Longitudinal relations of maternal supportiveness and child task-approach behavior to early cognitive development of children with developmental risks

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ABSTRACT

The purpose of study was to investigate the longitudinal relations among maternal supportiveness, child task-approach behavior, and cognitive development for children with developmental risks. The participants ($N = 400$) in this study were a subset of the National Early Head Start Research and Evaluation Project. The current study used structural equation modeling analyses including growth-curve models.

Findings are that maternal supportiveness was moderately stable from the time the children were 14 to 36 months of age, but stability of child task-approach behavior was weak between 14 and 24 months of age. Child task-approach behavior became stronger as children grew older. Earlier maternal supportiveness influenced later child task-approach behavior, but earlier child task-approach behavior did not influence later maternal supportiveness. Child task-approach behavior across time influenced the initial level of child cognition and the rate of cognitive development from 14 to 36 months of child age. Earlier maternal supportiveness influenced the initial level of child cognition, and later maternal supportiveness influenced the rate of cognitive development. Maternal education and age were positively related to maternal supportiveness. The initial level of child cognition and earlier child task approach behavior were related negatively to the rate of cognitive development.

This study provides evidence that mothers' supportive interactions are important in children's cognitive development, as well as their task-approach behaviors, and children's task approach behaviors influence their rate of cognitive development. These findings support providing intervention services for low-income mothers, especially those who are young or less well educated in order to enhance their interactions with their children. Also,

this study supports the potential utility of improved capabilities for the early diagnosis of developmental delays and more sensitive eligibility criteria for early intervention services.

CHAPTER 1. INTRODUCTION

Researchers have identified links between risks associated with poverty and poor developmental outcomes. These studies are important not only for their contributions to our theoretical understanding of how children facing risks develop cognitively, but also because they can guide intervention programs and lead to policy changes allowing intervention to maximize desirable developmental outcomes and prevent or minimize dysfunctional outcomes for these children (Magnuson & Duncan, 2002).

In his process model, Belsky (1984) emphasized that parenting can provide an important buffer against risk as children develop. Similarly, Lynch and Cicchetti (1998) argued that the parenting process may buffer the effects of environmental risk on children's development. The importance of parent-child interaction is increasingly recognized in practice, as well as in theory (Kelly & Barnard, 2000). As a result, many intervention programs are designed to focus on both the child and on parent-child interactions based on the assumption that this approach will have greater effects on children's developmental outcomes.

While many intervention programs target families living in poverty, researchers have not provided evidence that parenting practices in low-income families are dramatically different from those in middle class families (Magnuson & Duncan, 2002). Rather, low-income parents may be less responsive or provide less stimulating home learning environments; thus, investigation of the relations between child outcomes and parent-child interaction in low-income families is reasonable, just as it is in middle-income families. Further, parents of children with disabilities often have difficulty interacting with their children (Shonkoff, Hauser-Cram, Krauss, & Upshur, 1992). Therefore, understanding the nature of interaction between parents and children who are facing developmental risks is important (McLoyd, 1990).

Several empirical studies of cognitive development have provided evidence that family poverty is related to children's cognitive outcomes through their home environments (Linver, Brooks-Gunn, & Kohen, 2002; Whiteside-Mansell & Bradley, 1996). Further, empirical evidence of the relations between proximal environments (e.g., parent interaction) and developmental catch-up from early deprivation has been supported by the study of Romanian children adopted in the U.K. (Croft, et al., 2001; Rutter & the English & Romanian Adoptees Study Team, 1998).

On the other hand, children also take active roles in constructing their own development. Magnuson and Duncan (2002) pointed out that research on children in poverty has largely ignored the effects of child characteristics on parent-child interactions and on child outcomes. They suggested that child characteristics should be recognized as more prominent factors in research models of parent-child interaction and child outcomes in populations living in poverty. Mastery motivation is one characteristic that influences children's cognitive development. Most studies of mastery motivation among children with developmental risks have included very small samples. Therefore, relations among mastery motivation, parent-child interaction, and cognitive development are not clear.

One major methodological trend among child development researchers is the effort to understand longitudinal relations among various determinants of child development. This trend is underpinned by Bronfenbrenner's ecological perspective. According to Bronfenbrenner (1989), a child's development should be understood within the context of the relations between the child's personal characteristics and his/her social interactions across time. Sameroff and Mackenzie (2003) also emphasized research analyses of transactions in the parent-child interaction in child development.

Most previous studies of cognitive development, however, have employed regression models, which have used earlier outcomes to predict later outcomes, or pre-post designs in which differences in cognitive outcome scores between two different times are compared. Rogosa, Brand, and Zimowski (1982) pointed out that these analyses are problematic in several ways. First, regression analyses, which predict the final outcomes by controlling for the effect of initial measurements, entail violation of the random error of variance assumption, and often result in no significant findings when the variable's stability is strong. Second, comparison between scores taken at two different times provides limited information about change over time, as the relations are often not linear. Therefore, growth curve modeling is a better method to examine the relations among variables related to child development across time.

In sum, early cognitive development among children living in poverty should be understood within the context of parent-child interactions and children's characteristics, especially for children who face additional risks such as disabilities. These relations often change across time.

The purpose of this study was to test comprehensive models that capture relations among child characteristics, parent-child interactions, and child cognitive development across time. This study provides a better understanding of the early cognitive development of low-income children who have identified developmental risk conditions by examining the relations among children's task-approach behaviors and social environments. It also provides information relevant to policies regarding children in poverty and at risk and contributes knowledge to guide early intervention services.

CHAPTER 2. LITERATURE REVIEW

Many researchers have investigated relations among child characteristics, familial social environments, and child cognitive outcomes. However, few studies have examined the longitudinal relations between parent-child interaction and child outcomes, as well as child characteristics. This review of literature will discuss empirical research on child cognitive outcomes associated with parent-child interaction, child's mastery motivation, and developmental risks, as well as the theoretical backgrounds guiding this empirical research.

Theoretical Background

A large body of research on child development has found relations among familial, parental, and child characteristics. Several theoretical perspectives, such as ecological and transactional theories, as well as socialconstructivism, have guided this research.

In the ecological perspective, Bronfenbrenner (1989) emphasized the relations between developmentally relevant environments and individual developmental processes. Bronfenbrenner and Morris (1998) warned developmental psychologists and researchers against using social or demographic characteristics in isolation to determine individual behavior patterns. They proposed the bioecological model, which facilitates understanding a child's development in relation to personal and environmental characteristics of the ecological contexts through time.

Transactional theories also posit that child development is the result of dynamic interactions between characteristics of the child and his/her environment across time. The child's biological constitution affects the development of the child, as does the child's environment (Sameroff & Chandler, 1975). These mutual influences between environments and human beings on child development are called transactional relations. Parents determine the child's environment, which affects the child's development, and each individual child not only responds differently to environments but also constructs his/her own environments (Scarr, 1992). According to these transactional theorists, relations between child characteristics and parent-child interaction are transactional, and these two factors mutually influence each other in the context of child development.

Scarr (1992) argued that environmental effects on children's normal development are minimal when a rearing environment falls within the range of normal environments because parental differences in rearing styles, social class, and income have small effects on the measurable differences in intelligence, interests, and personality among their children. She emphasized the importance of providing a rearing environment that is within this normal range for children's normal development. It is likely that the effect of a supportive environment is more significant on the development of children who are facing multiple risks than those at low risk.

How, then, do environments and characteristics of children at high risk interact to affect the development of these children? This question has brought the attention of many researchers to the development of children in familial social environments (Belsky, 1984; Lynch & Cicchetti, 1998; Rutter & the English & Romanian Adoptees Study Team, 1998; Sameroff, Seifer, Baldwin. & Baldwin, 1993). Lynch and Cicchetti (1998) argued that, in risk situations, environmental factors, which are enduring and proximal, may inhibit the child's development. Significant empirical evidence of relations between enriched environments and developmental catch-up from early deprivation was shown by the study of Romanian children adopted in the U.K. (Rutter & the English & Romanian Adoptees Study Team, 1998).

Based on many empirical studies supporting the importance of social environments, Belsky (1984) proposed the process model to describe child development using parenting processes in the context of where children live. In his model, parenting behavior patterns are influenced by parental characteristics (e.g., maternal age, internal locus of control, psychological attributes such as depression, cognitive and motivational competence, and socioemotional development), social contextual factors (e.g., marital relationship, social network, work), and child characteristics (e.g., temperament, behavioral styles, premature birth, other risk factors). Over time, parenting practices buffer children against these risk factors that can influence development. Since Belsky first presented this process model, it has been used by many researchers to explain parenting behaviors and child development in familial contexts. Based on Belsky's model, van Bakel and Riksen-Walrave (2002) showed relations between familial factors and infants' cognitive outcomes. However, Belsky's process model could not explain transactional relations among these factors. Sameroff and Mackenzie (2003) pointed out current research limitations for capturing transactions in the parent-child interaction, child characteristics, and child development in social contexts.

While Belsky (1984) explained how familial and child characteristics can determine parenting processes as well as child development, traditional constructivism has been expanded to socialconstructive perspectives to include the relations between individuals and the social situations in which the individual's cognitive development occurs. Vygotsky highlighted the importance of social interaction with advanced social members in children's cognitive development and learning (Vygotsky, 1978, 1987). According to Vygotsky, adults' active, sensitive involvement with the activities that children undertake is an important influence on children's cognitive development (Seifert, 1993). Optimal development of children's cognitive capacity occurs when adult's support, or scaffolding, of children's activities help move them from the skill levels they can demonstrate independently to the higher skill levels they can demonstrate with the adults' support. This is referred to as the "zone of proximal development" (Vygotsky, 1978; Wertsch, 1984, 1985). Especially for young children, many interactions occur at home under the guidance and supervision of their parents (Rogoff, 1990). Thus, mothers who respond sensitively to their children and who are emotionally available understand and support their children's cues appropriately, or in other words provide appropriate scaffolding for their children's development. These mothers are working within their children's zone of proximal development and providing environments that optimize their children's development (Kivijärvi, et al., 2001). When mothers sensitively support their infant's development, they provide scaffolding through their interactions (Bringen & Robinson, 1991). Parent-child interaction is associated with many parent and child characteristics. The parent and child bring their own characteristics to their social interaction context individually as well as collectively, and these characteristics influence the cognitive development process (Fagot & Gauvain, 1997).

In sum, theoretical perspectives support the importance of both parent-child interaction and child characteristics in child cognitive development. These perspectives have guided research in child development to focus on understanding child development within social contexts. Ecological perspectives emphasize the effects of personal and environmental characteristics on child development; transactional theories explain transactional relations among these variables (e.g., child's personal and environmental characteristics and development); and socialconstructivism highlights the importance of social interaction in children's cognitive development. Belsky proposed that especially for children in poverty and those facing other risks, familial social environments may buffer the effects of risk factors on normal development.

Cognitive Development

A variety of instruments has been used to measure cognition in child development research. The Bayley Mental Development Index (MDI; Bayley, 1993) has been used commonly as a measure of cognitive development for infants and young children through three years of age (Black & Berenson-Howard, 2000; Halpern, Carcia Coll, Meyer, & Bendersky, 2001; Hooper, Burchinal, Roberts, Zeisel, & Neebe, 1998; Murrary, Fiori-Cowley, & Cooper, 1996; Wijnroks, 1998). The Stanford-Binet Intelligence Scale (Bacharach & Baumeister, 1998; Cohen & Parmelee, 1983; Krishnakumar & Black, 2002) and the McCarthy Scales of Children's Abilities (Croft, et al., 2001) have been used to measure the cognitive skills of children older than three years. Ayoun (1998) and Tzuriel and Weiss (1998) have measured specific cognitive skills such as search for hidden objects, learning of a contingency rule, or cognitive modifiability.

Researchers have made many attempts to explain children's cognitive development using a variety of predictors. Parent-child interactions (Ayoun, 1998; Cohen & Parmelee, 1983; Croft, et al., 2001; Halpern, et al., 2001; Hopper, et al., 1998; Poehlmann & Fiese, 2001; Tzurie & Weiss, 1988; Wijnroks, 1998), quality of the home environment (Bacharach & Baumeister, 1998; Hopper, et al., 1998; Krishnakumar and Black, 2002; Murray, et al., 1996), child characteristics (Bacharach & Baumeister, 1998; Black & Berenson-Howard, 2000; Cohen & Parmelee, 1983; Halpern, et al., 2001; Murray, et al., 1996; Poehlmann & Fiese, 2001; Tzurie & Weiss, 1988; Wijnroks, 1998), and familial risk factors (Bacharach & Baumeister, 1998; Cohen & Parmelee, 1983; Hopper, et al., 1998; Krishnakumar & Black, 2002; Murray, et al., 1996; Poehlmann & Fiese, 2001) have all been used to predict child cognitive development. In later sections of this literature review, parent-child interactions, child characteristics, and familial factors will each be discussed in more detail.

Studies of children's cognitive development can be divided into those that have investigated children's concurrent cognition and those that have predicted later cognition. In studies of concurrent cognition, Hooper et al. (1998) investigated the relations between cognition and a familial risk factor index, and other researchers have examined the relations between specific indicators of child cognition and parent-child interaction (Ayoun, 1998; Tzurie & Weiss, 1998). Further, van Bakel and Riksen-Walraven (2002) used a comprehensive model to test the relations among parental, contextual, and child characteristics to explain parent-child interactions and infant cognition.

Hooper and her colleagues (Hooper, et al., 1998) examined a cumulative risk model to predict infants' cognition. In this study, distal factors (e.g., SES, maternal education, stressful life events, etc.) and proximal factors (e.g., parent-child interaction, quality of home environment, quality of childcare environment, etc.) were combined into one cumulative risk index based on Sameroff's (Sameroff, Seifer, Baldwin, & Baldwin, 1993; Sameroff, Seifer, Barocas, Zax, & Greenspan, 1987) risk model. Results indicated that the cumulative risk index was not associated with child cognitive development. It may be that this study failed to find any significant relations between the cumulative familial factors and children's cognition because proximal and distal factors affect child cognition in different ways.

Unlike Hooper et al. (1998), other studies have found relations between parent-child interaction and child cognition. Ayoun (1998), and Tzurie and Weiss (1998) have examined the relations between specific indicators of cognition and distal and/or proximal factors.

Ayoun focused on the effects of maternal responsiveness on infants' cognition. She observed mother-infant dyads, and used tasks of search for hidden objects (which is similar to Piagetian A-not-B error task) and learning of a contingency rule (which tests the infant's ability to detect a relation between moving a lever and some reinforcement) to measure infants' cognition. Ayoun found that infants who succeeded in both tasks had mothers who were more responsive and talked more about information related to their infants' activities, which stimulates infants' learning.

Whereas Ayoun (1998) investigated the effects of maternal responsiveness on infant's cognition, Tzurie and Weiss (1998) included child personality and the mother's attitudes toward her child in their investigation of the effects of mother-child interactions on children's concurrent cognition. These researchers used cognitive modifiability to measure children's cognition in the second grade and mother-child interaction with mediated learning experience (MLE) in play situations. They found that the MLE explained the child's cognitive modifiability even though participants were older children and their mothers. This study showed that none of the distal factors influenced children's cognitive modifiability directly; but they affected it indirectly through mother-child interactions, which means that mother-child interaction is a critical influence on child cognition.

While Ayoun (1998) and Tzurie and Weiss (1998) have investigated relations between specific parent-child interaction and children's specific cognition, van Bakel and Riksen-Walrave (2002) used Belsky's process model of the determinants of parenting to explain infant's general cognition using familial variables. Participants were healthy 15-month-old infants and their primary caregivers in Holland. In their model, parental characteristics (personality, parental attachment security, parental intelligence, and education), contextual characteristics (marital support and satisfaction, social network), child characteristics (temperament), and quality of parenting were included. One of their findings was that infants' cognition was related directly to parental intelligence and quality of parental interaction.

Findings from these studies of children's concurrent cognition have provided strong evidence for the relations between parent-child interaction and child cognition (Ayoun, 1998; Tzurie & Weiss, 1998; van Bakel & Riksen-Walrave, 2002). An exception is the study of Hooper et al. (1998), which used parental interaction as one factor in a cumulative risk index. Most researchers, however, have been interested in examining what kinds of factors may predict children's later cognition. Several researchers (Black & Berenson-Howard, 2000; Murray, Fiori-Cowley, & Cooper, 1996; and Poehlmann & Fiese, 2001) have investigated a variety of factors, including earlier maternal sociodemographic variables, child characteristics, and parent-child interaction, as predictors of later child cognition.

