as a “possible world box” for reality (Nichols & Stich, 2000) or “twin earths” representing real and pretend possibilities (Lillard, 2001).

Others theorize that a meta-representation capacity, or mental concept of one’s own or others’ mental states, underlies the capacity to *share in pretense* with a social partner (Leslie, 2002).

Empirical evidence based upon general population samples generally supports the view that early cognitive development is associated with pretend or symbolic play. Toddlers with lower expressive language scores or who develop expressive language skills later in development spend less time pretending during play; they also appear less interested in play and are rated lower in pretend play/imitation by their parents on questionnaires (Rescorla & Goosens-Milrod, 1992; Irwin, Carter & Briggs-Gowan, 2002). Research spanning infancy through childhood has demonstrated that both receptive language and expressive language are correlated with pretend play abilities during imitation and structured pretend play tasks (Lewis, Boucher, Lupton, & Watson, 2000; Tamis-Lemonda & Bornstein, 1994).

To date, few studies have examined income-based differences in pretend play, and no published research has examined differences in the structure of pretend play between low- and middle-income parent-infant and parent-toddler dyads. A small literature suggests that there are differences between low-income and middle-income preschoolers in their understanding of pretense and fantasy (Garner, Curenton &

Taylor, 2005), their likelihood of engaging in pretend play with peers (Udwin & Shmukler, 1981), and the level of social pretend play attained with peers (Doyle, Ceschin, Tessier & Doehring, 1991). There is no research exploring the impact of socioeconomic risk on dyadic pretend play in early development. However, research suggests that emotional stress—a variable that is strongly correlated with low-income status (Evan & Kim, 2013)—may interfere with overall engagement in pretend play. In a study of middle-income families, Creasey and Jarvis (1994) found that higher levels of stress in mothers was correlated with less pretend play among 2-year-olds. Taken together, the findings from these studies suggest that low-income dyads may have less optimal patterns of play when engaging in pretense. These differences are likely to show up in the contingent behaviors that initiate and maintain joint engagement in pretend.

Empirical studies on parent-child interaction, while often acknowledging the complexity of social interaction, commonly use mean-level or correlational analyses that do not allow for an analysis of those complexities. Sequential analysis, on the other hand, is an analytic approach that measures behavioral contingencies in interaction (Bakeman & Gottman, 1997). With sequential analysis, sequential patterns of behavior can be derived from existing streams of discrete behaviors, creating new sequences of interaction to use for analyses. Importantly, the current study uses such sequential analytic techniques to address a second goal of this research: to identify

interaction sequences that differentiate optimal dyadic interaction, both in terms of dyadic structure—contingency and reciprocity in interaction—and content—shared positive affect and pretend. Specifically, time-window sequential analysis is used to test whether or not discrete parent behaviors increase the probability of subsequent child behaviors, within a time window of 2 seconds. Dyads may, for instance, be less able to use social referencing behavioral sequences to disambiguate interaction in pretend, as reported in Nishida and Lillard (2007). As in Nishida & Lillard (2007), in the current study, I ask whether or not social referencing behaviors are likely to increase the likelihood of child positive emotion expression or pretend behaviors. I also examine behavioral imitation, affective responsivity to the others' play, and affective mirroring (within a 2 second window). Since sequential analysis can also directly address questions of directionality, I examine the extent to which the parent or the child engages in the above patterns of dyadic interaction. I explore income-based differences in these interactional patterns.

In summary, the present study will involve an analysis of the effect of poverty on sequential structures of interaction that reflect parent-infant dyadic reciprocity, and an analysis of whether any such observed effects subsequently affect infant cognitive skills. I predict that as one or both members of low-income dyads may be less responsive to cues for interaction, they will have greater difficulty establishing interactions characterized by reciprocity. It is anticipated that bi-directionality in

parent-child interactions will be moderated by income status such that bi-directionality will be more evident in middle-income dyads compared to low-income dyads. This final prediction is based upon evidence to suggest that low-income parents might be more impacted by the lack of infant or toddler interactive behaviors as a result of poverty-related psychological stress.

Moderated Mediation Model

The theoretical process model proposed in the current study represents how poverty and parent-child interaction may combine to influence cognitive outcomes in early development. Income status and child age are expected to act as moderators. In this model, poverty may influence cognitive abilities in two ways: 1) Indirectly, through its impact on parent-infant interaction; and 2) Directly, not through poverty's influence on parent-infant interaction. In Figure 2, the paths represent hypothesized associations between the variables under study. The figure shows a direct causal path from income status to cognitive outcomes. This figure also shows an indirect or mediated path: from income to parent-child interaction, and from parent-child interaction to child cognitive outcomes. Finally, a moderator is included in the model, as the effect of parent-child interaction on child outcomes is expected to interact with income status to influence child cognitive ability.

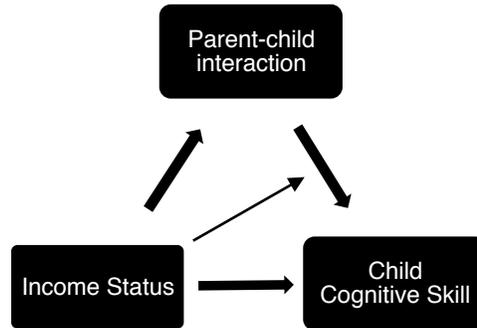


Figure 2: Conceptual Model: Moderated Mediation
 Parent-child interaction as the mediator between income status and child cognitive skill .The relationship between parent child interaction and child cognitive skill is moderated by income status, such that the relationship is strongest for low-income families.

Analyses based on the model in Figure 2 assess whether path coefficients estimated from the data are consistent with hypotheses about mediation of effects of income through parent-child interaction, with income status moderating the relationship between parent-child interaction and child cognitive outcomes.

Hypotheses

Poverty is consistently identified in research as a risk factor for development.

However, gaps in the research remain in the identification of these risks early in development and in the level of specificity of effect. Research and theory suggests that language and executive function abilities are likely impacted by poverty early in development. Therefore, the first question this research is designed to answer is: Are

language (receptive vocabulary) and executive function abilities impacted by poverty during the first two years of development, as these skills are emerging? There is also much yet to learn about how parent-child interaction is compromised among low-income dyads in early development, and whether or not differences in interaction might mediate the relationship between income status and developmental outcomes. To date, most research testing the relationship between parent-child interaction and child outcomes has used holistic, global measures of discrete behaviors comprising interaction. The current study takes an important step in testing a mediation model of poverty's impact on cognitive development using micro-level measures and sequential analytic techniques to measure parent-child interaction.

The preceding literature review leads to the formulation of the following specific hypotheses:

H1: Income status is related to developmental outcomes of receptive language and executive control at 12- and 24- months.

H2: Income status is related to dyad ability to initiate dyadic interaction.

The more complex sequential interaction pattern found in dyadic social referencing, characterized by mutuality in gaze and affect as well as contingent interaction, is expected to be an optimal pattern of interaction. Other contingent and reciprocal interaction patterns, specifically behavioral imitation, affective mirroring and emotional responsiveness to others' pretend gestures, are also examined and expected

to reveal income differences. Specifically, on the basis of the literature reviewed in this chapter, the following hypotheses are tested:

H3: Reciprocity in the initiation of interaction is associated with increased time spent in dyadic pretend play and mutual positive emotion expression.

H4: Mutual engagement in interaction is expected to be influenced by the independent behaviors of either or both members of the dyad, and differ by age and income group.

The dyad's use of social referencing to disambiguate meaning during pretense and other patterns that reflect meaningful contingency will be examined and compared across groups, with low-income dyads expected to be less skillful in establishing contingency.

H5: Parent-infant dyadic interaction mediates the relationship between income status and child developmental outcomes; this relationship is expected to be moderated by income status. Low-income dyads, with fewer resources and experiencing the cumulative effects of stress from poverty impacting one or both members of the dyad, are expected to be less able to leverage other effective tools for developing child cognitive skills. The relationship between parent-child interaction deficits and child cognitive outcomes are therefore expected to be strongest among low-income dyads.

Chapter Three

Methodology

This chapter presents the methods used in this study to test the hypotheses presented in Chapter Two. The chapter begins with a description of the recruitment process and a demographic description of the study participants. Next, the specific procedures and tools used in collecting the survey-based (demographic data, child language skill) and observational data (child executive function skill, parent-child interaction) are explained in detail. The coding schemes used to measure the variables based on observation are described, and the procedures implemented for reducing the data are delineated.

Participants

Participants were recruited from local community agencies serving low-income families, through publicly available birth records, using brochures distributed to early childhood care and education facilities, pediatricians, and other community organizations serving families, and through a shared database of families recruited from the local hospital at the time of infant birth. Income eligibility in the study was determined using the US Census Bureau's poverty thresholds. After an initial screening for other disqualifying factors—developmental delays and other factors—families who were interested in the study were invited to participate two weeks before or after the target child's first or second birthday. Participants were recruited into the “low income” group if their annual family income was below the poverty threshold,

given family size. Participants were recruited into the “middle income” group if their annual income was twice the poverty threshold, given family size. All others were determined to be ineligible for participation. Because of the relatively low proportion of non-white children in Tompkins and surrounding counties, only Caucasian parent-child dyads were recruited.