Murray and colleagues (Murray, et al., 1996) investigated the contribution of maternal depression and personal and social adversity to the quality of mother-infant face-to-face interactions observed at two months, and in turn, the influences of those interactions on the quality of infants' attachment to their mothers and to infants' cognition at 18 months. Murrary et al. found that earlier maternal interaction was a strong predictor of children's cognition, and other maternal risk variables were related to maternal interaction but not to children's cognition.

Like Murrary et al. (1996), Poehlmann and Fiese (2001) predicted children's later cognition using early parent-child interaction. However, Poehlmann and Fiese used neonatal risk, maternal risk, and parent-child interaction at six months to predict children's cognition at 12 months. Results indicated that quality of early parent-infant interaction mediated the relation between neonatal risk and children's later cognition and that maternal sociodemographic index (not married, less than high school education, and minority status) was not a significant predictor. Both of these studies predicting children's later cognition (Murrary et al., 1996; Poehlmann & Fiese, 2001) have found that earlier parent-child interaction was related strongly to children's later cognition.

Rather than predicting children's later cognition with earlier familial and children's characteristics, Black and Berenson-Howard (2000) examined changing patterns of cognitive development in a sample of healthy infants and toddlers from low-income families. These researchers divided participants into two groups - infant and toddler based on a cut-off age of 12 months - and compared cognition between these two groups. They found that infants' and toddlers' scores were significantly different on cognition. Infants' performances were higher than those in the norm sample, and toddlers' performances were lower. Black and Berenson-Howard argued that toddlers in low-income families had less exposure to developmentally stimulating environments as they grew older; therefore, they may be delayed in cognitive development as compared to infants. However, Black and Berenson-Howard employed a cross-sectional design, rather than a longitudinal design, which has limitations for describing the developmental changes or cognitive differences over time.

Other researchers have investigated child cognition using the same samples across different time points (e.g., Cohen & Parmelee, 1983; Croft, et al., 2001; Halpern, et al., 2001; Krishnakumar & Black, 2002; Wijnroks, 1998) in efforts to understand developmental changes in children's cognition. Cohen and Parmelee (1983) found that cognition at age five was predicted by infant's early visual attention and by a combination of developmental assessments (e.g., Gesell's Developmental Schedules for maturation level of the infant, the Bayley MDI, Casati-Lezine Cognitive Development for sensory motor development, and receptive language development). Maternal education was related to child cognition at 24 months and five years, but infant neonatal risks did not predict cognition at age five years or at any of the earlier age periods.

Halpern et al. (2001) examined the relations among infant temperament, mothers' interaction behaviors, and infants' cognition at 12 and 18 months of age. In this study, rather than predicting later cognition with earlier maternal interaction and other variables, Halpern et al. analyzed separate models at each age. Infants were divided into two groups: small-for-gestational-age (SGA) and appropriate-for-gestational-age (AGA), and their cognition and temperament were assessed at eight months, as were their mother-infant interactions. They found no significant group differences in infants' cognition at 12 and 18 months of age, but mother-infant interaction variables predicted cognition at 12 and 18 months differentially for infants with different types of temperament, as well as for the groups of SGA and AGA infants.

Cohen and Parmelee (1983) and Halpern et al. (2001) have found significant relations between the quality of maternal interaction and children's cognition during both infancy and early childhood. However, findings regarding the relations among child characteristics, mother-child interaction, and cognition are not consistent from one study to the next. Cohen and Parmelee did not find any significant relation between the child risk factors (e.g., gestational age, birth weight, and length of hospitalization) and cognition, but Halpern et al. found that child characteristics moderated relations between the quality of mother-child interaction and children's cognition, and these relations were different for children of different ages. These findings illustrate the need for further study of the relations among child cognition, maternal interaction, and child characteristics, including child risk factors.

Cohen and Parmelee (1983) and Halpern et al. (2001) conducted separate analyses to examine predictors of cognition at different time points rather than examining how the relations between these variables might differ across time within the same model. Even though Cohen and Parmelee examined earlier cognition as a predictor of later cognition, they used different measures of cognition at different ages, which limits the ability to explain changes in the relations between child cognition and other variables across time.

Croft et al. (2001) investigated changes in the quality of parent-child interaction and cognitive development across time using a sample of children adopted into the U.K. following severe earlier privation, and a comparison sample of nondeprived U.K. adoptees. They measured child cognition using the Global Cognitive Index, McCarthy Scales of Children's Abilities (McCarthy, 1972) at ages four and six. Their longitudinal analyses revealed that the increase in positive parent and child interaction was greater for children with initially lower scores of cognition and who exhibited cognitive catch-up. This research shows the importance of a high quality environment for promoting the cognitive development of children at risk, and that parent-child interaction changes with child's cognition across time.

Whereas Croft et al. (2001) examined differences in cognition between an earlier and later time point, Krishnakumar and Black (2002) and Wijnroks (1998) have tried to examine whether the relations between cognition and other predictors would be different across time in the same models using autoregressive regression analyses. Krishnakumar and Black (2002) investigated the influence of proximal risk factors (maternal depression and the quality of the home environment) on cognition (Standford-Binet scores) at ages five and six. Their study included 217 mother and child dyads from low-income African American families. Their path analyses indicated that the quality of the home environment buffered the association between maternal alcohol use and child cognition. However, they failed to find any relations between proximal risk factors and child cognition at age six. The researchers' explanation was that the results were due to the high stability of child competence.

Wijnroks (1998) investigated the relations among maternal interactive behaviors, cognitive development, and attention in preterm infants. Like Krishnakumar and Black (2002), Wijnroks' path analysis that included maternal involvement and infant responsiveness at 6, 9, and 12 months and infant cognition at 6, 12, and 24 months, showed that cognition at 12 months and maternal involvement at six months directly predicted cognitive outcome at 24 months. Infant responsiveness at six months and 12 months was indirectly related to cognition at 24 months through cognition at 12 months. However, they found that cognition was quite stable across time. Neither earlier maternal interaction, except at six months, nor earlier child responsiveness influenced later child cognition directly.

Wijnroks (1998) and Krishnakumar and Black (2002) used regression models, which included earlier cognition to predict later cognition in their longitudinal studies of cognitive development. These regression analyses are known as auto-regressive models, which predict the final outcomes while controlling for the effects of initial measurements. This method often yields no significant findings when stability among variables is strong, as it violates the random error variance assumption. Croft et al. (2001) examined differences in scores of cognition between two different times, which fails to provide information about change over time (Rogosa, Brand, & Zimowski, 1982). Therefore, more comprehensive analysis models, such as growth curve models, are necessary to examine how influencing factors are related to cognitive development using scores of cognition at more than two points of time.

Previous researchers have provided strong evidence that parent-child interaction is related to children's concurrent cognitive outcome, and may be related to their later cognition as well. Some studies have conducted separate analyses to examine predictors of cognition at different time points and have found that relations between predictors and cognition are different at each time point, which does not explain later cognition or patterns of cognitive development (Cohen & Parmelee, 1983; Halpern, et al, 2001). Other studies have used autoregressive models to examine earlier cognition as a predictor of later cognition, however the ability to capture longitudinal relations with this method is limited (Wijnroks, 1998; Krishnakumar & Black, 2002).

In addition, some researchers have investigated relations among parent-child interaction, children's cognition, child characteristics, and familial characteristics, but their findings have not been consistent (e.g., Poehlman & Fiese, 2001; Halpern et al, 2001). These relations between parent-child interaction, child characteristics, and cognition will be discussed in the next sections in detail.

Parent-Child Interaction

Many developmental theorists have emphasized parent-child interaction as one of the most influential socioenvironmental factors in child development. Based on this notion, many researchers have provided strong empirical evidence of relations between parent-child interaction and children's cognitive outcomes and have investigated the associations of parent-child interaction and many other factors: child characteristics (e.g., neonatal risk factors, temperament, gender, etc.) and parental characteristics (e.g., social support, marital support, depression, education, socioeconomic status, marital status, parental attachment, etc.). This section will focus on how parent-child interaction behaviors have been measured, and the relations between parent-child interactions and factors other than child cognition.

Researchers have used a variety of instruments to measure parent-child interaction, depending on their research purposes and the ages of participating children. For example, Tzurie and Weiss (1998) investigated the effects of mother-child interactions on children's cognitive modifiability, and they assessed mother-child interactions for evidence of mediated learning experiences (MLE) such as intentionality, reciprocity, transcendence, meaning, feelings of competence, and regulation of behavior in free-play and structured play situations. Parent, Gosselin, and Moss (2000) assessed responsibility sharing in mother-child joint planning with four- to seven-year-olds to examine the relation between quality of mother-child attachment and level of familial adversity. Murray and colleagues (Murray, Fiori-Cowley, & Cooper, 1996) observed mother-infant face-to-face interactions to investigate the contributions of maternal familial adversity to the mother-infant interaction at two months, and then, the effect of this interaction on infants' cognition at 18 months.

Most studies of parent-child interaction have used various multi-dimensional measures to capture parent-child interaction. Among these multiple dimensions of parent-child interaction behavior, some researchers have measured level of activity (Wijnroks, 1998), visual contact, social and play behavior (Kivijärvi, et al., 2001), play quality, verbal behavior, and reciprocal play behavior (Halpern, et al., 2001). However, in many studies, parent interactive behavior has been measured with involvement, sensitive responsiveness (Kivijärvi, et al., 2001; NICHD ECCRN, 1999; Owens, et al., 1998; Wijnroks, 1998), positive aspects (Croft, et al., 2000; Kivijärvi, et al., 2001; NICHD ECCRN, 1999), and non-intrusiveness (NICHD ECCRN, 1999; Wijnroks, 1998).

Though parent-child interaction measures vary, parent-child interaction behavior is commonly measured via observation of structured- or free-play situations (e.g., Croft, et al., 2001; Halpern, et al., 2001; Kivijärvi, et al., 2001; Owens, et al., 1998; Pauli-Pott, Mertesacker, Bade, Bauer, & Beckmann, 2000; Wijnroks, 1998). These researchers have tried to capture multidimensional aspects of parent-child interaction behaviors. In contrast, some researchers have used summative scores of parent-child interaction measures. For example, Poehlmann and Fiese (2001) examined the relations among infants' neonatal and sociodemographic risks, their cognitive development, and the quality of parent-infant interaction. The quality of parent-infant interaction was observed using the Pediatric Infant Parent Exam (Fiese, et al., 2001) and scores of interactional reciprocity and positive affect during parent-child interaction were summed. Owens et al. (1998) measured several maternal behaviors (look, vocalize, touch, hold, or none of these behaviors) and infant behaviors (look, vocalize, touch, fuss/cry, or none of these behaviors). They scored these behaviors as appropriate, insufficient, or intrusive during each three-second interval observed and calculated summative scores of maternal responsiveness. Pauli-Pott et al. (2000) rated the promptness and adequacy of mother's responses to infant cues during home visits by using a 1-minute time-sampling technique and used the total frequencies of mothers' responses in their analyses.

Unlike the three studies mentioned above (Owens, et al., 1998; Pauli-Pott, et al., 2000; Poehlmann & Fiese, 2001), other researchers have selected dimensions of maternal interaction based on their statistically significant bivariate correlations with cognition and then have used each dimension separately in further analyses (Wijnroks, 1998; Halpern, et al., 2001; Croft, et al., 2001). For example, Wijnroks (1998) measured several dimensions of maternal interactive behaviors (e.g., involvement, sensitive responsiveness, non-intrusiveness, and level of activity as mothers' behaviors), as well as child interactive behavior, and then used maternal involvement for path analyses. Halpern et al. (2001) observed maternal play quality, maternal verbal behavior, and reciprocal play behavior for maternal interaction and investigated the relations among maternal play quality, reciprocal play behavior, infant temperament, and cognition. Croft et al. (2001) analyzed relations between children's cognition and mothers' positivity, one of their four subscales of parent-child interaction: negativity and positivity of child behavior and of parent behavior.

Researchers have faced methodological difficulties when analyzing these multidimensional parent-child interactions due to multicollinearity problems. Thus, some researchers have used summative scores of multiple dimensions while others have analyzed only selected dimensions that were statistically significant in preliminary analyses. Both of these methodological approaches ignore measurement error variances of parent-child interaction measures and the multidimensional aspects of parent-child interaction behavior.

Several researchers have found direct relations between maternal interaction and child cognition (Ayoun, 1998; Cohen & Parmelee, 1983; Croft, et al., 2001; Krishnakumar & Black, 2002; Murrary, et al., 1996; Poehlmann & Fiese, 2001; Tzurie & Weiss, 1998; van Bakel & Riksen-Walrave, 2002; Wijnroks, 1998, etc.). However, Magill-Evans and Harrson (2001) included both parents' interactions, perceptions of parenting stress, spousal relationship, and infant characteristics (e.g., preterm and gender) in their analyses but did not find that any parental social interaction variables predicted child cognition. In this study, the nonsignificance of specific parents' social environmental variables may be due to multicollinearity among these variables (e.g., paternal and maternal interaction, parenting stress, etc.).

Researchers have investigated the relations between parent-child interaction and child characteristics (Crockenberg, 1987; Croft, et al., 2000; Halpern, et al., 2001; Owens, et al., 1998; Pauli-Pott, Mertesacker, Bade, Bauer, & Beckmann, 2000; Poehlmann & Fiese, 2001; van Bakel & Riksen-Walrave, 2002, etc.). Most of these studies have assessed how child temperament influences parental interaction behavior (Pauli-Pott et al., 2000: Owens et al., 1998; van Bakel & Riksen-Walrave, 2002). Poehlmann and Fiese (2001) examined relations among neonatal risk factors, maternal interaction, and child cognition. Further, Halpern et al. (2001) investigated the relations between infant temperament and mothers' interaction behaviors in predicting child cognition by neonatal risk group and non-risk group.

Among studies of the relations between children's temperament and parental interaction, Crockenberg (1987) assessed adolescent mothers and their two year-old children to investigate influences of maternal prior experiences, social support, and infant irritability on maternal interaction behavior with their children and found that the maternal interaction behavior predicted the infant irritability. Unlike the findings of Crockenberg (1987), van Bakel and Riksen-Walrave (2002) tested whether child temperament influenced directly to the quality of parental interaction in their study examining the relations among parental and child characteristics, parent-child interaction, and child cognition. They found the statistically significant path from the child temperament to the quality of parental interaction. In longitudinal examination of the relations between child temperament and parental interaction, the NICHD Early Child Care Research Network (1999) also found that child temperament is a predictor of later parent-child interaction.

Unlike the findings noted above (NICHD ECCRN, 1999), Crockenberg and McCluskey (1986) found that children's earlier irritability did not influence later maternal interaction behavior, nor did the early maternal interaction behavior predict later maternal interaction behavior. Owens et al. (1998) did not find longitudinal relations between child irritability and maternal responsiveness at 12 and 18 months (e.g., cross-lagged effects). They found statistically significant correlations between irritability and responsiveness, and these relations were negative at concurrent time points. The magnitude of the relations between infant irritability and maternal responsiveness were different at 12 months and at 18 months. While both maternal responsiveness and infant irritability were quite stable across time, maternal responsiveness was more stable than infant irritability. There were no gender differences in infant irritability or in maternal responsiveness.

Investigating the longitudinal relations between maternal interaction and infant temperament, Pettie and Bates (1984) found stability for both mother interaction behavior and for infant temperament. The scores of maternal interaction were more stable than those of child temperament, which is consistent with the findings of Owens et al. (1998).

In sum, previous researchers (Crockenberg, 1987; Owens, et al., 1998; van Bakel & Riksen-Walrave, 2002) have found concurrent relations between child characteristics (e.g., emotionality, irritability, temperament) and maternal interaction even though these researchers have used different child characteristic variables. Next, in longitudinal research, two studies (Pettie & Bates, 1984; Owen, et al., 1998) have found stability in parental interaction and in child temperament, but Crockenberg and McCluskey (1986) did not find stability in parental interaction. Crockenberg and McCluskey argued that this result might be because they used different measures at each time (e.g., maternal responsiveness at three months and maternal sensitivity at 12 months). Findings regarding transactional relations between child characteristics and maternal interactive behavior across time are not consistent. For example, Crockenberg and McCluskey (1986) and the NICHD Early Child Care Research Network (1999) have shown relations between early child irritability and later parental interaction, but Owens, et al. (1998) did not find any transactional relations between these two variables.

Whereas the studies described above (Owens, et al., 1998; van Bakel & Riksen-Walrave, 2002) have investigated child temperament, Croft et al. (2001) and Poehlmann and Fiese (2001) have examined the relations among infants' risks, their cognitive development, sociodemographic risks, and parent-infant interaction. Croft et al. found that early developmental delay was associated with more negative and less positive parent-child interaction.