Although a total of 108 children and their primary caregiving parent participated in this study, data is reported for 95 dyads with dyadic interaction data (43 low-income and 52 middle-income dyads). One parent dropped out of the study; 3 children refused the pretend interaction; 7 pretend interactions were captured with one camera, precluding dyadic analysis; and in 2 cases, both pretend interaction videos were missing. Sample demographics are reported in Table 1.

Table 1: Sample Demographics

12 month olds			
	Overall Sample (N=46)	Low Income (N=23)	Middle Income (N=23)
Average monthly income		\$1,758 (901.95)	\$5,186 (1483.65)
Average parental age		27.19 (4.13)	34.52 (4.58)
Child gender			
Male	19 (41.30%)	7(30.43%)	12 (52.17%)
Female	27 (58.70%)	16 (69.57%)	11 (47.83%)
Marital status			
Married	31 (67.39%)	9 (39.13%)	22 (95.65%)
Divorced	2 (4.35%)	1 (4.35%)	1 (4.35%)
Single	11 (23.91%)	11 (47.83%)	0
Education			
Some high school	4 (8.70%)	4 (17.39%)	0
High school graduate	6 (13.04%)	6 (26.09%)	0
Some college	14 (30.43%)	9 (39.13%)	5 (21.74%)
College graduate	10 (21.74%)	1 (4.35%)	9 (39.13%)
Some graduate work	10 (21.74%)	1 (4.35%)	9 (39.13%)
24 month olds			
	Overall Sample (N=49)	Low Income (N=20)	Middle Income (N=29)
Average monthly income		\$1978.68 (1182.30)	\$4399.43 (1372.31)
Average parental age		28.50 (8.08)	33.58 (4.93)
Child gender			
Male	26 (53.06%)	10 (50%)	16 (55.17%)
Female	23 (46.94%)	10 (50%)	13 (44.83%)
Marital status			
Married	29	10 (50%)	19 (90%)
Divorced	3	3 (15%)	0 (0%)
Single	9	7 (35%)	2 (9.52%)
Education			
Some high school	0	0	0
High school graduate	10 (20.41%)	9 (45%)	1 (3.45%)
Some college	9 (18.37%)	7 (35%)	2 (6.90%)
College graduate	12 (24.49%)	3 (15%)	9 (31.03%)
Some graduate work	15 (30.61%)	1 (5%)	14 (48.28%)

Procedure Overview

This research was part of a larger study of income-based differences in early development. Families were compensated \$175 for participation and participated in research during a 1½ hour laboratory and 1½ hour home visit. Two trained research assistants video-recorded the interaction, while a third research assistant, trained in the study protocols, conducted the home- and lab-visits. Data used in the current study were collected during both visits. During the first visit, at the research laboratory, the experimenter provided an overview of the study and the overall study goals in order to gain informed parental consent. During this first visit, demographic data and measures of language skill and executive function skill were collected. The observational data collection to measure parent-child interaction occurred during a two-minute pretend play session during the second (home) visit.

Measures

The key measures in this research are parent-report (questionnaire) measures of demographic characteristics of the mother and infant, family income, and child receptive language, and observational measures of dyadic interaction and inhibitory control.

Parent Questionnaires

Parent and child demographics

Primary caregivers reported their age, education level, monthly income and work experiences on a demographic questionnaire during the first laboratory visit. Child gender and age were also assessed through parental report.

Child Language

Child receptive vocabulary was assessed by maternal report, using an age appropriate version of the MacArthur Communicative Development Inventory short form (MCDI; Fenson *et al.*, 2000). Parents of 12-month-olds completed the Infant Form designed for infants between eight and 18 months and containing 89 words. The parents of 24-month-olds completed the Toddler form which is designed for infants between 16 and 30 months and contains 96 words. Caregivers were asked to indicate whether their child understood or both understood and said each word item on the questionnaire. To calculate receptive and productive vocabularies, the total number of words each infant comprehended and produced (respectively), a proportion was derived by dividing the total number of words the parent identified the child as understanding or produced by the total number of words in the respective forms.

Observations

Executive Control

Hide the Pots (Bernier, 2012, adapted from Hughes & Ensor, 2005). During this location search task with 12-month-olds, an attractive sticker was hidden in full sight

of the child under one of three opaque pots of different shapes and colors. In the warm-up phase the child was immediately asked to retrieve the sticker. Three practice trials were conducted to provide the children with experience of retrieving the sticker from each pot. In the testing phase, the experimenter hid the sticker and then covered the pot with a blanket before inviting the child to find the sticker. This required that the child hold the location of the sticker in his or her memory. The number of correct trials (0-3) (on first attempt), and the number of perseverative errors (0-2) were calculated. Performance on the *Hide the Pots* task is significantly associated with other executive function measures among 18-26 month-old children (r range = .25 to -.28) (Bernier, 2012); thus, this task is a valid measure of executive control.

Spin the Pots (Hughes & Ensor, 2005). During this location search task six stickers were hidden in a group of eight visually distinct opaque pots (two of the pots were empty). The experimenter said, “We’re going to play a game that’s lots of fun, and you



Figure 3: Hide the Pots Task for 12-month-olds

can win lots of stickers. Would you like that? Let's open each of these pots. Now we'll put a sticker in six of them, like this. We haven't got enough stickers for all the pots, so these two pots are empty. Now I'll cover it up like this [places silk scarf over tray].” The pots were covered by a scarf and rotated on a lazy Susan. “Now, we're going to spin the tray, and I want you to choose a pot. Can you do that? Show me which pot you want to open.” As soon as the child chose a pot, the child was encouraged, the remaining pots were covered with the scarf and the experimenter spun the pots on the lazy Susan. Each time a sticker was found, the sticker was removed and the pots were covered and rotated again on the lazy Susan. The task ended when all six stickers were found, with a maximum of 16 trials. The score was calculated as 16 minus the number of errors made (i.e., looking under a pot in which no sticker had been hidden or perseverative looking). The number of perseverative errors was also calculated and scored (0-5). In research with 24 month olds, pass/fail phi-contingency coefficients for success on spin the pots were significantly associated with other tasks designed to measure executive function (Phi Contingency = .20 and .39, $p < .05$ and .001, respectively) (Hughes & Ensor, 2005).



Figure 4: Spin the Pots Task for 24-month olds

Dyadic Interaction during Pretense

Following Lillard et al (2007), dyads sat across from each other with children seated in a booster seat with feeding tray and safety belt, and they were instructed to pretend to share a snack of cheerios and a drink with one another. Parents were provided with the pretend play materials (two sets of eating bowls, plates, drinking cups and utensils, an empty box of cheerios and a pitcher). The interaction was recorded via two video cameras facing each member of the dyad for approximately 2 minutes. Specifically, the experimenter said, “We are interested in how children react to their parent’s actions. What I will ask you to do today is to pretend to share a snack together. While you do this we’ll be recording both you and your child so that we can go back later

and watch how your child reacts to your actions. This should take about 2 minutes.

Do you have any questions?”



Figure 5: Split screen view of mother and infant interacting with pretend materials.

Coding

Parent and infant emotions, gazes, and pretend behaviors were microcoded (.01 second) continuously using ELAN (Lausberg & Sloetjes, 2009; <http://tla.mpi.nl/tools/tla-tools/elan/>), a freely available behavioral coding program developed by the Max Planck Institute for Psycholinguistics, The Language Archive, Nijmegen, The Netherlands. Prior to coding, the separate parent and infant videos were synchronized at a single start time using ELAN's media synchronization tool. One undergraduate and one graduate student were trained as observers. Each observer read the coding manual and then learned to watch and code both mother and infant behavior. Approximately 15% of the interactions were coded with a consensus score from both trained observers. Coders attained an inter-rater reliability

of at least Cohen's Kappa .75 on each of the below codes. The following behaviors were continuously coded for both the parent and the child.

Looking behavior: Looking behavior was coded for looks directed at the other's face, directed towards the actions of the other, those directed at some aspect of the task (e.g., the utensils, napkin, food), and those directed elsewhere.

Percent time, frequency per minute, and average duration of looks at the others' face, actions or to pretend play materials were calculated.

Emotion Expression: Positive emotion was coded when child or parent smiled or laughed. Negative emotion was coded when the child or parent grimaced, fussed or cried. Otherwise, emotion was coded as neutral.

Percent time, frequency per minute, and average duration of positive emotion expression was calculated to create measures of positive emotion expression for each member of the dyad.

Pretend behaviors. Pretend eating, drinking, and serving behaviors were coded.

Pretending to eat involved behaviors such as stirring with the spoon in the bowl or plate, movement toward the mouth with the spoon from the bowl or plate, and chewing and swallowing. Pretending to drink involved stirring with the spoon in the cup, lifting the cup towards the mouth, and holding the cup near the mouth.

Pretending to serve involved holding the pitcher, tilting the pitcher to suggest

pouring, and tilting the box of cheerios to suggest pouring into one's own or the other's bowls, plates or cups.

Pretend behaviors were combined to form a single pretend variable. Percent time, frequency per minute and average duration of pretend behaviors were calculated for each member of the dyad.