Poehlmann and Fiese (2001) examined the relations among infants' neonatal and sociodemographic risks, their cognitive development, and parent-infant interaction quality in order to identify mediating and moderating effects among these variables. One of their findings was that quality of early parent-infant interaction might mediate the relations between neonatal risk and infants' later cognition, and moderator effects of neonatal risk were not found in the relations between parent-child interaction and infants' later cognition.

However, Halpern et al. (2001) found that child temperament moderated the relations between maternal interaction and child cognition at 12 months but not at 18 months. They found that child temperament and maternal interaction predicted child cognition differentially between the birth-risk groups (small-for-gestational-age (SGA) vs. appropriate-for-gestational-age (AGA) infants). In their study, the SGA infants' temperament (e.g., emotional tone or attention) moderated the relations between infant cognition at 12 months of age, reciprocal play, and mothers' play quality. Within the AGA group, temperament and mothers' play behaviors demonstrated direct effects on infants' cognitive development. Halpern et al. showed that child characteristics (e.g., a birth risk factor, attention, and emotional tone) also influenced relations between parent-child interaction and child outcome differently across time.

Researchers have found concurrent relations between child characteristics and parent-child interaction. However, relations between children's risk factors, parental interaction, and child cognition could not be defined because findings have been inconsistent. For example, one study supported the notion that children's risk is an antecedent in relations between parental interaction and child cognition (Poehlmann & Fiese, 2001), but another study identified it as a moderator (Halpern, et al., 2001).

Researchers have examined variables besides child characteristics to explain parent-child interaction. The NICHD Early Child Care Research Network (1999) investigated relations among maternal sensitivity and child positive engagement during mother-child interaction at 6, 15, and 36 months; child characteristics; and familial social and demographic variables, as well as child care variables. This research found relations among family income, maternal education, child temperament, child gender, marital status, maternal depression, and maternal separation anxiety. Even though the purpose of this study was to determine relations between child care experience and maternal interaction while controlling for these child and familial variables, these child and family variables explained more variance in maternal interaction than did child care variables.

Parent and her colleagues (Parent, Gosselin, & Moss, 2000) examined whether the quality of mother-child attachment and level of familial adversity were related to differences in mother-child joint planning in 4-to 7-year-olds, and one of their findings is a familial adversity main effect on observed patterns of responsibility sharing for global planning. Those from the high adversity group were less likely to use these strategies. This study included father absence, low parent education, low family income, overcrowding, and maternal depression as family adversity. Parent et al. (2000) and NICHD Early Child Care Research Network (1999) have found relations between family characteristics and maternal interaction.

Pauli-Pott, Mertesacker, Bade, Bauer, and Beckmann (2000) examined the relations among maternal reactivity/sensitivity, infant's negative emotionality, caregiver's depression, and marital support. Using hierarchical regression analyses, they found that child emotionality was not a statistically significant predictor of maternal reactivity/sensitivity. While the overall model was not statistically significant, there was an interaction effect between child's negative emotionality and caregiver depression on caregiver reactivity/sensitivity. This result may have been due to the fact that negative and positive emotionality were highly correlated in their analyses.

Several researchers have found that familial risk factors were related negatively to parental interaction. Family income, maternal education, marital status, maternal depression, and maternal separation anxiety were used as family risk factors.

Overall, observations during play sessions have been used to measure parent-child interaction most frequently. While researchers have measured multiple dimensions of parent-child interactions, muticollinearity problems have caused methodological difficulties when researchers have analyzed these variables. Thus, for further analyses, some researchers have used summative scores of subscales, while others have analyzed only selected dimensions that were statistically significant in preliminary analyses. Therefore, new methodological approaches (e.g., Structural Equation Model) are necessary when analyzing multiple dimensions of parent-child interaction to account for measurement error variances and consider multidimensional aspects of parent-child interaction.

Dimensions of parent interactive behavior commonly measured include involvement, sensitive responsiveness (Kivijärvi, et al., 2001; NICHD ECCRN, 1999; Owens, et al., 1998; Wijnroks, 1998), positive aspects (Croft, et al., 2000; Kivijärvi, et al., 2001; NICHD ECCRN, 1999), and non-intrusiveness (NICHD ECCRN, 1999; Wijnroks, 1998). However, the dimensions of parent interactive behavior measured vary across studies.

According to these previous studies of relations among child characteristics (e.g., developmental delay, neonatal risk, temperament, emotionality, etc.), parent-child interaction, and child cognition, parent-child interaction is directly related to child cognition. However, effects of child characteristics on the parent-child interaction and child cognition are controversial. Most researchers have found statistically significant concurrent relations between child characteristics and maternal interaction even though these researchers have examined different child characteristic variables. Some longitudinal studies indicate stability in parental interaction and in child temperament, but findings of stability in parental interaction and transactional relations between child characteristics and parental interactive behavior across time are not consistent. For example, the study of Crockenberg and McCluskey (1986) did not find stability for parental interaction, but Owens et al. (1998)

found stability. The NICHD Early Child Care Research Network (1999) found relations between early child irritability and later parental interaction, but Owens, et al. (1998) did not find any transactional relations between these two variables.

Even though effects of child characteristics (e.g., developmental risk and neonatal birth risks) in relations between parent-child interaction and cognition are inconclusive, previous researchers (Halpern, et al., 2001; Poehlmann & Fiese, 2001) have shown that child characteristics may be related to parent-child interaction and child cognition, as well as family adversity (NICHD ECCRN, 1999; Parent, et al., 2000).

Mastery Motivation

Parent-child interaction influences children's development, but children are also active agents in constructing their own development (Bronfenbrenner, 1989; Overton, 1997). Many child characteristics (e.g., emotionality, interactive behavior, mastery motivation, temperament, etc.) are related to cognitive development. Among these child characteristics, mastery motivation is defined as a psychological force that originates and leads children to attempt to master tasks for the intrinsic feeling of efficacy without extrinsic rewards (Morgan, MacTurk, & Hrneir, 1995). Wachs and Combs (1995) defined two domains of mastery motivation: object mastery orientation and social mastery orientation. According to Wachs and Combs, object mastery orientation refers to children's orientation toward and attempts to master objects. Social mastery orientation refers to children's orientation toward the social environment and attempts to influence and obtain reactions from people (Wachs & Combs, 1995). They found that object and social mastery motivation were moderately stable between short-term intervals and different testing situations, but there was not a relation between object and social mastery motivation with toddlers. This result indicates that object and social mastery motivation seem to be different constructs. The next section of this literature review is focused on children's object mastery motivations.

Researchers have used a variety of measures to capture object mastery motivations. For example, Niccols and colleagues (Niccols, Atkinson, & Pepler, 2003) used the structured mastery tasks developed by Morgan et al. (1993) to score object-oriented persistence. Jennings, Yarrow, and Martin (1984) developed measures of mastery motivation that consist of three dimensions: producing effects, practicing skills, and persistence at solving difficult problems at 1 year of age, and curiosity, task orientation, and persistence at difficult tasks at three and half years of age. Messer et al. (1986) included visual attention, peripheral exploration, general exploration, task-directed behavior, goal-directed behavior, and success as mastery motivation in their study. Turner and Johnson (2003) measured child mastery motivation with three items (preference for challenge, persistence in the face of difficulty, and positive affect in response to learning) as rated by children's parents and teachers. Kelley et al. (2000) used children's persistence with and physical and verbal avoidance of tasks to measure mastery motivation. Maslin-Cole, Bretherton, and Morgan (1993) assessed mastery motivation with task persistence, task mastery pleasure, goal directedness, and attention span. Vlachou and Farrell (2000) measured dimensions of object mastery motivation: task pleasure, task persistence, success, and off-task behavior.

These studies have used various multi-dimensional measures to assess mastery motivation, which makes it difficult to generalize relations between mastery motivation and other variables. However, Morgan et al. (1993) found, in their review of studies, that most mastery motivation has been focused on persistent, task-directed behaviors that could lead to the mastery of a task. These researchers have tried to capture task-approach behavior, such as persistence, attention, preference, and pleasure during children's working with tasks. Results of these previous studies of mastery motivation indicate a need to further explore measures of mastery motivation.

Since mastery motivation is defined as a psychological force leading the child to master tasks, efforts to determine relations between children's mastery motivation and their cognition have guided many studies of mastery motivation (e.g., Jennings, et al., 1984; Messer, et al., 1986; Niccols, et al., 2003). Niccols et al. (2003) investigated concurrent relations between mastery motivation and cognition, and Messer et al. (1986) examined relations between earlier mastery motivation and later cognition. Jennings et al. (1984) tried to investigate concurrent and longitudinal relations between mastery motivation and cognition.

Niccols et al. (2003) investigated relations between mastery motivation and cognition with preschoolers who had Down's syndrome ($N = 41$). They found positive correlations between cognitive and adaptive competence and mastery motivation (mastery task persistence) and no statistically significant differences in mastery motivation by socioeconomic status or by child gender. The mastery motivation scores of children with Down's syndrome were low compared to those of children in the norm group.

Jennings et al. (1984) investigated relations between mastery motivation and cognition when children ($N = 35$) were in infancy and three and half years old in order to find whether these relations differ across time. They found moderate correlations between overall mastery motivation and cognition in infancy ($r = .68$), and the relation between task orientation and cognition became weaker in early childhood (for boys, $r = .45$; for girls, $r = .37$). Jennings et al. argued that motivation was not largely differentiated from cognition in infancy, but that considerable differentiation occurred when children were more than three years old. They also found that relations between earlier mastery motivation and later cognition were not consistent across different dimensions of mastery motivation and gender. However, for girls, practicing skill, a dimension of mastery motivation at age one, was related to cognition at age three.

Like Jennings et al. (1984), Messer et al. (1986) attempted to predict later cognition with earlier mastery motivation. Messer et al. measured children's cognition with the Bayley MDI and Psychomotor Development Index (PDI) at 6 and 12 months and the McCarthy Scale of Children's Abilities (MSCA; McCarthy, 1972) at 30 months of age, as well as their mastery motivation behavior at 6 and 12 months. Results showed that cognitive competence in infancy (e.g., Bayley's MDI scores) was not correlated with cognitive competence at 30 months, whereas mastery motivation in infancy (e.g., time spent investigating toys at six months and persistence in solving tasks at 12 months) was related to cognition at 30 months. This study found negative relations between children's cognition at 30 months and task-directed behavior at 6 months but did not find the same relations between child's cognition at 30 months and task-directed behavior at 12 months. This study indicated that relations between child's mastery behavior and later cognition might change at different ages.

Even though Niccols et al. (2003) investigated relations between mastery motivation and cognition with children who have disabilities, Niccols et al. and Jennings et al. (1984) have found concurrent positive relations between mastery motivation and cognition. Further, these relations might change as children get older (Jennings, et al., 1984; Messer, et al., 1986). However, findings of relations between earlier mastery motivation behavior and later cognition from two studies (Jennings et al., 1984; Messer et al., 1986) are not consistent.

Jennings et al. found a positive relation between mastery motivation (practicing skill) in infancy and general cognition at age three for girls, whereas Messer et al. found negative relations between children's mastery motivation (task-orientation behavior) at six months and their cognition at 30 months for both girls and boys but did not find relations between motivation (task-orientation behavior) at 12 months and cognition at 30 months for either boys or girls. These findings show that there may be longitudinal relations between mastery motivation and cognition, and that these relations may be different across time. Thus, there is need for more investigation of these longitudinal relations. On the other hand, these studies (Jennings et al., 1984; Messer et al., 1986) have measured different dimensions of the mastery motivation with different tasks and have used different measures of cognition at earlier and later time points. These researchers have conducted bivariate correlational analyses between multi-dimensions of mastery motivation and cognition with relatively small samples. Therefore, it is possible that different measurements between two different ages, rather than changes in longitudinal relations, might influence these results.

One important element in the early development of mastery is social interaction (Heckhausen, 1992). Baker and Baker (1987) pointed out the importance of parental sensitivity for the maturation of emotional regulation, motivation, and self-esteem. Some research has supported social influences on mastery motivation (e.g., Kelley, Brownell, & Campbell, 2000; Maslin-Cole, Bretherton, & Morgan, 1993; Turner & Johnson, 2003).

Turner and Johnson (2003) investigated relations among parent characteristics, parent beliefs, parent-child relations, children's mastery motivation, and academic gains of preschoolers. They recruited four-year-old African American children at risk and their parents (N = 169) and measured children's mastery motivation as rated by their parents and teachers. They also measured children's academic gains with pre-and post-test with the Kaufman Survey of Early Academic and Language Skills (K-SEALS; Kaufman & Kaufman, 1993). Their major findings were positive relations between parent-child relations and children's mastery motivation, as well as between children's mastery motivation and children's achievement.

Kelley et al. (2000) and Maslin-Cole et al. (1993) have investigated longitudinal relations of mastery motivation with parental interaction and cognition, whereas Turner and Johnson (2003) tested several hypothesized models with the concurrent variables. Kelley et al. (2000) examined relations between maternal behavior during the second year of children's life and children's mastery motivation and expressions of self-evaluative affect a year later. They measured maternal controlling behavior and evaluative feedback during teaching tasks as maternal behavior, children's persistence with and physical and verbal avoidance of tasks as mastery motivation, and children's pride and shame as self-evaluative affect. Findings were that maternal negative and positive behavior at 24 months predicted children's shame and mastery motivation at 36 months.

Maslin-Cole, Bretherton, and Morgan (1993) reported relations similar to those found by Kelley et al. (2000) between maternal interaction and mastery motivation. Maslin-Cole et al. conducted a longitudinal study predicting toddlers' mastery motivation, Bayley MDI, and free-play competence. This study recruited 41 toddlers and their mothers and used repeated measures at two points (18 and 25 months of age) to assess stability of mastery motivation and prediction of child mastery motivation and cognitive competence over time using several measures of children's early social environment (e.g., mother-child attachment security, scaffolding effectiveness, martial relations, family adaptability and cohesion, and child temperament). Results showed evidence of stability for measures of the mastery motivation. These researchers found that the maternal scaffolding effectiveness was a more consistent predictor of children's mastery motivation and cognitive competence than attachment security; as well, it predicted children's later motivation and cognitive competence.

Three studies have investigated relations between parental behavior and children's mastery motivation. Turner and Johnson (2003) found concurrent relations between parent-child relations and children's mastery motivation and cognitive competence. Further, Kelley et al. (2000) and Maslin-Cole et al. (1993) have found longitudinal relations between earlier parental interactive behavior and children's later mastery motivation. Previous studies have shown that parental interactive behavior emerged as a strong predictor of children's mastery motivation and cognition in infancy as well as later in children's lives.

Other researchers have focused on children's mastery motivation in samples of children with disabilities (e.g., Hauser-Cram, 1996; Niccols, et al., 2003; Vlachou & Farrell, 2000) or facing risk factors (e.g., Turner & Johnson, 2003). Hauser-Cram (1996) found that there were not statistically significant differences in mastery motivation between toddlers with motor impairment ($n = 25$), developmental delay ($n = 25$), and typical development ($n = 25$) when matched for mental age.

Unlike Hauser-Cram (1996), Vlachou and Farrell (2000) compared the level of object mastery motivation between children with Down's syndrome ($n = 4$) and children without disabilities ($n = 4$) matched for mental ages. Results showed there were no statistically significant differences in task pleasure and persistence between children with Down's syndrome and those without disabilities, but, in regard to success and off-task item of mastery dimension, there were differences between these two groups depending on different tasks.

Two studies mentioned above (Hauser-Cram, 1996; Vlachou & Farrell, 2000) have compared mastery motivation between children with and without disabilities after matching their mental ages. Other researchers have restricted their participants by controlling for possible compounding variables related to children's disability status or risk factors. Niccols, et al. (2003), and Turner and Johnson (2003) have investigated mastery motivation only with a sample of children with disabilities or children facing risk factors. Even though Niccols et al. used only children with disabilities in their study, they argued that the scores of mastery motivation of children with Down syndrome were lower than those of children in the norm group.

Results of studies that examined the mastery motivation of children with disabilities (Hauser-Cram, 1996; Vlachou & Farrell, 2000) were not consistent. These studies have been conducted with relatively small samples to compare with typically developing children. These previous studies have indicated that research on mastery motivation with larger samples is needed.

In sum, moderate stability in mastery motivation has been found (Maslin-Cole, et al., 1993). There are concurrent relations between children's mastery motivation and cognition (Jennings, et al., 1984; Niccols, et al., 2003; Turner & Johnson, 2003). However, findings regarding whether early mastery motivation enhances the development of later cognition are contradictory. Jennings et al. (1984) found a positive relation between infant mastery motivation and cognition at age three for girls even though one dimension of the mastery motivation scale was used, whereas Messer et al. (1986) found a negative relation between early mastery motivation and children's later cognition. Previous studies have indicated that longitudinal relations between mastery motivation and cognition may change as children get older (Jennings, et al., 1984; Messer, et al., 1986).

Maternal interaction influences children's mastery motivation (Kelley, et al., 2000; Maslin-Cole, et al., 1993; Turner & Johnson, 2003). Researchers have found concurrent relations between maternal interaction and children's mastery motivation, as well as relations between early parental behavior and children's later mastery motivation (Kelley, et al., 2000; Maslin-Cole, et al., 1993).

A large part of the research on children's mastery motivation has focused on samples of children with disabilities (e.g., Hauser-Cram, 1996; Niccols, et al., 2003; Vlachou & Farrell, 2000) or risk factors (e.g., Turner & Johnson, 2003). Some researchers have found differences in relations between mastery motivation and cognition between children with and without disabilities (Niccols, et al., 2003; Vlachou & Farrell, 2000), but others have not found difference in these relations (Hauser-Cram, 1996). Even though their findings are not consistent and have used relatively small samples, children's risk factors, including disability status, may moderate relations between mastery motivation and cognition.

Most previous studies on mastery motivation have investigated concurrent and longitudinal relations among parental behavior, mastery motivation, and cognition by examining different dimensions of mastery motivation at different times and with small sample sizes. Longitudinal investigations with larger samples may help to generalize these relations between parental behavior, child mastery motivation, and cognition across time.

According to transactional theorists, children are active agents in creating their social environments. This notion prompts a question: how does children's mastery motivation influence parent-child interaction behavior? There is lack of empirical studies investigating whether children's mastery motivation influences parent-child interaction behavior.

Developmental Risks

Another child characteristic that could affect development is the risks they face. The effects of risk factors on child cognitive development have been examined frequently. In some studies, researchers have constrained infant risk factors in efforts to consider their effects on child outcomes. For example, Benasich and Brooks-Gunn (1996) examined the effects of maternal knowledge of child development on the home environment and on cognitive outcomes for preterm children who were low-birth-weight.

Other studies have investigated directly the effects of child risk factors on child cognition (e.g., Halpern, et al., 2001; Molfese, et al., 1996; Poehlmann & Fiese, 2001). For example, Molfese et al. (1996) used perinatal risk, family SES, home environment, and child's mental ability at 12 months to predict children's outcomes. In this study, perinatal risk was based on the Siegel Risk Index. Perinatal risks included gravidity, maternal smoking, number of abortions, Apgar scores, hyperbilirubinaemia, gestational age, gender, and birth-weight. Molfese et al. found that among perinatal risk factors only gestational age predicted child intelligence at three and four years. However, in their discriminate analyses, a perinatal index predicted child outcomes across different ages.

Some researchers have investigated not only whether there are statistically significant relations between neonatal risks and cognition, but also how these risks are related to cognition. Poehlmann and Fiese (2001) examined the relations among infant's neonatal risks, parent-infant interaction, and child cognitive development in order to identify mediating and moderating variables. In their study, infants' neonatal risks included infants' birth-weight (more than 500g and less than 2500 g), Apgar score (less than 7), hospitalization (more than 1 week and less than one month), intubation (more than 1 week and less than one month), and presence of respiratory complications as neonatal risk factors. One of their findings showed that the neonatal risk was an antecedent variable in the relation between quality of early parent-infant interaction and later infant cognitive development.

Halpern et al. (2001) found that infants' temperament and a specific risk factor (SGA vs. AGA) showed moderating effects on the relations between mothers' interaction and infants' cognition at 12 months. For the SGA infants, temperament moderated the relations between reciprocal play, mothers' play quality, and infant cognition. The infants of SGA who were higher in negative emotionality and did not experience mothers' reciprocal play at eight months of age showed poorer 12-month cognitive development. However, for the AGA group, temperament and mothers' interaction related directly to infants' cognition.

Landry, Smith, Miller-Loncar, and Swank (1997) investigated relations between parent interaction and child developmental outcomes by comparing biological risk groups. Their participants were infants of full-term and very low birth weight (VLBW; less than 1600g) groups; the VLBW group was divided into medically low and high-risk subgroups. High-risk infants were diagnosed with at least one severe medical complication, such as bronchopulomanr dysplasia (BPD), severe intraventricular hemorrhage (IVH), or periventricular leukomalacia (PVL). Landry et al. found that infants who had parents who were sensitive and did not control nor restrict improved more in child outcomes than did those of parents who were not sensitive, or were controlling or restrictive. This relation was stronger for the high-risk children than for the other two groups.

Whereas Halpern et al. (2001), Landry et al. (1997), Molfese et al. (1996), and Poehlmann and Fiese (2001) have examined the relations between infant's birth risk factors and child outcomes, Hauser-Cram, Warfield, Shonkoff, and Krauss (2001) investigated the relation between children's disabilities and their developmental outcomes. Their participants were children who had Down's syndrome, motor impairment, or other developmental delay; predictors of child outcomes were type of disability, mastery motivation, behavior problems, maternal interaction, interaction of disability and mastery motivation, social support, and problem-focused coping. Results were that children's type of disability predicted trajectories of cognitive development.

Shonkoff and colleagues (Shonkoff, Hauser-Cram, Krauss, & Upshur, 1992) also investigated interactions between mothers and infants with disabilities and found that these mothers of children with disabilities had greater difficulty in reading the children's signals and in facilitating their learning. However, there was a statistically significant relation between improvement in mother-child interactive behavior and increasing developmental gains for children.

Researchers investigating effects of child risk factors, including disability status, on child cognition have shown that children's risk factors were related to their cognition, and that these relations were mediated by parent-child interaction. It is also possible that child risk factors moderate the relation between parental interaction and developmental outcomes (e.g., Halpern, et al., 2001; Hauser-Cram, et al., 2001). Therefore, it is necessary to consider children's developmental risk factors, including their disability status, in future research investigating relations between parent-child interaction and cognition.

Summary

In an effort to understand child cognitive development, researchers have investigated the relations between child development and contextual factors. These researchers were influenced by ecological, transactional, and social constructive theories. Social constructivism highlights the importance of social interaction in children's cognitive development; ecological perspectives emphasize the effects of personal and environmental characteristics on child development over time; and transactional theories explain transactional relations among these personal and environmental characteristics and children's development across time. These theories suggest that research on child cognitive development needs to investigate transactional relations among social interaction and children's characteristics longitudinally.

According to previous research on child cognitive development, parent-child interaction and child characteristics are related to child cognition. Most studies investigating relations between parent-child interaction and child cognition have found direct relations between maternal interaction and child cognitive development (Ayoun, 1998; Cohen & Parmelee, 1983; Croft, et al., 2001; Krishnakumar & Black, 2002; Murray, et al., 1996; Poehlmann & Fiese, 2001; Tzurie & Weiss, 1998; van Bakel & Riksen-Walrave, 2002; Wijnroks, 1998, etc.). The exception are the studies of Hooper et al. (1998) and Magill-Evans, and Harrson (2001), which have not found that parental interaction predicted children's cognition. These latter findings may be a result of using a cumulative risk variable or multicollinearity among several social environmental variables.

Among studies on relations between parental interaction and child characteristics (Crockenberg, 1987; Croft, et al., 2000; Halpern, et al., 2001; Owens, et al., 1998; Pauli-Pott, Mertesacker, Bade, Bauer, & Beckmann, 2000; Poehlmann & Fiese, 2001; van Bakel & Riksen-Walrave, 2002, etc.), some studies have investigated relations between child temperament and parental interaction (Crockenberg, 1987; Owens, et al., 1998; van Bakel & Riksen-Walrave, 2002) and have found concurrent relations between child characteristics (e.g., emotionality, irritability, temperament) and maternal interaction. In longitudinal research, stability in parental interaction is not consistent. Some studies (Pettie & Bates, 1984; Owens, et al., 1998) have found stability in parental interaction and in child temperament, but Crockenberg and McCluskey (1986) did not find stability in parental interaction across time. Findings of transactional relations between child characteristics and maternal interactive behavior across time are not consistent. For example, the NICHD Early Child Care Research Network (1999) found relations between early child irritability and later parental interaction, but Owens et al. (1998) did not find any transactional relations between these two variables. Longitudinal relations among theses child characteristics and parental interaction variables are not consistent (stabilities and transactional relations). Like Owens et al., Crockenberg and McCluskey (1986) did not find a relation between child temperament and later maternal interaction.

Among child characteristics related to cognitive development, mastery motivation refers to a psychological force that leads children to attempt to master tasks (Morgan, et al., 1995). Consistent with previous research on children's mastery motivation, moderate stabilities in mastery motivation across time have been found (Maslin-Cole, et al., 1993). There are statistically significant concurrent relations between children's mastery motivation and cognition (Jennings, et al., 1984; Niccols, et al., 2003; Turner & Johnson, 2003). However, findings about whether early mastery motivation enhances the development of later cognition are contradictory. Jennings et al. (1984) found that the positive relation between infants' mastery motivation and cognition at three years old held only for girls even though it was one dimension of the mastery motivation scale, whereas Messer et al. (1986) found that early mastery motivation was negatively related to children's later cognition. Previous studies have indicated that longitudinal relations between mastery motivation and cognition may change when children get older (Jennings, et al., 1984; Messer, et al., 1986).

Maternal interaction influences children's mastery motivation (Kelley, et al., 2000; Maslin-Cole, et al., 1993; Turner & Johnson, 2003). Previous studies have found concurrent relations between maternal interaction and children's mastery motivation, and between early parental behavior and children's later mastery motivation (Kelley, et al., 2000; Maslin-Cole, et al., 1993).

On the other hand, according to transactional theories, children are also active agents in creating their social environments. This notion prompts the question of how children's mastery motivation influences parent-child interaction behavior. However, there is lack of empirical studies investigating whether children's mastery motivation influences parent-child interaction behavior, even though there are a couple of studies investigating transactional relations between children's temperament and their cognition.

Most previous studies examining longitudinal relations among parental behavior, mastery motivation, and cognition have used different dimensions of mastery motivation at different time points and small sample sizes. Longitudinal investigations with larger samples may help to generalize these relations between parental behavior, child mastery motivation, and cognition across time.

Studies investigating effects of child risk factors, including status of disability, on child cognition have shown that children's risk factors are related to their cognition. Results have shown that these relations were mediated by parent-child interaction (Poehlmann & Fiese, 2001). There is also a possible moderating effect of child risk factors on the relation between parental interaction and developmental outcomes (e.g., Halpern, et al., 2001; Hauser-Cram, et al., 2001). Even though effects of child risk factors (e.g., developmental risk and neonatal birth risks) on the relations between parent-child interaction and cognition are inconclusive, previous research (Halpern, et al., 2001; Poehlmann & Fiese, 2001) has shown that child characteristics may be related to parent-child interaction and child cognition (NICHD ECCRN, 1999; Parent, et al., 2000).

A large part of the research on children's mastery motivation has focused on samples of children with disabilities (e.g., Hauser-Cram, 1996; Niccols, et al., 2003; Vlachou & Farrell, 2000) or risk factors (e.g., Turner & Johnson, 2003). Some studies have found that there are differences in relations between mastery motivation and cognition between children with and without disabilities (Niccols, et al., 2003; Vlachou & Farrell, 2000), but others have not found difference in these relations (Hauser-Cram, 1996). Even though the findings are not consistent and have used relatively small samples, children's risk factors, including disability status, may moderate relations between mastery motivation and cognition. Therefore, it is necessary to consider children's developmental risk factors, including their disability status, in future research investigating relations among parent-child interaction, children's mastery motivation, and cognition.

Previous studies investigating relations between familial risk factors and maternal interaction have found that family risk factors related negatively to parental interaction. For family risk factors, researchers have used family income, maternal education, marital status, maternal depression, and maternal separation anxiety (NICHD ECCRN, 1999; Parent, et al., 2000; Pauli-Pott, et al., 2000).

From a methodological perspective, most previous longitudinal studies of cognitive development have examined regression models, which used earlier outcomes to predict later outcomes, or differences in cognitive outcome scores between two different times. These regression analyses are known as auto-regressive models, which predict the final outcomes while controlling for the effects of initial/earlier measurements. Since this entails violation of the random error variance assumption, these analyses often yield no statistically significant findings among variables when stability among variables is strong. Comparing means at two different points in time does not provide enough information about change over time. Therefore, growth curve models are necessary to examine how a variety of factors are related to cognitive development over more than two points of time.

Parent-child interaction behavior is commonly measured via observation during structured- or free-play situations in research on parent-child interaction (e.g., Croft, et al., 2001; Halpern, et al., 2001; Kivijärvi, et al., 2001; Owens, et al., 1998; Pauli-Pott, et al., 2000; Wijnroks, 1998). These studies have tried to capture multidimensional aspects of parent-child interaction behavior and have measured involvement, sensitive responsiveness (Kivijärvi, et al., 2001; NICHD ECCRN, 1999; Owens, et al., 1998; Wijnroks, 1998), positive aspects (Croft, et al., 2000; Kivijärvi, et al., 2001; NICHD ECCRN, 1999), and non-intrusiveness (NICHD ECCRN, 1999; Wijnroks, 1998). When researchers analyzed these multidimensional parent-child interactions, however, they faced methodological difficulties due to muticollinearity problems. Thus, for further analyses, some researchers have used summative scores of multiple dimensions (Owens, et al., 1998; Pauli-Pott, et al., 2000), while others have analyzed only selective dimensions, which were statistically significant in preliminary analyses (Croft, et al., 2001; Halpern, et al., 2001; Kivijärvi, et al., 2001; Wijnroks, 1998). Both of these methodological approaches ignore measurement error variances of parent-child interaction measures and the multidimensional aspects of parent-child behavior. Therefore, methodological considerations (e.g., Structural Equation Modeling) are necessary when analyzing multiple dimensions of parent-child interaction to account for measurement error variances and consider multidimensional aspects of parent-child interaction.

Conceptual Model

The current study was undertaken with a sample of low-income children who had indicators of developmental risk to investigate relations among children's task-approach behaviors and mother-child interactions at three different time; an initial level of children's cognition; and the rate of change in children's cognition. The conceptual model for this study is presented in Figure 1. To test this model, the following hypotheses were be addressed:

1. Maternal supportiveness during mother-child interaction and children's task-approach behaviors will be stable across three different points of time.
2. There will be cross-lagged effects of maternal supportiveness during mother-child interaction on children' task-approach behaviors.
3. There will be cross-lagged effects of children's task-approach behaviors on maternal supportiveness during mother-child interaction.
4. Maternal supportiveness during mother-child interaction and children's task-approach behaviors at 14 months will be related to children's initial levels of cognition.

5. Maternal supportiveness during mother-child interaction and children's task-approach behaviors at 36 months will be related to the rate of change in children's cognition.
6. Maternal supportiveness during mother-child interaction at 14 and 24 months will be related to the rate of change in children's cognition.
7. Children's task-approach behaviors at 14 and 24 months will be related to the rate of change in children's cognition.
8. Familial and maternal variables (family income, maternal education, age, and marital status with biological father of the target child) will be related to maternal supportiveness during mother-child interaction and children's task-approach behaviors at 14 months.