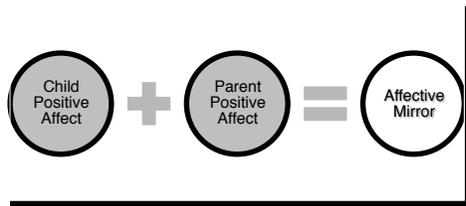
Data Reduction of Sequential Behaviors

I performed sequential analysis of interactions using SDIS-GSEQ (Bakeman and Quera's, 2011: Sequential Data Interchange Standard – Generalized Sequential Querier) statistical program, in order to capture and quantify dyadic behavioral sequences. Following Bakeman and Quera (2011), I recoded the parent and child behavioral data based on sequential patterns of interest. The results of these analyses were used to create the following dyadic variables:

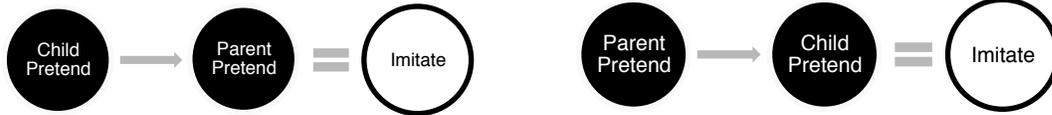
- 1) Dyadic Emotional Mutuality: Positive emotion expression followed by positive emotion expression of the other;
- 2) Dyadic Behavioral Imitation: Parent or child behavioral imitation of pretend behavior (pretend behavior by one of the social partners, followed by any pretend behavior by the other);
- 3) Dyadic Responsiveness: Parent or child positive emotion expression following the onset of the social partner's pretend play;

4) Dyadic Social Referencing: Parent-child use of social reference (parent initiated pretend followed by parent gaze to child's face, and then the child's positive emotion matching or pretend behavior imitation response (as in Nishida & Lillard, 2007).

Dyadic Affective Mirroring Sequence



Dyadic Imitation Sequence



Dyadic Responsiveness Sequence



Dyadic Social Referencing Sequence



Figure 6. Behavioral Contingencies

Chapter Four

Results

In this chapter, the results of the data analyses are presented. I begin with descriptive analyses of the variables under study. The outcome measures of interest, language and executive function, are presented first. Then, the pretend play behaviors of parents and children (looks to social partner, positive and negative emotion expression, and pretend play) are presented. Age and income differences are also considered.

Next, I present the results of the time-window sequential analysis of contingencies between low-income and middle-income parent and child behaviors and emotion expression (pooled), within a 2-second time window. First, dyadic variables of antecedent and target behaviors are derived, and means and standard deviations are presented. Analyses of comparisons across age and income groups are conducted. Then, contingency tables are presented to demonstrate the rates of expected and observed occurrences of antecedent and target behaviors. Both child- and parent-behaviors are considered as “given” and “target” behaviors to allow interpretations regarding directionality of effect. Odds ratios and Yule’s Q, which take into account base rates of antecedent behaviors, are presented to quantify the statistical and practical significance of findings, and to compare the relative influences of parents and children to the interaction dynamic. Results from 12- and 24-month olds, and low-and middle-income groups are reported separately.

Finally, I used Preacher & Hayes' (2004) approach to test intervening variable effects in my proposed moderated mediation model. In this method, bootstrapping is used to generate Confidence Intervals for estimates of the product of model coefficients for the indirect or mediating effects. The results are reported separately for 12- and 24-month olds and the two dependent variables under study: executive function and receptive language outcomes.

Results

Hypothesis 1: Income status is related to the developmental outcomes of receptive language and executive control at 12- and 24- months.

Language. At 12 months, infants understood an average of 31 (SD=15.1) words. There were no statistically significant gender differences in receptive vocabulary between boys and girls, *Means* = 29.96 (*SD*=15.98) and 32.45 (*SD*=14.53), respectively, $t(50) = .60$, *ns*. A regression analysis selecting for gender revealed that income significantly predicted receptive vocabulary scores in 12 month old females, $\beta = .423$, $t(39) = 2.19$, $p = .04$. Mean differences in language scores by income are displayed in Table 3. Data from two subjects were excluded from these analyses because of extreme values.

At 24 months, infants understood an average of 153 ($SD=252.24$) words; the large standard deviation shows that there was a high level of variability in the data. As with 12-month olds, there were no apparent gender differences, as boys and girls knew approximately the same number of words, $Means = 153.92$ ($SD=254.57$) and 152.20 ($SD=255.14$), respectively, $t(48) = .02$, *ns*.

Executive function. At 12 months, the average score on the executive function assessment was 1.17 (range 0-3, $SD = .80$). Boys and girls did not differ from one another in terms of performance, as boys' average score for executive function was 1.06 ($SD=.73$) and girls scores averaged at 1.26 ($SD=.86$), $t(39) = .81$, *ns*. Of those who were able to demonstrate understanding of the task in the warm-up phase ($n=41$), only 4.3% were able to complete the assessment without error; 21.7% had one error; 34.8% had two errors; 10.9% had three errors. Low-income infants ($M=1.13$, $SD=.71$) did not have significantly different scores than middle-income infants ($M=1.20$, $SD=.89$), $t(39) = .29$, *ns*.

At 24 months, among those completing the 24-month old executive function task ($n=37$), the average score on the executive function assessment was 5.00 (range 2-6, $SD = 1.63$). The girls' average scores were 5.00 ($SD=1.45$) and boys' average scores were 4.47 ($SD=1.70$). These differences were not statistically significant, $t(35)=1.02$, *ns*. (A regression analysis revealed a non-significant trend in the expected direction, with middle-income infants ($M=5.18$, $SD=1.24$) scores on the executive function task

higher than low-income infant scores ($M=4.25$, $SD=1.88$), $\beta=.825$, $t(35)=1.63$, $p=.103$.

Table 2 Child Receptive Language and Executive Function, By Income Group

	12 MONTH		24 MONTH	
	Low	Middle	Low	Middle
	Mean (SD)	Mean (SD)	Mean (SD)	Mean SD)
Receptive Language	26.89 (09.10)	33.59 (15.00)	127.84 (48.48)	174.62 (52.96)
Hide the Pots	1.13 (00.72)	1.20 (00.87)	-	-
Spin the Pots	-	-	4.33 (01.81)	5.12(4.76)

Time window sequential analysis

Using time-window sequential analysis, parent and child behavioral data were recoded as specified behavioral sequences occurring within a time window of 2 seconds.

Observed and expected joint frequencies (probability of target behavior multiplied by the frequency of the given behavior), or contingencies in behavior between parent and child, pooled across low- and middle-income dyads, were calculated.

H2: Income status is related to dyad ability to initiate dyadic interaction.

Results of sequential parent-child contingencies are presented in a series of contingency tables that represent specific sequential patterns of behavior during initiation of interaction, namely, affective mirroring, dyadic imitation, dyadic responsiveness, and dyadic social referencing. Parent- and child-led patterns were considered side-by-side for all patterns except for social referencing, which was

examined only for parent-led initiation of interaction using social referencing sequences.

As in Chorney, Garcia, Berlin and Bakeman (2010), the contingency tables presented below include cell labels A (cell includes number of seconds that target behavior occurred within the time window), B (cell includes number of seconds within the time window that the target behavior did not occur), C (cell includes number of seconds that the target behavior occurred), and D (cell includes the number of seconds that the neither the target nor the given behaviors occurred). The data presented represent data pooled across low- and middle-income dyads for income-based comparisons, and reported separately for dyads with 12- and 24-month olds. Odds Ratios with corresponding 95% Confidence Intervals (CI), and Yule's Q values were calculated to measure the effect sizes and strength of the contingency between behaviors. Statistical significance can be inferred from a confidence interval; a 95% CI corresponds with a p-value of .05 frequently used in hypothesis testing. (Davies & Crombie, 2009). In working with Odds Ratios, an Odds Ratio of 1 indicates zero effect. Therefore, a 95% CI for an Odds Ratio that does not include 1 in the range of values corresponds to a statistically significant increase in odds at a .05 significance level. Following Bakeman & Quera (2011), Odds Ratios between 1.25-2.00 are considered weak, between 2.00 and 3.00 are considered moderate, and over 3 are considered strong effect sizes. A z-test which tests for statistically significant differences between observed and expected

values, was calculated by dividing the difference between observed and expected values by the standard deviation of the difference. Z-test values above the cutoff of 1.96 are statistically significant at $p < .05$ (Chorney, Garcia, Berlin & Bakeman, 2010). Following Knoke and Bohrnstedt (1991), absolute values of the Yule's Q between .25 and .49 are considered "weak", .50 to .74 are considered moderate, and .75 to 1 are considered strong contingencies.

Affective Mirroring

To what degree does a parent's expression of positive emotion influence the same emotional experience in the infant or toddler within a 2 second window? Among 12-month-olds, low income infants had a 2.49 increased likelihood of responding to parent positive emotion expression with positive emotion expression within 2 seconds, with a statistically significant 95% CI [1.37, 4.52]. The χ^2 -test of the 2.49 increased likelihood of infant positive emotion beginning within the 2 second window of the onset of the parent's emotion expression equaled 3.26, above the cutoff of 1.96 for a statistically significant finding with a p-value set at .05 ($\chi^2 = 3.26, p < .0001$). The Yule's Q contingency coefficient of .43 indicated a relatively weak contingency between these behaviors. Middle income infants were 3.18 times more likely to respond with positive emotion within 2 seconds of parent positive emotion expression ($\chi^2 = 4.39, p < .0001$), with a statistically significant 95% CI [1.76, 5.76]. The Yule's Q contingency coefficient, .52, indicates a contingency of moderate strength. Independent sample t-tests were

conducted testing for a significant difference between the mean Yule's Q contingency coefficients for low- and middle-income dyads. The difference was not significant, $t(43)=-.401, ns$.