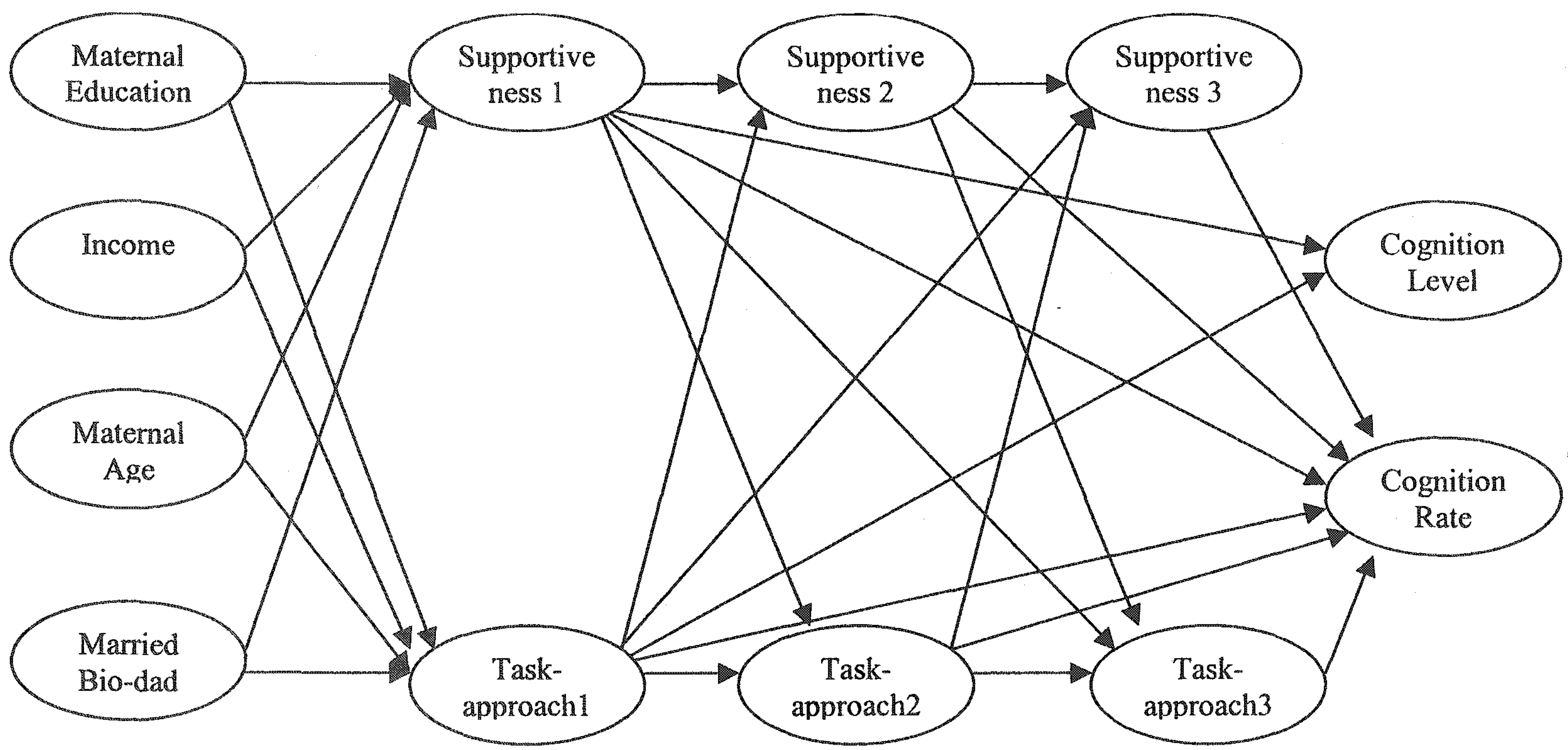

Figure 1. The conceptual model.

CHAPTER 3. METHODS

This study is embedded within a longitudinal study that investigated the impact of the Early Head Start program. Early Head Start is a two-generation program designed to provide a wide range of services to low-income pregnant women and families with infants and toddlers up to age three (Administration for Children and Families, 1999; 2003). The programs provide a range of services including home visiting, case management, child development, parenting education, child care, health care and referrals, and family support to enhance child and family development (Administration for Children and Families, 1999; 2003).

The Early Head Start Evaluation Research and Project was designed to examine the effectiveness of Early Head Start on infants and toddlers and their families and investigate what kinds of programs and services can be effective for children and families with different characteristics. Families (N = 3,001) from 17 sites were recruited into this project when their infants were less than 12 months between July 1996 and September 1998; they were randomly assigned to the Early Head Start program group or to a control group that did not receive Early Head Start services, although they were free to get any other services available in their communities (Administration for Children and Families, 2003). Before enrollment in this research project, families completed the Head Start Family Information System (HSFIS) application and enrollment forms, which were used to document demographic information, as well as eligibility for a variety of social services including Early Head Start services. Parent interviews and child assessments were conducted with all families when the target children were around 14, 24, and 36 months olds. Families provided information regarding the variety of services they received by completing Parent Services Follow-up Interviews

(PSIs) at 7, 16, 28 and 36 months on average after enrollment into the research project. The PSI facilitated collection of information related to the use of Early Head Start services, as well as other services that families received, participation in education, welfare receipt, working status, and family and child health. Among these children and families, about 35% completed all planned assessments at all three scheduled time points when the children were 14, 24, and 36 months of age (Administration for Children and Families 2002).

Participants

Across program and control group status, 1,234 children were identified as having developmental risks at one or more data collection points (e.g., before project enrollment, at 7, 16, 28 and 36 months after enrollment). These children included those identified by their parents as receiving (n = 99) or likely eligible for Part C services (n = 187) during one or more of the parent interviews, as well as children who had suspected developmental delays (n = 948) based on information gathered via parent interviews or direct child assessments at any of the scheduled data collection points after enrolling the EHS study. Part C services are an intervention program for families of infants and toddlers who have disabilities or developmental needs and are designed to enhance these children's development.

In multivariate analyses, when variables in a covariance matrix are based on different numbers of cases, it is possible that some of the values may be mathematically out of range (Kline, 1998). Then, it is problematic to conduct tests of structural equation models. Listwise deletion, which means that cases with missing observations on any variable are excluded in analyses, was employed to facilitate structural equation modeling analyses.

Among the 1,234 children with developmental risks in the EHS sample, 794 had mothers who served as consistent respondents across all data collection points. But only 400 of these mother and child dyads (50%) completed all child assessments and parent interviews across all three time points included in this study. These 400 children, the sample for the current study, include children who were identified by their parents as receiving (n = 30) or likely eligible for Part C services (n = 61), as well as children who had suspected developmental delays (n = 309).

Demographic description of the mothers included in the current study (N = 400) is presented in Table 1. The majority of mothers (75%) spoke English as their primary language, and another 21% of the mothers spoke Spanish as their primary language. The majority of mothers were Caucasian (40%), African American (28%), or Hispanic (26%). Mothers' ages ranged from 14 to 47 years; 37% of mothers were under 20 years old, and 4% were over 35 years old when their children were born. Demographic information regarding maternal education, marital status, employment, and income was collected at the time these families enrolled in the larger project. More than half the mothers in this sample (58%) were single, and 50% had not completed high school. Average gross annual income was $9,102.68. Approximately half of the children in the sample (48 %) were girls.

According to the attrition analyses, there were not statistically significant differences between the children and mothers who included in the current study (n = 400) and those who were not included (n = 394) in level of children's disability ($\chi^2(2) = 2.11, p = .35$) or maternal marital status with biological father of the target children ($\chi^2(1) = 1.21, p = .27$). Among maternal characteristics and children's variables, t-tests were conducted with continuous variables to compare those included in the current study and those not included. Results are presented at Table 2. There were statistically significant differences in ratings of children's task-approach behaviors at 14 months between the groups. Children included in

Table 1

Demographic Characteristics for Mothers (N = 400)

Characteristics	*N*	%	*M (SD)*	Range
Age (year) [a]			23.14 (5.98)	14-46
14-15	9	2.3		
16-20	137	34.3		
21-25	126	31.5		
26-30	74	18.5		
31-35	38	9.5		
36-40	10	2.5		
40+	6	1.5		
Ethnicity [c]				
Caucasian	160	40.0		
African-American	113	28.3		
Hispanic	104	26.0		
Others	14	3.5		
Marital status [d]				
Married with biological father of the target child	150	37.5		

(table continues)

Note. [a] Maternal age at birth of the child

[b] Maternal education from PSI at 16 months. Missing values were imputed based on the data from other timepoints

[c] Total number and percentage values don't equal 400 and 100, respectively, due to non-responses

[d] Marital status at 14 months of child age

[e] Mean incomes for all timepoints after imputation based on regression estimations at each timepoint.

Table 1 (continued)

Characteristics	*n*	%	*M (SD)*	Range
Education[b]				
<6th grade	13	3.3		
6th-8th grade	52	13.0		
9th grade	29	7.3		
10th grade	41	10.3		
11th grade	50	12.5		
High school/GED	136	34.0		
Some college	33	8.3		
Associate degree in college	36	9.0		
Bachelor's degree	7	1.8		
Post-college	3	0.8		
Employment [c]				
Full-time	102	25.5		
Part-time	46	11.5		
Unemployed	87	21.8		
Homemaker	104	26.0		
In school/training	83	20.8		
Annual income ($) [e]			13,280 (6,938)	1,400-43,090
0-2,999	18	4.5		
3,000-5,999	35	8.8		
6,000-11,999	143	35.8		
12,000-17,999	105	26.3		
18,000-23,999	72	18.0		
24,000-29,999	19	4.8		
30,000+	8	2.0		

this study were more likely to score ratings of high task-approach behavior than were children in the attrition group. The mothers participating in this study had completed fewer years of education than had those excluded at the time they completed the Parent Service Interview at six months.

Table 2

Group Differences for Maternal Characteristics and Children's Task-approach Behaviors and Cognition at 14 Months between the Study Group [a] (n = 400) and Non-study Group (n = 394)

	Study	Non-study	
Variables	*M* (*SD*)	*M* (*SD*)	*t(df)*
Mother			
Education (year) [b]	10.72 (2.89)	11.14 (2.71)	2.09 (792)*
Income ($) [b]	9,416.06 (7,241.26)	9,063.83 (7,319.70)	-.40 (276)
Age at birth (year)	23.14 (5.98)	23.69 (6.16)	1.22 (730)
Mother-child interaction			
Sensitivity	4.29 (1.29)	4.12 (1.35)	-1.66 (685)
Cognitive stimulation	3.45 (1.22)	3.38 (1.23)	-0.68 (685)
Positive regard	3.62 (1.18)	3.61 (1.18)	-0.12 (685)
Child			
Task-approach behavior	3.64 (.99)	1.73 (3.42)	-10.51 (452)***
MDI	94.85 (5.73)	94.14 (6.52)	-1.46 (655)

Note. [a] Study group refers to the children and mothers included in this study, and non-study groups refers those not included due to missing data.

[b] Variables from the Parent Service Interview at 6 months.

* $p < .05$ *** $p < .001$.

Data Collection Procedures

Before recruitment, a parent survey was employed to gather information about program eligibility, assistance or welfare participation, family SES, employment status, child-birth risks, etc. Sample recruitment began in 1996 and was completed in 1998 (Administration for Children and Families 2002). Participating families were interviewed (PSIs) about their use of a wide range of services at approximately 7, 16, and 28 months after enrollment, as well as when they exited the program. During parent interviews, data related to children's development and family functioning were collected in person or via telephone. Data were collected by interviewing the parents, assessing the children, and videotaping parent-child interaction sessions. All of the parent interviews were conducted in the families' homes, when the children were 14, 24, and 36 months olds. To minimize biases, the interviewers and assessors collected data without knowing which families were in the program or the control group.

Measures

The current study used measures of mother-child interaction and children's task-approach behaviors beginning when the children were a little more than one year old which is generally the time that children begin to express themselves verbally and understand more complex language. As children begin to use language more effectively at two to three years of age, their interactions with their mothers become more reciprocal. During these early years of life, one of the primary developmental areas to emerge is the self-system, which reflects children's mastery motivation (Brownell & Kopp, 1991; Dweck & Leggett, 1988; Piaget, 1952).

During mother-child interactions, three indicators of maternal supportiveness were measured; these were behaviors observed during mother-child play sessions. The Bayley Scales of Infant Development II (Bayley, 1993) was used as a measure of children's cognition. The Behavior Ranting Scale (BRS, Bayley, 1993) was used as a measure of children's task-approach behaviors; six indicators (later combined into 3 indicators) from the BRS were used in this study. In addition, maternal demographic characteristics were included as control variables (see Table 3).

Mother-child Interaction

The quality of mother-child interaction was coded by observers watching videotaped sessions during which mothers played with their infants during 10 minutes of a semi-structured free play tasks at their home. The mother and child were given three bags of toys appropriate for each age point (e.g., a book ("Good Dog Carl"), stove/pots, and ark/animals at 14 months; a book ("The Very Hungry Caterpillar"), stove/pots, and ark/animals at 24 months; a book ("The Very Hungry Caterpillar") cash register/groceries, and Duplo blocks at 36 months). They were asked to play with the toys in the sequence described above, but were not given time limits for any of the specific toys. The interactions were coded using observation scales adapted from the NICHD Study of Early Child Care's Three Box Coding Scales (NICHD Early Child Care Research Network, 1997; 1999), which includes nine 7-point scales (e.g., 1 "Very Low Sensitivity" to "Very High Sensitivity"). This coding scheme consists of the Scales for Parent Behaviors and Scales for Child Behaviors. Six dimensions of parent behaviors were coded: (1) parental sensitivity, (2) intrusiveness, (3) parental stimulation of cognitive development, (4) parental positive regard, (5) parental negative regard, and (6) parental detachment. Three dimensions of child behavior were coded: (1) child engagement of parent, (2) sustained attention with objects, and (3) negativity toward the parent.

In this study, three of the mothers' interaction behaviors -- sensitivity, stimulation of cognitive development, and positive regard -- were used as the measures of mothers'

Table 3

List of Variable Names and Labels at Tables and Figures

Variable name	Variable label
Maternal characteristics	
Maternal education at 14 months	Edu
Average gross family income across 4 time	Inc
Maternal age at birth of the target child	Age
Maternal marital status with biological father of child at 14 months	Mar
Maternal supportiveness during interaction [a]	Sup
Maternal sensitivity at 14 months	Sens1
Maternal stimulation at 14 months	Stim1
Maternal positive regard at 24 months	Pos1
Maternal sensitivity at 24 months	Sens2
Maternal stimulation at 24 months	Stim2
Maternal positive regard at 36 months	Pos2
Maternal Sensitivity at 36 months	Sens3
Maternal stimulation at 36 months	Stim3
Maternal positive regard at 36 months	Pos3
Child task-approach behavior [a]	C-Task
Activity level /Hypersensitivity at 14 months	Act1
Adaptation to change/Cooperation at 14 months	Adap1
Attention to task/Persistence at 14 months	Atten1
Activity level /Hypersensitivity level at 24 months	Act2
Adaptation to change/Cooperation at 24 months	Adap2
Attention to task/Persistence at 24 months	Atten2
Activity level /Hypersensitivity at 36 months	Act3
Adaptation to change/Cooperation at 36 months	Adap3
Attention to task/Persistence at 36 months	Atten3
Child cognition	
Level of cognition [a]	Cog-Level
Rate of change in cognition [a]	Cog-Rate
Raw scores of Bayley's Mental Scale at 14 months	Bayley 1
Raw scores of Bayley's Mental Scale at 24 months	Bayley 2
Raw scores of Bayley's Mental Scale at 36 months	Bayley 3

Note. [a] Latent constructs

supportiveness during mother-child interactions. Operational definitions for each rating point on these scale of maternal supportiveness are presented in Appendix B. Maternal sensitivity refers to how the mother observes and responds to the child's cues (gestures, expressions, and signals) and the mother's awareness of her child's needs, moods, interests and capabilities (e.g., changing the pace when the child appears under-stimulated or tired) during mother-child interaction. High ratings on Sensitivity indicate that the mother's behavior is child-centered. Maternal stimulation of cognitive development refers to the degree to which the mother provides effortful teaching to enhance perceptual, cognitive, and linguistic development, and whether the mother stimulates cognitive development based on the child's developmental level and tries to bring the child above that level (e.g., presenting activities in an organized sequence of steps and elaborating on the pictures and actions in the book). Maternal positive regard measures the degree of the mother's expression of love, respect, and admiration for the child during mother-child interaction (e.g., speaking in a warm tone of voice).

A six-member coding team was trained by a team leader to establish and maintain inter-rater reliability (Administration for Children and Families, 1999; 2003). Inter-rater agreement rates among coders using these nine scales were established to a criterion of agreement within one point on 85 percent of the items before coding began. The team conducted intermittent inter-rater reliability checks on a randomly selected 15 percent of each coder's weekly videotape assignment. A total of 8.5 percent of tapes served as reliability tapes, and interrater agreement on these tapes averaged 93 percent (Range = 84 - 100) across all reliability checks for all coders (Administration for Children and Families, 1999; 2003).

These trained observers coded the videotapes while blind to the research status of the mother-child dyads.

Normality of scores for these three measures of mother's supportiveness behaviors was examined. Skewness of sensitivity, stimulation of cognitive development, and positive regard were -0.23, 0.20, and 0.11 at 14 months; -0.50, 0.06, and 0.08 at 24 months; and -0.22, 0.16, and 0.08 at 36 months, respectively. Kurtosis of sensitivity, stimulation of cognitive development, and positive regard were -0.68, -0.31, and -0.25 at 14 months; -0.18, -0.40, and -0.64 at 24 months; and -0.72, -0.40, and -0.55 at 36 months, respectively. Both skewness and kurtosis for these indicators of maternal supportiveness were within good ranges (range of skewness within $\pm$ 2 and range of kurtosis within $\pm$ 7 are considered acceptable), which indicates that the assumption of normal distribution is met for each of these indicators. Internal consistency for each of these indicators was checked by calculating Cronbach's alpha coefficients. Results showed good internal consistency for these three indicators of maternal supportiveness with coefficients of .83, .83, and .84 at 14, 24, and 36 months of child age, respectively.

Child Task-approach Behavior

Children's mastery motivation is usually measured using structural tasks or free play situations (Barrett, Morgan, & Maslin-Cole, 1993; MacTurk, Morgan, & Jennings, 1995). However, in this study, 13 items from the Orientation and Engagement Subscale and the Emotional Regulation Subscale of the Behavior Rating Scale (BRS), which is a part of the Bayley Scales of Infant Development (BSID-II, Bayley, 1993), were used to measure the children's sensitivity, adaptation and attention toward the tasks, as well as, persistence, cooperation, and activity level during test taking. Each item of the BRS is scored on a 5-point

Likert-type scale ranging from 1 "Constantly off task" to 5 "Constantly attends" on the basis of the degree of presence or absence of the behavior. The assessors who administered the BSID-II scored this Behavior Rating Scale based on their interactions with the child during administration of the BSID-II.

First, all 13 items of the BRS were examined for internal consistency. They were submitted to factor analyses, which resulted in a two-factor solution. However, the results showed poor model fit indices, and the items did not show distinctive factors. All items from the Orientation/Engagement Subscale and the Negative affect item from the Emotional Regulation Subscale were eliminated due to small squared multiple correlations (e.g., less than .4 which indicates less than 40% of variance of the total items is explained by the latent factor) and low factor loadings, as well as conceptual considerations that indicated some items were very different than the other items used. Finally, six items (Hypersensitivity, Activity level, Adaptation to change, Cooperation, Attention to task, and Persistence) were submitted to additional factor analyses across each time point. This resulted in a single-super factor solution. Factor loadings for the six items at 14, 24, and 36 months are presented in Table 4. Internal consistency reliabilities for these six items were .86 ($R^2 = .36 - .56$), .90 ($R^2 = .46 - .71$), and .90 ($R^2 = .48 - .68$) at 14, 24 and 36 months of child age, respectively.

For simplicity of models and enhancing variability of variables, three composite indicators at each data point were created using these six items. Composite indicators were created because a minimum of three indicators per latent variable is recommended due to model underidentification (Kline, 1998). The first indicator included Hypersensitivity and Activity level; the second indicator included Adaptation to change and Cooperation; and the third indicator included Attention to Task and Persistence. Skewness of Activity level/

Table 4

Factor Loadings of Emotional Regulation items with Oblimin Rotation at 14, 24, and 36 Months of Children's Age *(N = 400)*

	14 months	24 months	36 months
Hypersensitivity	.76	.80	.83
Adaptation to change	.68	.76	.75
Attention to task	.82	.88	.86
Persistence	.76	.83	.82
Cooperation	.84	.89	.88
Activity level	.82	.80	.80
Total variance explained (%)	60.85	68.39	67.35

Hypersensitivity, Adaptation to change/Cooperation, Attention to task/Persistence were -0.60, -0.51, and -0.80 at 14 months, -0.59, -0.78, and -0.44 at 24 months, and -0.52, -0.79, and -0.42 at 36 months. Kurtosis of Activity level/Hypersensitivity, Adaptation to change/Cooperation, Attention to task/Persistence were 0.18, 0.31, and 0.65 at 14 months, 0.19, 0.88, and 0.15 at 24 months, and -0.22, 0.21, and -0.10 at 36 months. These skewness and kurtosis indices are within good ranges to assume univariate normality for each indicator.

Child Cognition

Infants' cognitive functioning was assessed using the Bayley Scales of Infant Development II (BSID-II, Bayley, 1993), which measures the developmental functioning of infants and children from the ages of 1 to 42 months. The purpose of BSID-II is to diagnose developmental delay and facilitate planning of intervention strategies.

The Mental Scale of the BSID-II contains 177 items, any number of which can be administered to a child depending on his/her chronological age. The criterion for a child's performance to receive credit for each item is specified. In this study, 87-105 items were administered when the children were 14 months of age, 113-148 items were administered at 24 months, and 140-168 items were administered at 36 months. The Mental Scale is designed to measure an infants' sensory perceptual acuities, discriminations, early acquisition of object constancy and memory, problem-solving ability, vocalizations and the beginning of verbal communication, and early evidence of generalizations and classification (Bayley, 1993; Pollitt, & Triana, 1999). The BSID-II is a standardized test, and responses can be used to calculate the standardized Mental Development Index (MDI) in order to examine the infants' overall cognitive abilities; however, in this study, raw scores were used to examine growth curve models (initial level of infants' cognition, and rate of change in cognition). Very good internal consistency has been reported for the Mental Scale; coefficient alphas were .83, .92, and .89 at 15, 24, and 36 months, respectively (Bayley, 1993). Test –retest reliability was $r =$ .91. The Bayley MDI is correlated with the McCarthy Scales of Children's Abilities (MSCA) and the Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R) [e.g., MSCA's General Cognitive Index ($r = .79$), MSCA subscales (r ranging from .57 to .77), and WPPSI-R ($r = .73$)] (Bayley, 1993).

In this sample, means on raw scores of the Mental Scale were 94.85 ($SD = 5.73$), 127.68 ($SD = 6.38$), and 150.21 ($SD = 6.95$) at 14, 24, and 36 months, respectively. Averages of the MDI, which is a standardized score, were 96.22 ($SD = 10.92$), 84.42 ($SD = 13.50$), and 86.67 ($SD = 12.01$) at 14, 24, and 36 months, respectively. Internal consistency coefficient Cronbach's alphas were .80, .85, and .82 at 14, 24, and 36 months, respectively. Skewness were -0.51, -0.24, and -0.16 at 14, 24 and 36 months, and Kurtosis were 0.71, 0.31, and 0.84, respectively. The skewness and kurtosis indices for raw scores of the Bayley Mental Scale were within good ranges (range of skewness is within $\pm$ 2 and range of kurtosis is within $\pm$ 7) to assume univariate normality of each indicator.

Maternal Characteristics

Maternal age and education, family income, and maternal marital status with the target child's biological father were used as exogenous control variables. These familial characteristics were collected via parent interview at various points of time, including before the enrollment.

Since correlations between per capita income and other variables and correlations between annual gross income and other variables were very similar, average of annual gross family income across five data points (before enrolling in the EHS study and after 7, 15, 28, and 36 months of the enrollment) were computed after imputation of missing observations with estimated income scores by using multiple regression based on existing scores at different points of time (Kline, 1989).

Maternal age and marital status with the target child's biological father were gathered during the parent interview when the children were 14 months of age, and years of mothers' education during the PSI at 15 months after enrollment into the study. Imputation of missing observations of maternal education was made using observations at other data points, and missing observations of marital status ($n = 9$) were replaced with 0 values as "Not married to the child's biological father." Skewness of maternal education, age, and income were -1.10, 1.00, and 0.72, respectively, and kurtosis of maternal education, age, and income were 2.65, 0.94, and 0.54, respectively. There were a few outliers, which were more than 3 standard deviations from the means, among observations of maternal age and years of education. However, these outliers seem to represent true scores from the population, and the skewness and kurtosis statistics for the sample were within an acceptable range. Therefore, these data points were included in the analyses competed for this study.

Data Analysis Procedures

To evaluate longitudinal relations among mother-child interactions, children's task-approach behaviors, and children's raw scores on the Bayley Mental Scale at three points in time, structural equation modeling analyses were employed by using the LISREL statistical program. Structural equation modeling analyses allow researchers to test the several causal relationships specified simultaneously and postulate several alternative models to identify a model most appropriate to explain the data (Jőreskog, 1993), as well as consider measurement errors among observed variables submitted to the analyses (Bollen, 1989; e.g., autocorrelations, errors of measurement, accounting for error variance of observed variables).

First, a Pearson product moment correlation matrix was created to allow examination of the relations between all variables. Second, growth-curve models estimating latent initial levels of the maternal supportiveness, children's task-approach behaviors, and children's cognition and rate of change in these variables were examined for their linearity and variability of the variances (See Figure 2). However, there was not much variability of variance for the initial level or for the rate of change in the variables except for the children's raw scores on the Bayley Mental Scale. For the trajectory model for the children's raw scores on the Bayley Mental Scale, the path from the slope to raw scores of Bayley Mental Scale at 36-months were set free when the growth curve analyses were conducted, which means that the rate of change in the raw scores on Bayley Mental Scale may not be linear, and the rate of change is, at least to some extent, different across time and not interpretable. Next, measurement models for maternal supportiveness and the children's task-approach behaviors were examined at each data point. After examination of measurement models for each latent construct, the overall measurement model with all indicators was investigated. Confirmatory factor analyses allow examination of whether the relations between the relevant indicators observed from the sample and the underlying constructs are satisfactory. Confirmatory factor analyses also prove that a set of indicators measuring the same construct are correlated highly, which is evidence of convergent validity, and correlations among indicators of different latent constructs are not excessively high, which is evidence of discriminate validity (Bollen, 1989). Finally, the developmental trajectory of the children's raw scores on the Bayley Mental Scale and stability and cross-lagged effects of maternal supportiveness and children's task-approach behaviors at the three time points were examined. A series of sequential models was investigated to find an appropriate model that best fit the current data. Table 5 presents the structural paths in a series of sequential model comparisons (see Table 3 for variable names and labels). Maximum likelihood (ML) estimation was used to estimate the parameters in the measurement model and the structural models.

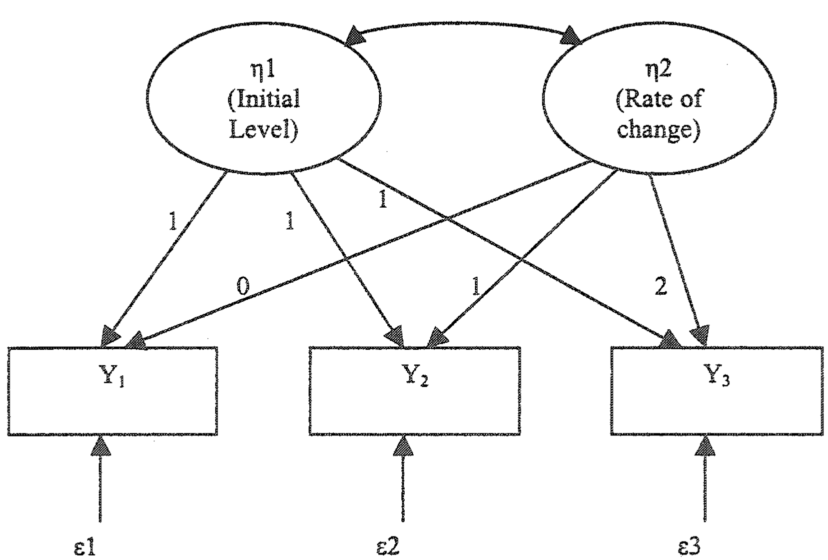

Figure 2. Diagram of a growth-curve model

Table 5

Structural Paths in a Series of Sequential Model Comparisons

	Model 0a	Model 1	Model 2	Model 2a	Model 3	Model 4	Model 5
Exogenous variables							
Edu → Sup1		X	X	X	X	X	X
Inc → Sup1		X	X	X	X	X	X
Age → Sup1		X	X	X	X	X	X
Mar → Sup1		X	X	X	X	X	X
Edu → Task1		X	X	X	X	X	X
Inc → Task1		X	X	X	X	X	X
Age → Task1		X	X	X	X	X	X
Mar → Task1		X	X	X	X	X	X
Stability							
Sup1→ Sup2		X	X	X	X	X	X
Sup2→ Sup3		X	X	X	X	X	X
C-Task1 → C-Task2		X	X	X	X	X	X
C-Task2 → C-Task3		X	X	X	X	X	X
Cross-lagged							
Sup1→C-Task2			X		X	X	X
Sup1→C-Task3			X		X	X	X
Sup2→C_Task3			X		X	X	X
C-Task1→Sup2				X	X		
C-Task1→Sup3				X	X		
C-Task1→Sup3				X	X		
Direct effect							
Sup1→Cog-Level		X	X	X	X	X	X
Sup3→Cog-Rate		X	X	X	X	X	X
C-Task3 →Cog-Rate		X	X	X	X	X	X
C-Task1 →Cog-Level		X	X	X	X	X	X
C-Task1 →Cog-Rate						X	X
C-Task2 →Cog-Rate						X	X
Sup1→Cog-Rate							X
Sup2→Cog-Rate							X
Corr exogenous vars [a]	X	X	X	X	X	X	X
Correlations TE [b]	X	X	X	X	X	X	X

Note. [a] Correlation among exogenous variables [b] Correlation among measurement errors

Measurement Model (Model 0)

The measurement model is most parsimonious since there was no structural path between latent constructs and provides a baseline model against which to evaluate the alternative or nested models. Based on modification indices for measurement errors in the initial measurement model, the measurement model was respecified to improve its fit to the data (Model 0a).

Stability Model (Model 1)

The stability model added several structural paths: (1) four stability paths among maternal supportiveness and children's task-approach behaviors across time, (2) paths from four maternal exogenous variables to maternal supportiveness and to children's task-approach behaviors at 14 months of age, (3) paths from maternal supportiveness and children's task-approach behaviors at 14 months to the initial level of children's cognition, and (4) paths from maternal supportiveness and children's task-approach behaviors at 36 months to the rate of change in children's cognition. In addition to these structural paths, correlation paths between maternal supportiveness and children's task-approach behaviors at three concurrent time points were included.

Cross-lagged Effect of Maternal Supportiveness Model (Model 2)

This model included cross-lagged paths from maternal supportiveness to children's task-approach behaviors in the stability model (Model 1). Thus, model 2 tests whether maternal supportiveness at 14 months influences children's task-approach behaviors at 24 and 36 months, as well as whether maternal supportiveness at 24 months influences children's task-approach behaviors at 36 months. The stability model (Model 1) is nested within Model 2.

Cross-lagged Effect of Child Task-approach Behavior Model (Model 2a)

This model added cross-lagged paths from children's task-approach behaviors to maternal supportiveness in the stability model (Model 1). Thus, this model was created to examine the effect of children's task-approach behaviors at 14 months on maternal supportiveness at 24 and 36 months, and the effect of children's task-approach behaviors at 24 months on maternal supportiveness at 36 months. The stability model (Model 1) is a special case of Model 2a.

Reciprocal Cross-lagged Effect Model (Model 3)

This model included cross-lagged paths between children's task-approach behaviors and maternal supportiveness in the stability model (Model 1). Thus, Model 3 has paths from children's task-approach behaviors at 14 and 24 months to maternal supportiveness at 24 and 36 months, as well as paths from maternal supportiveness at 14 and 24 months to children's task-approach behaviors at 24 and 36 months. Model 2 and Model 2a are nested within Model 3.

Direct Effect of Child Task-approach Behavior on Rate of Change in Cognition Model (Model 4)

In Model 4, paths from children's task-approach behaviors at 14 and 24 months to the rate of change in children's cognition were added to Model 2. Model 2 is a special case of Model 4. This model enables examination of whether children's earlier task-approach behaviors at 14 and 24 months influence directly the rate of change in children's cognition.

Direct Effect of Maternal Supportiveness on Rate of Change in Cognition Model (Model 5)

This model included paths from maternal supportiveness at 14 and 24 months to the rate of change in children's cognition in Model 4. Model 5 enables examination of whether maternal supportiveness at 14 and 24 months influence directly the rate of change in children's cognition. Model 4 is nested within Model 5.

In order to assess these proposed models, it is necessary to evaluate goodness-of-fit indices for each model. First, the likelihood ratio χ^2 statistic and its p-value are commonly used to evaluate fit based on the null hypothesis that the population covariances are identical with those predicted from the model estimates. However theses indices were confounded by sample size (Gerbing, & Anderson, 1993), and using ratio of χ^2/df is suggested in these instances (Wheaton, Muthën, Alwin, & Summers, 1977). The Goodness-of-Fit Index (GFI) and Adjusted Goodness-of-Fit Index (AGFI) are often used for model evaluation along with χ^2 statistic. The GFI measures the relative amounts of variance and covariance in the observed matrix that are predicted by those in the population matrix, and the AGFI, adjusted for the number of degrees of freedom in the specified model, are influenced by sample size (Bollen, 1989). Normal Fit Index (NFI; Bentler & Bonett, 1980) examines fit by the incremental fit of the model of interest relative to the uninteresting nested baseline model. Comparative Fit Index (CFI: Bentler, 1990), which is revised from the NFI, takes sample size into account, and a value above .90 indicates an acceptable fit. Root Mean Square Error of Approximation (RMSEA) takes into account the error of approximation in the population, and a value less than .05 indicates a good fit (Byrne, 1998). RMSEA (Steiger & Lind, 1980) is sensitive to the number of estimated parameters in the model and is influenced by sample size. Hoelter's Critical N (CN) indicates the adequacy of sample size. A CN value in excess of above 200 is indicative of a model that adequately represents the sample data (Byrne, 1998). Among these indices, there is not one single index to satisfy all criteria to test models (Gerbing, & Anderson, 1993). Currently, methodologists have suggested use multiple goodness-of-fit indices to evaluate model fit. Therefore, in the current study, χ^2, ratio of χ^2/df, GFI, AGFI, NFI, CFI, RMSEA, and CN were used to assess the proposed models.