There was no evidence of contingency between parent emotion expression and their 24-month olds' emotional responses. The observed and expected contingency tables for dyads with 12- and 24-month olds are presented below in Table 3 and Table 4, respectively.

Table 3: 12-Month-Old Target Behavior (Child Affect) given Window (Parent Affect)

	Child Affect	No Child Affect	Low Income Total	Child Affect	No Child Affect	Middle Income Total
Inside Parent Affect Window	15(A)	319 (B)	334	16 (A)	308 (B)	324
Expected value:	7	327		6	318	
Outside Parent Affect Window	45 (C)	2381 (D)	2426	39 (C)	2389 (D)	2428
Expected value:	53	2373		49	2379	
Total	60	2700	2760	55	2697	2752

Odds ratio (Low Income) = $(A/B)/(C/D)=(AxD)(BxC)=2.49$, 95% CI[1.37, 4.52]; Yules Q (Low Income)= $(AD-BC)/(AD+BC)=0.43$

Odds ratio (Middle Income) = $(A/B)/(C/D)=(AxD)(BxC)=3.18$, 95% CI[1.76, 5.76]; Yules Q (Middle Income)= $(AD-BC)/(AD+BC)=0.52$

Table 4: 24-Month-Old Target Behavior (Child Affect) given Window (Parent Affect)

	Child Affect	No Child Affect	Low Income Total	Child Affect	No Child Affect	Middle Income Total
Inside Parent Affect Window	12(A)	209(B)	221	16 (A)	285 (B)	301
Expected value:	7	214		9	292	
Outside Parent Affect Window	57(C)	1918(D)	1975	60 (C)	2055 (D)	2115
Expected value:	62	1912		67	2048	
Total	69	2127	2196	76	2340	2416

Odds ratio (Low Income) = $(A/B)/(C/D)=(AxD)(BxC)=1.93$, 95% CI[1.02, 3.66]; Yules Q (Low Income)= $(AD-BC)/(AD+BC)=0.32$

Odds ratio (Middle Income) = $(A/B)/(C/D)=(AxD)(BxC)=1.92$, 95% CI[1.09, 3.38]; Yules Q (Middle Income)= $(AD-BC)/(AD+BC)=0.32$

Alternatively, are parents more likely to express positive emotion within 2 seconds of infant or toddler expression of positive emotion, than other times? Low-income and middle-income parents with 12-month olds were 2.53 times ($\chi^2= 3.59, p<.0002$; 95% CI [1.46, 4.40]) and 3.83 times ($\chi^2=5.17, p<.0001$; 95% CI [2.29, 6.39]), respectively, more likely to express positive emotion, given the onset of child positive emotion expression in the previous 2 seconds. This increase in odds is therefore statistically significant. The corresponding Yule's Q contingency coefficient was of weak strength, .43, for low-income dyads and of moderate strength, .59, for middle-income dyads. Independent sample t-tests were conducted testing for a significant difference between the mean Yule's Q contingency coefficients for low- and middle-income dyads. The difference was not significant, $t(44)=-1.01, ns$.

Among 24 month-olds, only low-income dyads evidenced contingency for parent positive emotion expression given child positive emotion expression. Low income parents were 3.07 times more likely to express positive emotion given the onset of child positive emotion expression in the previous 2 seconds, $\chi^2=4.04, p<.0001$; 95% CI [1.75, 5.38]. The increase in odds is statistically significant. The contingency coefficient, Yule's Q, was moderate at .51. The observed and expected contingency tables for dyads with 12- and 24-month olds are presented below in Table 5 and Table 6, respectively.

Table 5 12-Month-Old Target Behavior (Parent Affect) given Window (Child Affect)

12 month	Parent Affect	No Parent Affect	Low Income Total	Parent Affect	No Parent Affect	Middle Income Total
Inside Child Affect Window	16 (A)	162 (B)	178	20 (A)	145 (B)	165
Expected value:	7	171		7	158	
Outside Child Affect Window	97 (C)	2485 (D)	2582	90 (C)	2497 (D)	2587
Expected value:	106	2476		103	2484	
Total	113	2647	2760	110	2642	2752

Odds ratio (Low Income) = $(A/B)/(C/D)=(AxD)(BxC)=2.53$, 95% CI[1.46, 4.40]; Yules Q (Low Income)= $(AD-BC)/(AD+BC)=0.43$

Odds ratio (Middle Income) = $(A/B)/(C/D)=(AxD)(BxC)=3.83$, 95% CI[2.29, 6.39]; Yules Q (Middle Income)= $(AD-BC)/(AD+BC)=0.59$

Table 6 24-Month-Old Target Behavior (Parent Affect) given Window (Child Affect)

24month	Parent Affect	No Parent Affect	Low Income Total	Parent Affect	No Parent Affect	Middle Income Total
Inside Child Affect Window	17 (A)	188 (B)	205	15 (A)	211 (B)	226
Expected value:	7	198		9	217	
Outside Child Affect Window	57 (C)	1934 (D)	1991	86 (C)	2104 (D)	2190
Expected value:	67	1924		92	2098	
Total	74	2122	2196	101	2315	2416

Odds ratio (Low Income) = $(A/B)/(C/D)=(AxD)(BxC)=3.07$, 95% CI [1.75, 5.38]; Yules Q (Low Income)= $(AD-BC)/(AD+BC)=0.51$

Odds ratio (Middle Income) = $(A/B)/(C/D)=(AxD)(BxC)=1.74$, 95% CI[.99, 3.06]; Yules Q (Middle Income)= $(AD-BC)/(AD+BC)=0.27$

Dyadic Imitation

Are infants and toddlers more likely to engage in pretend play behaviors within 2 seconds of parent

engagement in pretend play? At 12 months, there is no evidence of contingency between

parent-led pretend and child pretend. However, among low and middle income 24

month olds, toddlers are 2.59 and 3.3 times more likely to engage in pretend following

the onset of parent pretend (within two seconds), than any other behaviors, $\chi^2=4.58$,

$p<.0001$; 95% CI [1.72, 2.89] and $\chi^2=6.10$, $p<.0001$; 95% CI [2.19, 4.98], respectively.

The odds ratio suggests that the effect size for low-income dyads with 24-month olds was moderate, and significantly different than 1. The corresponding Yule's Q value indicated a weak contingency between behaviors. However, the effect size for middle-income dyads with 24-month-olds was moderate, with a Yule's Q value also indicative of a moderate strength in contingency between parent pretend behaviors and subsequent child pretend behaviors. Independent sample t-tests were conducted testing for a significant difference between the mean Yule's Q contingency coefficients for low- and middle-income dyads. The difference was not significant, $t(19.31)=-1.28, ns$. The observed and expected contingency tables for dyads with 12- and 24-month olds are presented below in Table 7 and Table 8, respectively.

Table 7: 12-Month-Old Target Behavior (Child Pretend) given Window (Parent Pretend)

12month	Child Pretend	No Child Pretend	Low Income Total	Child Pretend	No Child Pretend	Middle Income Total
Inside Parent Pretend Window	16 (A)	177 (B)	193	17 (A)	167 (B)	184
Expected value:	11	182		11	172	
Outside Parent Pretend Window	138 (C)	2429 (D)	2567	153 (C)	2415 (D)	2568
Expected value:	143	2423		159	2409	
Total	154	2606	2760	170	2582	2752

Odds ratio (Low Income) = $(A/B)/(C/D)=(AxD)(BxC)=1.59, 95\% CI [.93, 2.73]$; Yules Q (Low Income)= $(AD-BC)/(AD+BC)=0.23$

Odds ratio (Middle Income) = $(A/B)/(C/D)=(AxD)(BxC)=1.61, 95\% CI [.95, 2.71]$; Yules Q (Middle Income)= $(AD-BC)/(AD+BC)=0.23$

Table 8: 24-Month-Old Target Behavior (Child Pretend) given Window (Parent Pretend)

24 month	Child Pretend	No Child Pretend	Low Income Total	Child Pretend	No Child Pretend	Middle Income Total
Inside Parent Pretend Window	38 (A)	337 (B)	375	38 (A)	322 (B)	360
Expected value:	20	356		16	344	
Outside Parent Pretend Window	76 (C)	1745 (D)	1821	71 (C)	1985 (D)	2056
Expected value:	95	1726		93	1963	
Total	114	2082	2196	109	2307	2416

Odds ratio (Low Income) = $(A/B)/(C/D)=(A \times D)/(B \times C)=2.59$, 95% CI [1.72, 2.89]; Yules Q (Low Income)= $(AD-BC)/(AD+BC)=0.44$

Odds ratio (Middle Income) = $(A/B)/(C/D)=(A \times D)/(B \times C)=3.30$, 95% CI [2.19, 4.98]; Yules Q (Middle Income)= $(AD-BC)/(AD+BC)=0.53$

Alternatively, are parents more likely to engage in pretend play behaviors than other behaviors within 2 seconds of the onset of infant or toddler engagement in pretend play? As in parent-led pretend, at 12 months, there is no evidence of contingency between child-led pretend and subsequent parent pretend behaviors. However, low-income parents with 24-month-olds are 2.42 times more likely to engage in pretend play behaviors than other behaviors within 2 seconds of toddler engagement, $\chi^2=4.26$, $p<.0001$; 95% CI [1.62, 3.63]. Though significantly different than 1, the strength of the relationship was weak, as indicated by the Yule's Q contingency coefficient of .42. Middle income parents of 24 month old toddlers are 3.42 times more likely to engage in pretend play behaviors than other behaviors within 2 seconds of toddler engagement, $\chi^2=6.34$, $p<.0001$; 95% CI [2.29, 5.12], a statistically significant increase in odds. The corresponding Yule's Q contingency coefficient of .55 for middle-class dyads indicated a moderate contingency between parent pretend behaviors following child pretend initiation.