CHAPTER 4. RESULTS

In the current study, four latent constructs and four maternal variables, which served as covariates, were used in the analyses. The four latent constructs were based on observed variables collected across three time points. Among these constructs, the initial level of children's cognition and the rate of change in children's cognition were used in the growth-curve model.

In this chapter, first, correlations among these observed variables were examined. Second, results of structural equation modeling analyses are presented. In the measurement model, factor loadings for each observed variable within a construct, squared multiple correlations, and correlations between measurement errors are reported. Structural equation modeling was used to conduct confirmatory factor analyses and test the proposed structural models based on the measurement model.

Correlation Analyses

Intercorrelations, means, and standard deviations for all indicators measuring latent constructs are presented in Table 6. Among maternal characteristic variables, maternal education and age were related to indicators of maternal supportiveness, as well as to children's raw scores for the Bayley Mental Scale across time.

High intercorrelations among Sensitivity, Stimulation, and Positive regard, which are indicators of maternal supportiveness, existed at each time point (from .53 to .71), whereas there were moderate intercorrelations among these indicators across different points of time (from .27 to .50). These correlations among the indicators of maternal supportiveness were stronger between adjacent data points (14 months and 24 months; 24 months and 36 months) than they were between maternal supportiveness at 14 months and at 36 months. These

Table 6

Zero-order Correlations, Means, and Standard Deviations for Indicator Variables ($N = 400$)

Variables	1	2	3	4	5
Maternal variables					
1. Education	--				
2. Family Income	.16**	--			
3. Age at birth	.07	.15*	--		
4. Married with bio-father	-.05	.34***	.15**	--	
Parent-child interaction					
5. Sensitivity1	.28***	.12*	.20***	.11*	--
6. Stimulation 1	.34***	.08	.15**	.05	.61***
7. Positive regard 1	.28***	.10*	.21***	.07	.63***
8. Sensitivity2	.23***	.20***	.19***	.13*	.48***
9. Stimulation 2	.19***	.12*	.14**	.11*	.39***
10. Positive regard 2	.26***	.07	.09*	.02	.33***
11. Sensitivity 3	.27***	.21***	.24***	.13**	.42***
12. Stimulation 3	.33***	.13*	.16**	.01	.33***
13. Positive regard 3	.29***	.15**	.28***	.10	.28***
Task-approach					
14. Sensitivity/activity level 1	.06	.01	.09	.08	.12*
15. Adaptation/cooperation 1	.05	-.03	.08	.04	.16***
16. Attention/persistence 1	.19	.08	.09	.09	.14**
17. Sensitivity/activity level 2	.06	.07	.10	.16**	.20***
18. Adaptation/cooperation 2	.08	.05	.15**	.15**	.19***
19. Attention/persistence 2	.04	.08	.09	.14**	.19***
20. Sensitivity/activity level 3	-.02	.09	.12*	.13*	.21***
21. Adaptation/cooperation 3	-.07	-.04	.10*		.17***
22. Attention/persistence 3	-.05	.04	.13*	.11*	.23***
Mental Scale					
23. Bayley 1	.17**	.06	.13**	.05	.19***
24. Bayley 2	.25***	.09	.03	.04**	.24***
25. Bayley 3	.18***	.06	.09	.09	.35***
M	10.91	13.28	23.14	.38	4.29
SD	2.74	6.94	5.98	--	1.29

(table continues)

*p < .05. **p < .01. ***p < .001.

Table 6 (continued)

Variables	6	7	8	9	10
Maternal variables					
1. Maternal education					
2. Family Income					
3. Maternal age					
4. Married with bio-father					
Parent-child interaction					
5. Sensitivity1					
6. Stimulation1	--				
7. Positive regard1	.62***	--			
8. Sensitivity2	.38***	.41***	--		
9. Stimulation2	.46***	.39***	.68***	--	
10. Positive regard2	.37***	.39***	.68***	.53***	--
11. Sensitivity3	.32***	.35***	.50***	.45***	.44***
12. Stimulation3	.37***	.34***	.42***	.47***	.39***
13. Positive regard3	.27**	.34***	.37***	.30***	.44***
Task-approach					
14. Sensitivity/activity level 1	.04	.14**	.08	.04	.03
15. Adaptation/cooperation 1	.11*	.13*	.11*	.04	.08
16. Attention/persistence 1	.02	.09	.04	.04	.06
17. Sensitivity/activity level 2	.21***	.19***	.19**	.20***	.09
18. Adaptation/cooperation 2	.20***	.12***	.18***	.20***	.11*
19. Attention/persistence 2	.20***	.17**	.22***	.20**	.16**
20. Sensitivity/activity level 3	.17***	.14***	.14**	.13*	.01
21. Adaptation/cooperation 3	.19***	.15**	.10**	.15**	.05
22. Attention/persistence 3	.15**	.11*	.14**	.12*	.04
Mental Scale					
23. Bayley 1	.19***	.15*	.11*	.14**	.07
24. Bayley 2	.21***	.22**	.26***	.21***	.17***
25. Bayley 3	.25***	.32***	.32***	.25***	.28***
M	3.45	3.62	4.35	3.72	3.51
SD	1.21	1.18	1.14	1.15	1.29

(table continues)

Table 6 (continued)

Variables	11	12	13	14	15
Maternal variables					
1. Maternal education					
2. Family Income					
3. Maternal age					
4. Married with bio-father					
Parent-child interaction					
5. Sensitivity1					
6. Stimulation1					
7. Positive regard1					
8. Sensitivity2					
9. Stimulation2					
10. Positive regard2					
11. Sensitivity3	--				
12. Stimulation3	.65***	--			
13. Positive regard3	.71***	.54***	--		
Task-approach					
14. Sensitivity/activity level 1	.10*	.01	.07	--	
15. Adaptation/cooperation 1	.08	.02	.07	.65***	--
16. Attention/persistence 1	.06	.01	.07	.61***	.59***
17. Sensitivity/activity level 2	.08**	.12*	.06	.21***	.16**
18. Adaptation/cooperation 2	.13**	.14**	.07	.19***	.22***
19. Attention/persistence 2	.14**	.13*	.10	.18***	.19***
20. Sensitivity/activity level 3	.07	.06**	.03	.09	.11*
21. Adaptation/cooperation 3	.09	.14*	.05	.05	.03
22. Attention/persistence 3	.09	.12*	.03	.06	.01
Mental Scale					
23. Bayley 1	.11*	.10	.04	.12*	.20***
24. Bayley 2	.15**	.20***	.06	.08	.20***
25. Bayley 3	.26***	.30***	.14**	.03	.11*
M	4.48	3.65	3.49	3.81	3.74
SD	1.08	1.11	1.10	.83	.67

(table continues)

Table 6 (continued)

Variables	16	17	18	19	20
Maternal variables					
1. Maternal education					
2. Family Income					
3. Maternal age					
4. Married with bio-father					
Parent-child interaction					
5. Sensitivity1					
6. Stimulation1					
7. Positive regard1					
8. Sensitivity2					
9. Stimulation2					
10. Positive regard2					
11. Sensitivity3					
12. Stimulation3					
13. Positive regard3					
Task-approach					
14. Sensitivity/activity level 1					
15. Adaptation/cooperation 1					
16. Attention/persistence 1	--				
17. Sensitivity/activity level 2	.14**	--			
18. Adaptation/cooperation 2	.12*	.73***	--		
19. Attention/persistence 2	.14**	.71***	.73***	--	
20. Sensitivity/activity level 3	.07	.34***	.33***	.26***	--
21. Adaptation/cooperation 3	-.03	.28***	.31***	.25***	.68***
22. Attention/persistence 3	.04	.28**	.31***	.34***	.69***
Mental Scale					
23. Bayley 1	.31***	.09	.12*	.13**	.06
24. Bayley 2	.14**	.27***	.36***	.42***	.14**
25. Bayley 3	.02	.20***	.29***	.30***	.22***
M	3.58	3.70	3.72	3.51	3.81
SD	.65	.85	.78	.70	0.87

(table continues)

Table 6 (continued)

Variables	21	22	23	24	25
Maternal variables					
1. Maternal education					
2. Family Income					
3. Maternal age					
4. Married with bio-father					
Parent-child interaction					
5. Sensitivity1					
6. Stimulation1					
7. Positive regard1					
8. Sensitivity2					
9. Stimulation2					
10. Positive regard2					
11. Sensitivity3					
12. Stimulation3					
13. Positive regard3					
Task-approach					
14. Sensitivity/activity level 1					
15. Adaptation/cooperation 1					
16. Attention/persistence 1					
17. Sensitivity/activity level 2					
18. Adaptation/cooperation 2					
19. Attention/persistence 2					
20. Sensitivity/activity level 3					
21. Adaptation/cooperation 3	--				
22. Attention/persistence 3	.70***	--			
Mental Scale					
23. Bayley 1	.11*	.10	--		
24. Bayley 2	.26***	.22***	.30***	--	
25. Bayley 3	.31***	.33***	.20***	.48***	--
M	3.77	3.99	94.85	127.68	150.21
SD	.71	.60	5.73	6.38	6.95

correlations indicated moderate stability for maternal supportiveness. Overall, the indicators of maternal supportiveness were associated with children's raw scores for the Bayley Mental Scale across time. The indicators of maternal supportiveness at 14 months were related to children's raw scores for the Bayley Mental Scale at 14, 24 and 36 months of children's ages, and those of maternal supportiveness at 24 months were correlated with children's raw scores for the Bayley Mental Scale at 24 and 36 months. These correlations between the indicators of maternal supportiveness and children's later raw scores for the Bayley Mental Scale were relatively stronger than were concurrent relationships between the indicators of maternal supportiveness and children's raw scores for the Bayley Mental Scale. The indicators of maternal supportiveness were associated weakly with children's task-approach behaviors. For example, maternal positive regard at 36 months was not related to children's task-approach behaviors at any of the time points.

Correlations among children's task-approach behaviors (e.g., Activity level/Hypersensitivity, Adaptation to change/Cooperation, and Attention to task/Persistence) were relatively high at the concurrent data points (from .59 to .73), whereas correlations among these indicators across different time points were weak (from -.03 to .34). Correlations among children's task-approach behaviors were relatively weaker between 14 months and 36 months (from -.03 to .11) than they were between at 14 and 24 months (from .12 to .22) and between 24 months and 36 months (from .26 to .34). These correlations indicated little stability in children's task-approach behaviors across time. Overall, children's task-approach behaviors were moderately related to children's raw scores on the Bayley Mental Scale at concurrent data points.

In sum, strong correlations among the indicators within each of the latent constructs were revealed, especially at concurrent time points. Correlations among the indicators for different latent constructs were relatively weak.

Structural Equation Modeling Analyses

Results of the measurement model and the structural models are presented in this section. The relations among the variables were assessed simultaneously using the variance-covariance matrix after entering correlations and standard deviations. First, the measurement model was evaluated using overall model fit indices, significance of the factor loadings, the error variances, and squared multiple correlations. Modifications were made to improve the measurement model to fit the data by relaxing correlations between measurement errors. Second, comparisons of the proposed series of models were preformed, and goodness-of-fit-indictors for each model were compared to those of nested, structural models. These goodness-of-fit-indictors for each model were used to identify the model that best fit the data.

Latent Growth-Curve Model

To estimate the initial level (intercept) and the rate of change (slope) in the growth-curve model, the factor loadings linking the initial level of each child's three scores observed at 14, 24, and 36 months were all fixed at a value of 1. The factor loadings linking the rate of change to the three observed scores were fixed at values connected to the data collection time intervals. Thus, factor loadings were fixed at 0, 10, and 22 (see Figure 2) since these data were collected when the children were 14, 24, and 36 months old, respectively. In addition to these restrictions, there should be statistically significant positive variances in the rate of change in the variable across time and in the initial level of the variable, as well as covariance between these two latent constructs (the rate of change and the initial level).

Therefore, this study estimated the initial level of children's cognition and rate of change in cognition in the growth-curve model using raw scores for the Bayley Mental Scale by fixing the paths from level of child's cognition to the raw scores for the Bayley Mental Scale at 14, 24, and 36 months at a value of 1 and the paths from the rate of change in each child's cognition to raw scores for the Bayley Mental Scale at 14 and 24 months with the values of 0 and 10, respectively. However, the variances in these two latent constructs were negative when the path from the rate of change in child's cognition to the raw scores for the Bayley Mental Scale at 36 month was restricted at a value of 22. In this study, this path was relaxed; this indicates that the rate of change in children's cognition was nonlinear.

The mean estimations of children's initial levels of cognition and rates of cognitive development are presented in Table 7. For children' cognition, correlations between the initial level of cognition and the rate of change in cognition were negative ($r = -.48$, $t = -2.80$), and the estimates of the initial level and the rate of change were 94.85 ($t = 4.46$) and 3.28 ($t = 5.45$). The estimated path from the rate of change in cognition to the raw sores for the Bayley Mental Scale at 36 months was 16.83 ($t = 99.33$). This negative estimate of the correlation between the initial level of cognition and the rate of change in cognition indicates that children who received higher raw scores on the Bayley Mental Scale initially had a tendency to increase more slowly than children who received lower raw scores on the Bayley Mental Scale initially. General increments for the raw scores on the Bayley Mental Scale may not be linear. The variances for estimated initial level of cognition and rate of cognitive development were statistically significant, and these variances were positive. Correlation between estimations for children's initial levels of cognition and rates of cognitive development were statistically significant. For children's cognition, squared multiple correlations were .66 and .33 and .86, respectively.

Table 7

Estimations of Children's Initial Level of Cognition and Rate of Cognitive Development for the Growth Curve Model

	Initial level	Rate	Initial level<-> Rate
Mean (SD)	94.85 (0.29)	3.28 (0.04)	
Variance/Covariance (SE)	21.77 (4.88)	0.15 (0.03)	-.86 (0.31)
	Bayley 1	Bayley 2	Bayley 3
Error variance (SE)	11.08 (4.69)	39.70 (3.23)	5.84 (3.58)

Measurement Model

A measurement model served as a baseline model against which to test the series of models proposed in this study. In that model, restricted correlations among measurement errors (Model 0), exogenous variables (maternal education, income, age, and marital status with biological father) had one indicator, and no measurement errors were assumed for these exogenous variables. However, modification indices from Model 0 indicated that statistically significant and large autocorrelations existed between measurement errors among indicators of the same construct at different time points. Therefore, on the basis of these modification indices, Model 0 was modified to become Model 0a. Model 0a allowed for estimated autocorrelations between measurement errors for maternal sensitivity, stimulation, and positive regard at 14, 24, and 36 months and autocorrelations between measurement errors for Activity level/Hyperactivity, Adaptation to change/Cooperation, and Attention to task/Persistence at 14 and 24 months and 24 and 36 months (see Figure 3). In addition, Model 0a estimated correlations between the maternal supportiveness and task-approach behavior constructs at each time point. These statistically significant correlations among measurement error terms indicated that there were common shared variances in measurement errors among the same indicators across time. Correlations between measurement errors for the same indicators of maternal supportiveness at 14 and 36 months were still statistically significant after accounting for shared variances of measurement error at 14 and 24 months and at 24 and 36 months. This indicates that some measurement issues related to the indicators of maternal supportiveness were carried over time. Significant changes in overall model fit were made from Model 0 to Model 0a with autocorrelations between measurement errors ($\Delta\chi^2/\Delta$ df = 155.82 /15). However, model 0a still showed a huge chi-square value [$\chi^2(275)$ = 1,107.52], and all fit indices were relatively small.