Independent sample t-tests were conducted testing for a significant difference between the mean Yule's Q contingency coefficients for low- and middle-income dyads. The difference was not significant, $t(19.31)=0$, *ns*. The observed and expected contingency tables for dyads with 12- and 24-month olds are presented below in Table 9 and Table 10, respectively.

Table 9 12-Month-Old Target Behavior (Parent Pretend) given Window (Child Pretend)

12month	Parent Pretend	No Parent Pretend	Low Income Total	Parent Pretend	No Parent Pretend	Middle Income Total
Inside Child Pretend Window	11(A)	445 (B)	456	11(A)	492 (B)	503
Expected value:	11	445		11	491	
Outside Child Pretend Window	54 (C)	2250 (D)	2304	51(C)	2198 (D)	2249
Expected value:	54	2250		51	2198	
Total	65	2695	2760	62	2690	2752

Odds ratio (Low Income) = $(A/B)/(C/D)=(AxD)/(BxC)=1.03$, 95% CI[.53, 1.99]; Yules Q (Low Income)= $(AD-BC)/(AD+BC)=0.01$

Odds ratio (Middle Income) = $(A/B)/(C/D)=(AxD)/(BxC)=0.96$, 95% CI[.50, 1.86]; Yules Q (Middle Income)= $(AD-BC)/(AD+BC)=-0.02$

Table 10: 24-Month-Old Target Behavior (Parent Pretend) given Window (Child Pretend)

24 month	Parent Pretend	No Parent Pretend	Low Income Total	Parent Pretend	No Parent Pretend	Middle Income Total
Inside Child Pretend Window	37 (A)	303 (B)	340	39 (A)	283 (B)	322
Expected value:	20	320		16	306	
Outside Child Pretend Window	89 (C)	1767 (D)	1856	81 (C)	2013 (D)	2094
Expected value:	106	1750		104	1990	
Total	126	2070	2196	120	2296	2416

Odds ratio (Low Income) = $(A/B)/(C/D)=(AxD)/(BxC)=2.42$, 95% CI[1.62, 3.63]; Yules Q (Low Income)= $(AD-BC)/(AD+BC)=0.42$

Odds ratio (Middle Income) = $(A/B)/(C/D)=(AxD)/(BxC)=3.42$, 95% CI[2.29, 5.12]; Yules Q (Middle Income)= $(AD-BC)/(AD+BC)=0.55$

Dyadic Responsiveness

Are infants and toddlers more likely to show positive emotion expression within 2 seconds of onset of parent pretend? Overall, there was no evidence for contingent 12-month-old infant positive emotion following parent pretend behaviors. Middle-income dyads with 24-month old toddlers also did not show evidence of dyadic responsiveness. Low-income 24-month-old infants tended to respond to parent pretend behaviors with positive emotion expression within 2 seconds. Specifically, low-income 24-month olds were 2.19 times more likely to express positive emotion within 2 seconds of parent pretend, $\chi^2=2.90, p<.004$; 95% *CI* [1.30, 3.71], a statistically significant increase in odds. The corresponding Yule's Q contingency coefficient was .37, indicating a weak contingency. The observed and expected contingency tables for dyads with 12- and 24-month olds are presented below in Table 11 and Table 12, respectively.

Table 11: 12-Month Target Behavior (Child Positive Affect) given Window (Parent Pretend)

	Child Affect	No Child Affect	Low Income Total	Child Affect	No Child Affect	Middle Income Total
Inside Parent Pretend Window	2(A)	191 (B)	193	2(A)	182(B)	184
Expected value:	4	189		4	180	
Outside Parent Pretend Window	58(C)	2509(D)	2567	53(C)	2515(D)	2568
Expected value:	56	2511		51	2517	
Total	60	2700	2760	55	2697	2752

Odds ratio (Low Income) = $(A/B)/(C/D)=(AxD)(BxC)=0.45$, 95% *CI*[.11, 1.87]; Yules Q (Low Income)= $(AD-BC)/(AD+BC)= -0.38$

Odds ratio (Middle Income) = $(A/B)/(C/D)=(AxD)(BxC)=0.52$, 95% *CI*[.13, 2.16]; Yules Q (Middle Income)= $(AD-BC)/(AD+BC)= -0.31$

Table 12: 24-Month Target Behavior (Child Positive Affect) given Window (Parent Pretend)

	Child Affect	No Child Affect	Low Income Total	Child Affect	No Child Affect	Middle Income Total
Inside Parent Pretend Window	21(A)	354 (B)	375	8 (A)	352 (B)	360
Expected value:	12	363		11	349	
Outside Parent Pretend Window	48(C)	1773 (D)	1821	68(C)	1988 (D)	2056
Expected value:	57	1764		65	1991	
Total	69	2127	2196	76	2340	2416

Odds ratio (Low Income) = (A/B)/(C/D)=(AxD)(BxC)=2.19, 95% CI [1.30, 3.71]; Yules Q (Low Income)=(AD-BC)/(AD+BC)=0.37

Odds ratio (Middle Income) = (A/B)/(C/D)=(AxD)(BxC)=0.66, 95% CI [.32, 1.39]; Yules Q (Middle Income)=(AD-BC)/(AD+BC)=-0.2

Alternatively, are parents more likely to express positive emotion within 2 seconds of infant or toddler pretend onset? There was no evidence of contingency between child pretend behavior and subsequent parent positive emotion expression among low- and middle-income dyads, and among dyads with either 12 or 24-month olds. The observed and expected contingency tables for dyads with 12- and 24-month olds are presented below in Table 13 and Table 14, respectively.

Table 13 24-Month-Old Target Behavior (Parent Affect) given Window (Child Pretend)

12month	Parent Affect	No Parent Affect	Low Income Total	Parent Affect	No Parent Affect	Middle Income Total
Inside Child Pretend Window	16(A)	440 (B)	456	17(A)	486(B)	503
Expected value:	19	437		20	483	
Outside Child Pretend Window	97 (C)	2207 (D)	2304	93(C)	2156(D)	2249
Expected value:	94	2210		90	2159	
Total	113	2647	2760	110	2642	2752

Odds ratio (Low Income) = (A/B)/(C/D)=(AxD)(BxC)=0.83, 95% CI [.48, 1.42]; Yules Q (Low Income)=(AD-BC)/(AD+BC)= -0.09

Odds ratio (Middle Income) = (A/B)/(C/D)=(AxD)(BxC)=0.81, 95% CI [.48, 1.37]; Yules Q (Middle Income)=(AD-BC)/(AD+BC)=-0.10

Table 14 24-Month-Old Target Behavior (Parent Affect) given Window (Child Pretend)

24 month	Parent Affect	No Parent Affect	Low Income Total	Parent Affect	No Parent Affect	Middle Income Total
Inside Child Pretend Window	12 (A)	328(B)	340	10(A)	312 (B)	322
Expected value:	11	329		13	309	
Outside Child Pretend Window	62(C)	1794(D)	1856	91 (C)	2003(D)	2094
Expected value:	63	1793		88	2006	
Total	74	2122	2196	101	2315	2416

Odds ratio (Low Income) = (A/B)/(C/D)=(AxD)(BxC)=1.06, 95% CI[.56, 1.99]; Yules Q (Low Income)=(AD-BC)/(AD+BC)=0.03

Odds ratio (Middle Income) = (A/B)/(C/D)=(AxD)(BxC)=0.71, 95% CI[.36, 1.37]; Yules Q (Middle Income)=(AD-BC)/(AD+BC)=-0.17

Social Referencing

Are infants more likely to express positive emotion or engage in pretend within 2 seconds of the offset of a social referencing sequence (parent pretends, looks to child's face and smiles). At 12 months of age, there is no evidence for parent social referencing sequences (pretend – look – smile) leading into contingent child smiling or pretending with a 2 second window. Parent social referencing behaviors occurred relatively rarely among 12-month-old dyads (12 occurrences for low-income dyads, 7 occurrences for middle-income dyads). The observed and expected contingency tables for positive emotion expression and pretend behaviors following social referencing patterns among dyads with 12-month olds are presented below in Table 15 and Table 16, respectively.

Table 15 12-Month-Old Target Behavior (Child Affect) given Window (Social Referencing)

12 month	Child Affect	No Child Affect	Low Income Total	Child Affect	No Child Affect	Middle Income Total
Inside Parent Social Referencing Window	1 (A)	11(B)	12	0 (A)	7 (B)	7
Expected value:	0.26	11.7		0.14	6.86	
Outside Parent Social Referencing Window	59(C)	2689(D)	2748	55 (C)	2690(D)	2745
Expected value:	60	2688		55	2690	
Total	60	2700	2760	55	2697	2752

Odds ratio (Low Income) = (A/B)/(C/D)=(AxD)(BxC)=4.14, 95% CI[.53, 32.62]; Yules Q (Low Income)=(AD-BC)/(AD+BC)=0.61

Odds ratio (Middle Income) = (A/B)/(C/D)=(AxD)(BxC)=0; Yules Q (Middle Income)=(AD-BC)/(AD+BC)= -1

Table 16 12-Month-Old Target Behavior (Child Pretend) given Window (Social Referencing)

12 month	Child Pretend	No Child Pretend	Low Income Total	Child Pretend	No Child Pretend	Middle Income Total
Inside Parent Social Referencing Window	2 (A)	10(B)	12	0 (A)	7 (B)	7
Expected value:	0.67	11.3		0.43	6.57	
Outside Parent Social Referencing Window	152(C)	2596(D)	2748	170 (C)	2575(D)	2745
Expected value:	153	2594		170	2575	
Total	154	2606	2760	170	2582	2752

Odds ratio (Low Income) = (A/B)/(C/D)=(AxD)(BxC)=3.42, 95% CI[.74, 15.72]; Yules Q (Low Income)=(AD-BC)/(AD+BC)=0.55

Odds ratio (Middle Income) = (A/B)/(C/D)=(AxD)(BxC)=0; Yules Q (Middle Income)=(AD-BC)/(AD+BC)= -1

Among 24-month olds, there were expected patterns of contingency between social referencing and positive emotion expression or pretend play. The odds of expressing positive emotion or pretending following parent social referencing among low-income dyads is 7.48 and 5.45 times higher, respectively, $\chi^2=4.60, p<.0001$; 95% CI [2.74, 20.37] and $\chi^2=5.17, p<.0001$, 95% CI[2.16, 13.78], and significantly different than 1. The corresponding strengths of the Yule's Q contingency coefficients for child positive emotion expression following parent social referencing were .76 and .69,

indicating strong and moderate strengths, respectively. The odds of expressing positive emotion and pretending following parent social referencing among middle income dyads were 3.76 and 8.79 times higher, respectively, $\chi^2=2.91, p=.004$; 95% *CI* [1.45, 9.78] and $\chi^2=8.04, p<.0001$; 95% *CI*[4.59, 17.15]. This statistically significant Odds Ratio has corresponding Yule's Q contingency coefficients for child positive emotion expression and child pretend behavior following parent social referencing were .58 and .80, indicating moderate and strong relationships, respectively.

Independent sample t-tests were conducted testing for a significant difference between the mean Yule's Q contingency coefficients for low- and middle-income dyads. The difference between low- and middle-income infants expression of child positive emotion following parent social referencing was not significant, $t(31)=-.95, ns$. There was a non-significant trend in the expected direction in the t-test measuring the differences between low- and middle-income infants engaging in pretend play within two seconds of parent social referencing behaviors, $t(23)=-1.74, p=.10$.

The observed and expected contingency tables for positive emotion expression and pretend behaviors following social referencing patterns among dyads with 24- month olds are presented below in Table 17 and Table 18.

Table 17 24-Month-Old Target Behavior (Child Affect) given Window (Social Referencing)

24 month	Child Affect	No Child Affect	Low Income Total	Child Affect	No Child Affect	Middle Income Total
Inside Parent Social Referencing Window	5 (A)	22(B)	27	5 (A)	43 (B)	48
Expected value:	0.85	26		1.51	46	
Outside Parent Social Referencing Window	64(C)	2105(D)	2169	71 (C)	2297(D)	2368
Expected value:	68	2100		74	2294	
Total	69	2127	2196	76	2340	2416

Odds ratio (Low Income) = (A/B)/(C/D)=(AxD)(BxC)=7.48, 95% CI=[2.74, 20.37]; Yules Q (Low Income)= (AD-BC)/(AD+BC)=0.76

Odds ratio (Middle Income) = (A/B)/(C/D)=(AxD)(BxC)=3.76; 95% CI=[1.45, 9.78]; Yules Q (Middle Income)= (AD-BC)/(AD+BC)=0.58

Table 18 24-Month-Old Target Behavior (Child Pretend) given Window (Social Referencing)

24 month	Child Pretend	No Child Pretend	Low Income Total	Child Pretend	No Child Pretend	Middle Income Total
Inside Parent Social Referencing Window	6 (A)	21(B)	27	13 (A)	35 (B)	48
Expected value:	1	26		2	46	
Outside Parent Social Referencing Window	108(C)	2061(D)	2169	96 (C)	2272(D)	2368
Expected value:	113	2056		107	2261	
Total	114	2082	2196	109	2307	2416

Odds ratio (Low Income) = (A/B)/(C/D)=(AxD)(BxC)=5.45, 95% CI[2.16, 13.78]; Yules Q (Low Income)= (AD-BC)/(AD+BC)=0.69

Odds ratio (Middle Income) = (A/B)/(C/D)=(AxD)(BxC)=8.79, 95% CI[4.59, 17.15]; Yules Q (Middle Income)= (AD-BC)/(AD+BC)= 0.80

H3: Reciprocity in the initiation of interaction is associated with increased time spent in dyadic pretend play and mutual positive emotion expression.

Dyadic reciprocity scores were derived from the rate of interactions coded as dyadic (behavioral imitation, affective mirroring, responsiveness and social referencing).

Partial correlations, controlling for income, were conducted to test the relationship between reciprocity in interaction initiation and percent time spent in mutual pretend play and in mutual positive emotion expression.

Dyadic reciprocity in initiation of interaction had a strong positive correlation with mutual pretend play in 12-month old dyads ($r = .60, p < .0001$) and with mutual positive emotion expression in 24-month old dyads ($r = .70, p < .0001$). To test for income differences, bivariate Pearson product-moment correlation coefficients were computed separately for low- and middle-income, 12- and 24-month olds (see Table 19). The correlation coefficients were converted into a ζ -score using Fisher's r -to- ζ transformation. Then, the ζ -scores were compared using formula 2.8.5 from Cohen and Cohen (1983, p. 54, as cited in Preacher, 2002). No significant differences were found between income groups for dyads with 12-month olds in terms of correlations between mutual positive emotion expression and dyadic reciprocity and between mutual pretend play and dyadic reciprocity, $\zeta = -1.21, ns$, and $\zeta = .97, ns$, respectively.

Table 19 Pearson's Product Moment Correlations for Dyadic Contingency and Mutual Engagement Measures

	Mutual Engagement	
	Mutual Positive Emotion	Mutual Pretend Play
<i>Reciprocity in Interaction</i>		
12-month low-income	.107	.756***
12 month middle-income	.487*	.57**
24 month low-income	.753***	.078
24 month middle-income	.652**	.471*

* Correlation is significant at the .01 level;

*** Correlation is significant at the .0001 level

Correlations between mutual positive emotion expression and dyadic reciprocity, and mutual pretend play and dyadic reciprocity did not differ significantly between income groups among dyads with 24-month-olds, $\zeta = .56, ns$ and $\zeta = -1.21, ns$, respectively.

However, when comparing low-income infants at 12- and 24- months of age, the correlations between dyadic contingency and both mutual positive emotion and mutual pretend play were significantly greater among 24-month olds ($z = -2.67, p = .007$, and $z = 2.785, p = .005$, respectively).

H4: Mutual engagement in interaction is expected to be influenced by the independent behaviors of either or both members of the dyad, and differ by age and income group.

Discrete behaviors During Pretend Play Task. Summary measures of rate (frequency per minute), probability (proportion of a session spent engaging in behavior), and mean event duration (average amount of time engagement in behavior lasted) of behaviors observed during pretend play are presented first as independent behaviors of the parent and child, and then by dyadic measures derived through sequential analysis. Table 20 and Table 21 present income differences in discrete parent and child behaviors.

Looks to social partner's face. Analysis of discrete parent and child behavior suggests that parents looked to children's faces significantly more than children looked to parents' faces. Parents looked to their 12 month olds' faces ($M = 9.80, SD = 3.16$), on average, at approximately twice the rate (per minute) that infants looked to their parents' faces ($M=4.55, SD=2.24$), $t(45) = 10.98, p < .0001$. This data suggests that most of the time that infants spent looking to their parents' faces was time spent in mutual gaze. A

dyadic variable for mutual attention, derived through sequential analysis, revealed that twelve-month infants and their parents, in fact, shared visual attention to the others' face 13% of the time on average ($SD=7.66$). There were no income-based differences at 12-months, $t(43) = .81, ns$.

Similarly, parents looked to their 24-month olds' faces significantly more, at approximately twice the rate (per minute) ($M = 6.90, SD = 2.65$), as children looked to parents' faces ($M = 3.88, SD = 2.06$), $t(37) = 7.67, p<.0001$. Dyadic mutual gaze occurred 10% ($SD = 5.98$) of the time in dyads with 24-month olds. While there were no income differences in mutual gaze, $t(36) = .29, ns$, 12-month olds engaged in mutual gaze for a significantly larger proportion of time than 24-month olds, $t(81) = 1.99, p = .05$.

Table 20: Child Behavior during Pretend Play, By Income Group

	12 MONTH		24 MONTH	
	Low	Middle	Low	Middle
	M (SD)	M (SD)	M(SD)	M(SD)
Looks to others' face				
Rate	4.59 (2.34)	4.50 (2.19)	4.05 (2.27)	3.74 (1.91)
Probability	0.17 (0.09)	0.15 (0.09)	0.14 (0.07)	0.13 (0.08)
Mean Duration	2.12 (0.92)	1.93 (0.83)	1.98 (0.60)	2.16 (0.82)
Positive Emotion				
Rate	1.31 (1.15)	1.19 (0.91)	1.85 (1.42)	1.89 (1.46)
Probability	0.61 (0.06)	0.60 (0.06)	0.11 (0.09)	0.14 (0.13)
Mean Duration	2.20 (1.36)	2.01 (1.66)	3.85 (3.84)	3.59 (2.76)
Pretend Play				
Rate	3.35 (1.59)	3.74 (1.54)	3.09 (1.12)	2.72 (1.03)
Probability	0.31 (0.20)	0.39 (0.18)	0.40 (0.23)	0.41 (0.21)
Mean Duration	6.01 (4.45)	7.23 (5.61)	8.52 (7.35)	9.18 (5.23)

Positive emotion expression. Parents also expressed more positive emotion than their infants and toddlers. Parents of 12-month olds expressed positive emotion significantly more, at about twice the rate (per minute) as their infants ($M=2.44$, $SD = 1.03$ compared to $M = 2.44$, $SD = .20$), $t(45) = 5.44$, $p < .0001$. Dyads with 12-month-olds spent an average of 2.73% ($SD = 4.07$) of their time expressing positive emotion expression at the same time. There were no significant income differences in terms of time spent in mutual positive emotion expression, $t(43) = .57$, *ns*.

Parents with 24-month-olds, by contrast, did not express significantly more positive emotion significantly more (rate per minute) ($M = 2.28$, $SD = 1.44$) than their children ($M = 1.87$, $SD = 1.41$), $t(37) = 1.59$, *ns*. Only an average of 3.48% ($SD = 4.12$) of the time was spent expressing positive emotion simultaneously. There were no income differences in mutually expressed positive emotion among 24-month olds, $t(33) = .002$, *ns*, and no significant differences between dyads with 12- and 24- month olds $t(63) = 1.55$, *ns*.

Pretend play behaviors. Overall, at 12 months, infants engaged in pretend play significantly more than their parents ($M=3.54$ times per minute, $SD = 1.56$) compared to pretend play of their parents ($M=1.38$, $SD=1.75$), $t(45)=5.03$, $p < .0001$. The percent time engaging in pretend play simultaneously was much less common, occurring on average 8.5% of the time ($SD = 12.96$). Low-income dyads with 12-month olds spend

significantly less time in mutual pretend play ($M = 4.78\%$, $SD = 7.65$), compared to middle-income dyads ($M = 12.26\%$, $SD = 7.65$), $t(32) = 2.02$, $p = .05$.

At 24 months, the proportion of time that children and parents spent in pretend play was approximately equivalent ($M=2.90$, $SD = 1.07$, and $M=3.21$, $SD = 1.07$, respectively), $t(37) = 1.53$, *ns*. One-fifth of the time, 20.66% of the time ($SD = 10.72$) of the time, was spent in simultaneous pretend play. While there were not a significant income difference at 24 months, $t(36) = 1.03$, *ns*, mutual pretend play occurred for a significantly larger proportion of time for 24-month olds, as compared to 12-month olds, $t = 4.61$, $p < .0001$.

Table 21: Parent Behavior During Pretend Play, By Income Group

	12 MONTH		24 MONTH	
	Low Income <i>M (SD)</i>	Middle Income <i>M(SD)</i>	Low Income <i>M (SD)</i>	Middle- Income <i>M (SD)</i>
Looks to others' face				
Rate	9.74 (3.11)	9.85 (3.27)	6.72 (2.94)	7.06 (2.44)
Probability	0.56 (0.12)	0.58 (0.11)	0.53 (0.16)	0.53 (0.15)
Mean Duration	3.72 (1.21)	3.87 (1.42)	5.49 (2.51)	5.27 (3.33)
Positive Emotion				
Rate	2.46 (1.52)	2.42 (1.26)	2.02 (1.46)	2.51 (1.41)
Probability	0.25 (0.24)	0.15 (0.11)	0.28 (0.25)	0.19 (0.15)
Mean Duration	5.22 (4.60)	3.95 (2.38)	7.62 (7.69)	4.14 (2.53)
Pretend Play				
Rate	1.40 (1.84)	1.36 (1.70)	3.44 (1.08)	3.00 (1.05)
Probability	0.15 (0.23)	0.24 (0.31)	0.41 (0.20)	0.43 (0.21)
Mean Duration	2.78 (4.38)	4.90 (6.27)	7.98 (5.58)	9.39 (5.57)

Moderated Mediation Model

An SPSS script developed by Preacher and Hayes (2008) was used to estimate direct and indirect effects of poverty on each of the cognitive outcome measures, with parent-infant interaction quality, mutual pretend play, as a mediating variable. This method was chosen because of its strengths in working with small sample sizes. As noted in Hayes (2009), unlike other methods such as the Baron and Kenny or Sobel test methods, with bootstrapping methods, there are no assumptions made about the sampling distribution of the indirect effect; there is no need to estimate the standard

error of the indirect effect; and bootstrapping methods provide a flexible approach that works well with simple and complex models.

H5: Parent-infant dyadic interaction mediates the relationship between income status and child developmental outcomes; this relationship is expected to be moderated by income status.

Four regression analyses were performed, given separate analyses for 12- and 24-month olds, and including the dependent variables of language score and executive function score. In each analysis, the mediating variables were the parent-child interaction measures, and income was included as a moderator of the relationship between parent-child interaction and child cognitive outcome. Gender was entered as a co-variate. The models yielded insignificant results.

Chapter Five

Discussion

Overview

A brief overview of the study purpose, processes and results will be provided as an introduction to this discussion. The current study aimed to better understand the impact of poverty on child development by studying cognitive abilities early, as language and executive functioning skills are emerging, and by studying the contribution of micro-level measures of parent-child interaction to the relationship between poverty and cognitive development. Behavioral sequences indicative of dyadic reciprocity and mutuality in parent-child interaction were captured during a standardized pretend play task, an interactive context rich in positive emotion expression and complex social interaction. The results of this study are consistent with theory and other empirical research in several ways. Findings suggest that poverty may exert a negative influence on cognition earlier than previously studied, at 12- and 24-months of age, though this relationship was not as clear cut as in previous research with older children. More sensitive measures may be needed to better understand this relationship. Income also influenced the quality of interaction, again, with caveats. Sequential analysis revealed that economically disadvantaged dyads with 12-month-olds spent significantly less time in mutual pretend play than their middle-

class counterparts. There were no differences when comparing the 24-month-old income groups in time spent in mutual pretend play, and no income-based differences when viewing the data using means-level, rather than sequential analytic techniques. The notion that contingency in the structure of parent-child interaction, again as assessed through sequential analysis, plays a key role in early child development was partially supported in the current study. Patterns of contingency under study were found to be stronger, and had larger effect sizes, in dyads with older toddlers. Second, these patterns of contingency are impacted by income status, as contingencies were also stronger with larger effect sizes among middle-income as compared to low-income dyads. Importantly, the structure of the interaction influenced the amount of time dyads engaged in interaction characterized by mutual pretend play and mutual positive affect. However, analyses testing parent-child interaction as a mediator between income and child cognitive outcomes yielded non-significant results for dyads with both 12- and 24-month olds. Findings are reviewed below in more detail. Conclusions, limitations and recommendations for future research are also provided.

Review of findings

Language and Executive Function

The first hypothesis, that income status would be related to the developmental outcomes of receptive language and executive control at 12- and 24- months, was partially supported. Executive function ability trended towards a significant level in the expected direction for prediction by income status for 24-month-olds, while

scores on receptive language were predicted by income status for 12-month-old girls. The small number of males participating in the study in the low-income group may partially explain the finding that the income-based difference was limited to girls. Additionally, most 12-month-olds were unable to perform the executive function task downward adapted for infants. Nevertheless, these results lend partial support to the notion that the negative effects of poverty on cognitive abilities can be evidenced in infancy and toddlerhood.

Parent-child interaction

Parent-child interaction was measured in two ways: with commonly used means-based analyses of discrete, interdependent child and parent behaviors, and sequential interactive behaviors using time-window sequential analysis. Mean-based analyses of discrete child and parent behaviors revealed little difference in positive affect expression, looks to the social partners' face, and pretend play during interactions when comparing low- and middle-income dyads. In contrast, sequential analysis showed that individual and group differences in dyadic reciprocity and mutuality influences interaction quality, and differs by age and somewhat by income.

Generally, analyses of discrete parent and infant behaviors suggest that parents tended to spend more time attempting to engage dyadic interaction and expressing positive emotion than their infants. Parents sought more eye contact and expressed more positive emotion than children in each age group and across income groups. Though

extant research consistently reports differences in the affective quality of parent-child interaction, the current study found no income-based differences in gazes to the social partner's face or positive emotion expression from parent and child. The current study differs from most previous research on parent-infant interaction in three important ways; these differences likely explain the lack of general income-based differences in the affective content of interaction. First, the current study examined interaction during a task designed to elicit exaggerated positive affect. As such, more naturally-occurring differences in positive emotion expression may have been minimized. Second, the measure of positive emotion expression is based on behavior during a brief, 2 minute interaction. The brevity may have unintentionally created a ceiling effect, with dyads from each income group able to achieve similar levels of positivity given the short period. Finally, most research to date uses global measures or composite measures of qualitative differences in the emotional content of interaction. Such approaches are vulnerable to coder bias. In the current study, emotion expression was captured frame-by-frame; the results of the micro-level behavioral codes were compared across income groups.

Though there are few studies examining the impact of income status on pretend play, for theoretical and empirical reasons, income-based differences in pretend play were expected in the current study. Overall, at 12 months, infants spent slightly more than 1/3 of their time on average pretending, compared to 1/5 of the time parents spent

pretending. At 24-months of age, by contrast, parents and their children were spending a larger proportion of time (approximately 40% of the time for each member of the dyad) in pretend play; 20% of their time was spent in mutual pretend play, significantly more time than dyads with 12-months spent in old mutual play (less than 10% of the time). Importantly, economically disadvantaged dyads with 12-month-olds spent significantly less time engaging in mutual pretend play than middle-class dyads with 12-month-olds. Thus, in early in development, at 12-months of age, when mutual pretend play is harder to achieve, economically disadvantaged dyads experience greater difficulties achieving mutual pretend play than middle-class dyads.

Sequential analysis of patterns of interaction suggest some ways in which mothers and their infants and toddlers may be contributing to the individual and group differences found in mutual play. Four different patterns of dyadic contingency were examined using time-window sequential analysis (two second window): affective mirroring (contingency in positive emotion expression), dyadic imitation (contingency in pretend behaviors), dyadic responsivity (positive expression contingency with pretend behaviors) and social referencing (parent pretend then smile, followed by child pretend or smile). Overall, there were marked age differences, with 24-month olds being generally better able to achieve contingency during the pretend play task. In general, behavioral contingencies were found for both low- and middle-income dyads, in parent- and child-initiated behaviors; still, middle-income dyads evidenced stronger

contingencies and larger effect sizes as compared to low-income dyads. Unexpectedly, though each group of infants and toddlers expressed positive emotion contingent upon parent emotion expression, *middle-income* parents with 24-month olds did not respond to child positive emotion expression with contingent positive emotion expression. Neither low- nor middle-income dyads with 12-month-olds evidenced contingency in pretend play behaviors, whether initiated by parent or child. This provides further evidence that social pretend play is a challenge for dyads with 12-month-olds. Interestingly, low-income 24-month-olds were the only group of children who responded to parent pretend behaviors with contingent positive emotion expression. For their part, parents tended not to respond to child pretend with positive emotion expression, regardless of the child age or income of the family. The strongest contingency relationship was the contingency between parent use of social referencing behavior and subsequent child pretend or positive emotion expression among dyads with 24-month-olds. This suggests that social referencing is a particularly effective strategy for engaging infants and toddlers in interaction during pretend play. As in Nishida & Lillard (2007), these findings might also be interpreted to indicate effective scaffolding of infant understanding of pretend.

The findings in the current study suggest that dyadic contingency during pretend play is an important structural feature of interaction at 12- and 24-months of age.

Generally, dyadic contingency correlated with mutuality in positive emotion

expression and mutuality in pretend play for both low- and middle-income dyads with 12- and 24-month olds; this correlation was significantly stronger among dyads with low-income 24-month-olds, when compared to those with low-income 12-month olds. Together, with the evidence of stronger indicators of contingency strength and larger effect sizes among both dyads with older children and dyads of middle-class status, this research provides useful indicators of the ways in which parents and their infants and toddlers differ in how they structure and maintain interaction during pretend.

Direct and indirect effects of poverty

Tests of mediational model with differences in parent-child interaction underlying a relationship between income status and cognitive abilities were insignificant for dyads with 12- and 24-month olds. The relatively weak relationships between poverty and child cognitive outcomes, and lack of significant findings in the full mediation model may be explained by a number of factors. First, the small sample size due to loss of data may have prevented more significant results. Alternatively, other micro-analytic measures of parent interaction, such as joint attention, may have also been used to capture differences in dyadic interaction. Additionally, dyadic interaction during verbal exchanges, or an inclusion of content analysis of language during interaction, may contribute to our understanding of dyadic interaction at the micro- and macro-level, and better predict language and other cognitive outcomes as a result.

Limitations and recommendations for future research

Measures

One important caveat to consider is the reliance on single measures of predictor and outcome measures. Interactive behavior was measured during a single, brief (2 minute) interaction in the home using a single, standardized pretend play task; language skill was captured using a single parent-report instrument, and executive function was assessed during a single brief search and retrieve task. This over-reliance on single measures raises concerns about reliability of measurement. To create more robust, reliable measures of these variables, multiple measures could have been used. In the case of dyadic interaction, multiple, short standardized pretend play tasks could be used, and dyadic interaction scores could be average across tasks. The current study relied on nonverbal measures of dyadic interaction. Future research might also include the role of both parent and child use of language to disambiguate pretend, particularly at 24 months of age and older. Observational measures of spontaneous child speech or preferential looking tasks measuring vocabulary knowledge could have been used to complement the standardized parent-report measure.

Single measures of language that rely solely on parent report of child comprehension could also pose validity concerns. First, researchers have called attention to potential problems with the validity of language measures that rely on parent report. Social desirability bias or lack of awareness of child receptive and/or productive vocabulary

knowledge could have a significant influence on the measurement of language skill.

This concern is particularly relevant in this research, given the focus on group differences based on socioeconomic status. Low-income parents may provide more biased over-estimates of child language ability to compensate for perceived lower social status and/or may underestimate ability because of decreased awareness of developmental norms (Arriaga *et al.*, 1998; Feldman *et al.*, 2000). Observational measures to complement the parent report could address these potential concerns.

Additionally, the use of a standardized task raises concerns about external validity.

Measuring differences in pretend interactions as it occurs naturally, during free-play, may provide a better index of interaction quality as it naturally occurs. Future research might consider assessing interactions across different contexts to determine the comparative advantages of each in predicting language, executive function and, given the relationship between cognitive and emotional development, possibly socio-emotional child outcomes.

The micro-level measure of parent-child interaction focused on the structure of the interaction, specifically how parent-child dyads enter into interaction during a standardized pretend play task. Other micro-measures of relationship quality, measures based on the proportion of time spent mutually engaged in interaction, measures that focus on affective mismatch between partners, and measures of balance

in interaction initiation are other possible ways to capture relationship quality micro-analytically.

Finally, research using a combination of both micro-analytic and global indices of interaction would further distinguish the benefits and drawbacks of each method in studying income-based group differences in interaction in early development; such approach would also aid in empirically-driven decisions about coding methods and analytic strategies.

Design

In the model proposed in the current study, executive function and language are conceptualized as parallel outcomes. There may be theoretical reasons to consider alternative models, such as the contribution of language to executive function development or the contribution of executive function to language development. For instance, the symbolic representation of objects through words may facilitate and support development of attention and working memory aspects of executive function. At the same time, the attention and working memory aspects of executive function may contribute to infant ability to map word sounds onto word meanings efficiently, supporting vocabulary acquisition. There is no research to date testing the possible influences of language development on executive function in early development, and vice-versa. Future research should consider the possible influences of each of these skills both as these skills emerge and in the course of development.

While cross-sectional research is convenient for researchers, a longitudinal approach might have benefitted the present research in several ways. First, longitudinal research would clarify the relationship between interaction and cognitive development and better support a causal direction of influence between the context of poverty and the mediating role that parent–child interaction plays in the relationship between poverty and child development. Additionally, experimental research using a parent-child interaction intervention based on micro-analytic findings could provide additional insights into the relative importance of understanding and applying evidence regarding parent-child interaction quality at the micro-, rather than the macro-level.

Ages of children under study

Measurement issues related to child age are also apparent. The literature on language development suggests less reliability in measures of language for 12-month olds, relative to language measures for older toddlers. Additionally, the range of difference in language scores for 12 month olds is narrower than the range of differences in older children. A more sensitive, norm-based measure of vocabulary or other early language skill may be an improvement in future research. Individual differences in joint attention early in development are associated with individual differences in language development (Charman, Baron-Cohen, Swettenham, Baird, Cox, & Drew, 2000); thus, research that uses a standardized assessment of infant joint attention ability may prove fruitful. Alternatively, a longitudinal design that examines interaction

differences early and language development later, as early as 24 months and on, may be necessary to better understand the relationship between parent-infant interaction and early language development.

The executive function measure used was too difficult to understand for the 12-month olds. Typical response patterns suggested that despite the training, infants did not understand the task. Computer-based preferential looking paradigms with rewarding sounds and images, measuring infant ability to learn a rule and then switch to a new rule, might be better suited to measure executive function in infancy.

Income as a proxy for stress

Family stress models suggest that poverty exerts tremendous stress on families. It is the stress due to poverty, therefore, that most essentially underlies poverty's impact. Researchers have consistently found that indicators of that stress are apparent in parenting and other relationships; still, a more direct measure of emotional stress in both members of the dyad, whether it be due to financial strain or other life factors, might have operated as a more effective mediator in this study.

Conclusion

This research, despite the noted limitations, contributes to our understanding of how poverty might exert its influence in early development. This research extends prior research by examining poverty and development early, in the first two years of life, by using specific measures of cognitive development, and in its operationalization of

dyadic interaction using micro-analytic coding and sequential analysis. A more complete understanding of the dynamic processes in interaction that may be important for cognitive development is needed. Future research may apply these findings to the design and evaluation of an intervention designed to improve parent-child interaction.

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