For Model 0a, estimated factor loadings for manifest indicators of the latent constructs (e.g., maternal supportiveness and child's task-approach) in the confirmatory factor analyses are presented in Figure 3. In addition, correlations between maternal supportiveness and children's task-approach behaviors, as well as autocorrelations between measurement errors were estimated (See Table 8). The range of standardized factor loadings for the indicators of maternal supportiveness (from .63 to .92) and the range of standardized factor loadings for the indicators of children's task-approach behaviors (from .71 to .87) suggest that these indicators do fit the latent constructs appropriately. Autocorrelations among measurement error variances for the indicators of maternal supportiveness and for the indicators of children's task-approach behaviors were weak (from .06 to .14) but were

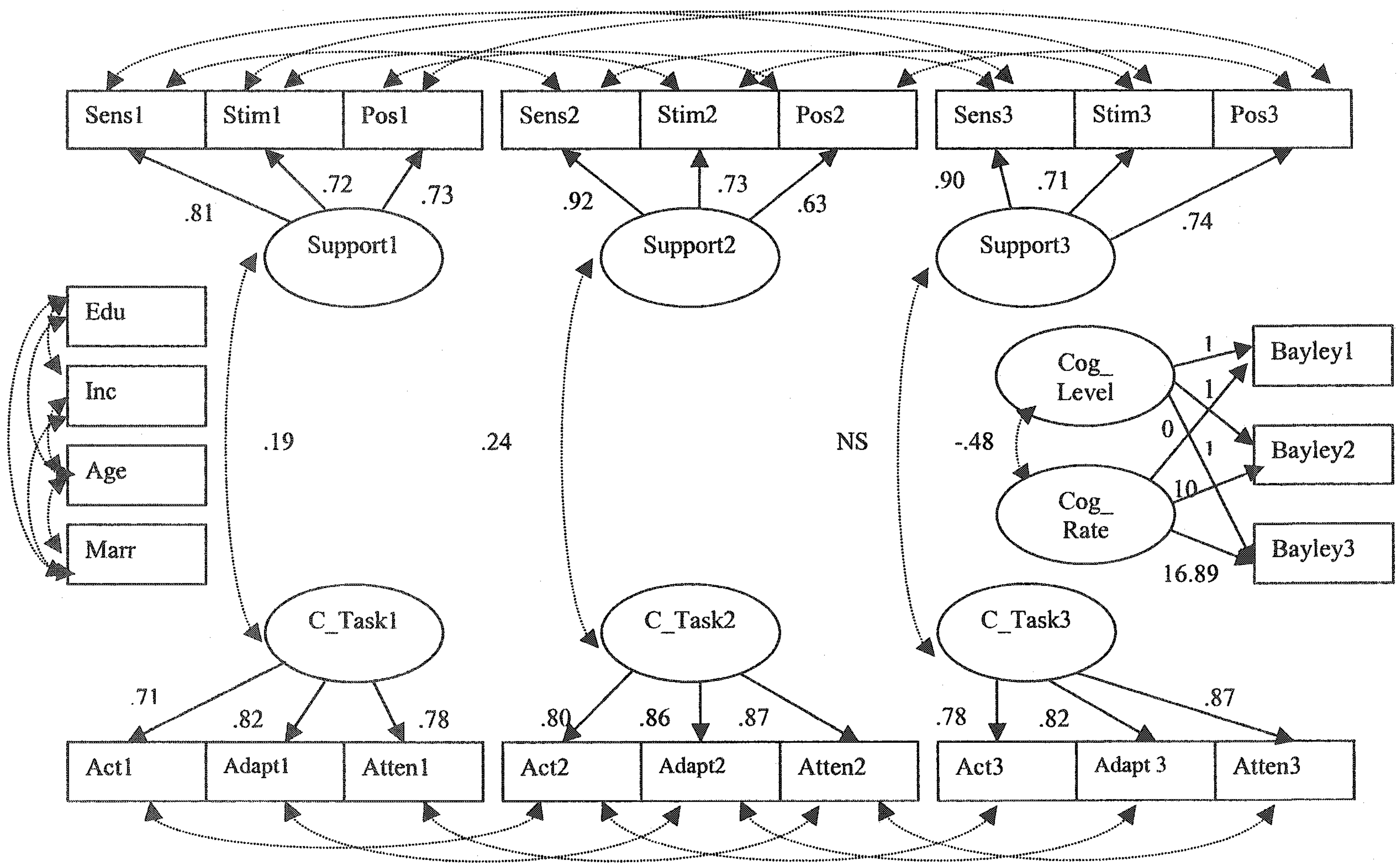

Figure 3. Standardized coefficients for the measurement model (Model 0a).

Table 8

Standardized Estimations of Correlations between Exogenous Variables and between Error Terms for the Measurement Model (Model 0a)

Correlation	*r* (*t-ratio*)
Correlations between Exogenous Variables	
Edu <–> Inc	.15 (2.98)*
Edu <–> Age	.03 (.69)
Edu <–> Mar	-.04 (-.86)
Inc <–> Age	.12 (2.40)*
Inc <–> Mar	.34 (6.45)*
Age <–> Mar	.16 (3.18)*
Correlations between Measurement Error Terms (TE)	
Maternal supportiveness	
Sens1 <–> Sens2	.11 (4.19)*
Stim1 <–> Stim2	.10 (3.40)*
Pos1 <–> Pos2	.07 (2.28)*
Sens2 <–> Sens3	.03 (1.10)
Stim2 <–> Stim3	.10 (3.42)*
Pos2 <–> Pos3	.14 (4.61)*
Sens1 <–> Sens3	.10 (3.72)*
Stim1 <–> Stim3	.09 (2.95)*
Pos1 <–> Pos3	.06 (2.09)*
Child's task-approach	
Act1 <–> Act2	.06 (2.18)*
Adapt1 <–> Adapt2	.06 (2.75)*
Atten1 <–> Atten2	-.02 (-.84)
Act2 <–> Act3	.07 (2.81)*
Adapt2 <–> Adapt3	.01 (.35)
Atten2 <–> Atten3	.08 (3.78)*

* t-ratio > 2

statistically significant except for three correlations (e.g., correlation between maternal Sensitivity at 24 months and 36 months; correlation between Attention to task/Persistence at 14 months and 24 months; and correlation between Adaptation to change/Cooperation at 24 months and 36 months). Table 9 presents estimations of squared multiple correlations for the endogenous variables and error variances for the indicators. The proportions of variance for each indicator explained by the latent constructs were from .51 to .85. This indicates that more than half of the variances of these indicators were explained by each latent construct, and further that these indicators were appropriate measures for each latent construct examined. Correlations between maternal supportiveness and children's task-approach behaviors at 14 and 24 months were statistically significant but maternal supportiveness and children's task-approach behaviors at 36 months were not correlated.

Evaluation of the Structural Models

Standardized estimated path coefficients of structural paths for the models proposed in this study are presented in Table 10. Among the maternal characteristics used as control variables in this study, only maternal education and age were related to maternal supportiveness at 14 months. None of maternal exogenous variables were related to children's task-approach behaviors when the children were 14 months of age. Maternal supportiveness and children's task-approach behaviors were somewhat stable across time. Maternal supportiveness showed moderate stability, and children's task-approach behaviors showed weak stability. However, stability of children's task-approach behaviors became stronger as children grew older. There were cross-lagged effects for maternal supportiveness at 14 months on children's task-approach behaviors at 24 and 36 months. There were not

Table 9

Estimations of Squared Multiple Correlations (R^2) and Error Variance for the Endogenous Variables for the Measurement Model (Model 0a)

Variables	R^2	Error Variance [a](t-ratio)
Maternal supportiveness		
Sens1	.66	.56 (8.64)
Stim1	.52	.67 (11.08)
Pos1	.54	.61 (10.84)
Sens2	.85	.19 (4.64)
Stim2	.53	.64 (11.88)
Pos2	.47	.80 (12.47)
Sens3	.81	.21 (5.62)
Stim3	.50	.61 (12.02)
Pos3	.54	.51 (11.56)
Child's task-approach		
Act1	.51	.30 (11.45)
Adapt1	.67	.16 (8.78)
Atten1	.61	.18 (9.94)
Act2	.64	.24 (11.08)
Adapt2	.73	.16 (9.34)
Atten2	.75	.13 (8.86)
Act3	.61	.28 (11.12)
Adapt3	.67	.22 (10.01)
Atten3	.75	.13 (8.22)
Child's cognition		
Bayley 1	.66	11.08 (2.36)
Bayley 2	.33	39.70 (12.30)
Bayley 3	.86	5.84 (1.63)

Note. [a] unstandardized value.

Table 10

Standardized Estimates of Structural Paths Fitting a Series of Sequential Models (N = 400)

	Model 1	Model 2	Model 2a	Model 3	Model 4	Model 5
Exogenous variables						
Edu → Sup1	.38 (7.56)*	.38 (7.48)*	.38 (7.56)*	.38 (7.48)*	.38 (7.48)*	.38 (7.48)*
Inc → Sup1	.03 (0.49)	.03 (0.48)	.03 (0.49)	.03 (0.48)	.03 (0.49)	.03 (0.47)
Age → Sup1	.21 (4.24)*	.22 (4.32)*	.21 (4.23)*	.22 (4.31)*	.22 (4.31)*	.22 (4.32)*
Mar → Sup1	.08 (1.48)	.09 (1.61)	.08 (1.47)	.09 (1.61)	.08 (1.59)	.08 (1.58)
Edu → C-Task1	.09 (1.65)	.09 (1.59)	.09 (1.67)	.09 (1.61)	.09 (1.60)	.09 (1.61)
Inc → C-Task1	-.03 (-0.49)	-.03 (-0.43)	-.03 (-0.47)	-.03 (-0.47)	-.03 (-0.44)	-.03 (-0.44)
Age → C-Task1	.09 (1.70)	.09 (1.66)	.10 (1.72)	.09 (1.67)	.09 (1.70)	.09 (1.71)
Mar → C-Task1	.08 (1.43)	.08 (1.40)	.08 (1.44)	.08 (1.40)	.08 (1.40)	.08 (1.40)
Stability						
Sup1 → Sup2	.60 (12.01)*	.61 (12.37)*	.59 (11.55)*	.61 (11.95)*	.61 (12.34)*	.61 (12.25)*
Sup2 → Sup3	.63 (13.06)*	.64 (13.23)*	.63 (12.60)*	.64 (12.60)*	.64 (13.23)*	.64 (13.15)*
C-Task1 → C-Task2	.25 (4.61)*	.19 (3.26)*	.25 (4.34)*	.19 (3.28)*	.19 (3.29)*	.19 (3.29)*
C-Task2 → C-Task3	.40 (7.61)*	.36 (6.48)*	.40 (7.61)*	.36 (6.48)*	.36 (6.37)*	.36 (6.39)*
Cross-lagged						
Sup1 → C-Task2		.25 (4.41)*		.25 (4.40)*	.24 (4.28)*	.24 (4.25)*
Sup1 → C-Task3		.18 (2.47)*		.18 (2.47)*	.19 (2.56)*	.18 (2.56)*
Sup2 → C-Task3		-.05 (-0.66)		-.05 (-0.65)	-.05 (-0.07)	-.05 (-0.73)

C-Task1→ Sup2			.02 (0.35)	.01 (0.28)		
C-Task2→ Sup3			-.01 (-0.28)	-.01 (-0.13)		
C-Task1→ Sup3			.03 (0.49)	.02 (0.43)		
Direct effect						
Sup1→Cog-Level	.31 (5.71)*	.31 (5.77)*	.31 (5.72)*	.31 (5.78)*	.29 (5.38)*	.25 (3.70)*
C-Task1 →Cog-Level	.16 (3.14)*	.16 (3.13)*	.16 (3.15)*	.16 (3.14)*	.31 (4.60)*	.32 (4.69)*
Sup3→ Cog-Rate	.15 (3.02)*	.15 (2.99)*	.15 (2.99)*	.15 (2.97)*	.15 (3.00)*	.06 (0.82)
C-Task3 →Cog-Rate	.29 (6.04)*	.28 (5.74)*	.29 (6.04)*	.28 (5.74)*	.23 (4.27)*	.23 (4.19)*
C-Task1 →Cog-Rate					-.26 (-3.84)*	-.27 (-3.93)*
C-Task2 →Cog-Rate					.20 (3.54)*	.18 (3.19)*
Sup1→ Cog-Rate						.01 (0.18)
Sup2→ Cog-Rate						.15 (1.82)
Correlations						
Sup1 <-> C-Task1	.14 (2.65)*	.13 (2.46)*	.14 (2.60)*	.13 (2.41)*	.13 (2.42)*	.13 (2.45)*
Sup2 <-> C-Task2	.10 (2.09)*	.07 (1.64)	.10 (2.12)	.07 (1.64)	.08 (1.77)	.08 (1.74)
Sup3 <-> C-Task3	.00 (-0.10)	-.01 (-0.25)	.00 (0.11)	-.01 (-0.23)	-.01 (-0.22)	-.01 (-0.18)
Growth-curve Model						
Cog-Level<-> C-Rate	-.51 (-2.89)*	-.51 (-2.86)*	-.51 (-2.89)*	-.51 (-2.86)*	-.46 (-2.53)*	-.46 (-2.52)*
Cog-Level	84.47 (50.92)*	84.41 (50.39)*	84.46 (50.69)*	84.39 (50.20)*	80.31 (38.05)*	80.73 (37.48)*
Cog-Rate	2.40 (17.72)*	2.42 (17.82)*	2.40 (17.71)*	2.42 (17.83)*	2.80 (13.87)*	2.78 (13.78)*
Cog-Rate → Bayley 3	16.86 (99.43)*	16.86 (99.43)*	16.86 (99.43)*	16.86 (99.43)*	16.85 (99.52)*	16.85 (99.54)*

* t-ratio > 2

statistically significant cross-lagged effects for children's task approach behaviors on maternal supportiveness. Children's task-approach behaviors across time influenced the initial level of children's cognition and the rate of change in children's cognition, whereas maternal supportiveness at 14 and 36 months influenced the initial level of children's cognition and the rate of change in children's cognition, respectively.

Stability Model (Model 1)

There were statistically significant stability paths for maternal supportiveness and children's task-approach behaviors across time. However, the stability of maternal supportiveness was moderate (.60 and .63), whereas the stability of children's task-approach behaviors was weak (.25 and .40). These results indicate that 36% of the variance in maternal supportiveness at 24 months was explained by the earlier supportiveness, and 40% of the variance in maternal supportiveness at 36 months was explained by the maternal supportiveness at 24 months. Only 6% of the variance in children's task-approach behaviors at 24 months was accounted for by the earlier task-approach behavior, and 16% of the variance of children's task-approach behaviors at 36 months was accounted for by the task-approach behavior at 24 months. Maternal supportiveness and children's task-approach behaviors at 14 and 36 months influenced the initial level of children's cognition and the rate of change in children's cognition, respectively. The relation between maternal supportiveness at 36 month and the rate of change in children's cognition was weaker than was the relation between maternal supportiveness at 14 month and the initial level of children's cognition. In contrast, the relation between children's task-approach behaviors at 36 months and the rate of change in children's cognition was stronger than was the relation between children's task-approach behaviors at 14 months and the initial level of children's cognition. Correlations between maternal supportiveness and children's task-approach behaviors at the concurrent time points were statistically significant at 14 and 24 months but these relations were weak.

Cross-lagged Effect of Maternal Supportiveness Model (Model 2)

Model 2 added cross-lagged paths from maternal supportiveness to children's task-approach behaviors in the stability model (Model 1). The cross-lagged effects from maternal supportiveness at 14 months to children's task-approach behaviors at 24 and 36 months of age were significant, but the cross-lagged effects from maternal supportiveness when children were 24 months of age to children's task-approach behaviors at 36 months of age were not. This indicates that earlier maternal supportiveness influenced children's later task-approach behaviors.

Cross-lagged Effect of Child Task-approach Behavior Model (Model 2a)

This model included cross-lagged paths from children's task-approach behaviors to maternal supportiveness to the model examined in the stability model (Model 1). Results showed there were not statistically significant cross-lagged effects from children's task-approach behaviors to maternal supportiveness.

Reciprocal Cross-lagged Effect Model (Model 3)

Model 3 included both cross-lagged paths of children's task-approach behaviors and of maternal supportiveness to Model 1. Results were similar to those of Model 2 and Model 2a. There were statistically significant cross-lagged effects of maternal supportiveness on children's task-approach behaviors, whereas there were not statistically significant cross-lagged effects of children's task-approach behaviors on maternal supportiveness.

Direct Effect of Child Task-approach Behavior on Rate of Change in Cognition Model (Model 4)

In this model, paths from children's task-approach behaviors at 14 and 24 months of age to the rate of change in children's cognition were added to Model 2. Children's task-approach behaviors at 14 and 24 months of age influenced directly the rate of change in children's cognition, but these relations showed different directions; the relation between children's task-approach behaviors at 14 months of age and the rate of change in children's cognition was negative, and the relation between children's task-approach behaviors at 24 months of age and the rate of change in children's cognition was positive.

Direct Effect of Maternal Supportiveness on the Rate of Change in Cognition Model (Model 5)

Model 5 added paths from maternal supportiveness when the children were 14 and 24 months of age to the rate of change in children's cognition in Model 4. Maternal supportiveness at 14 and 24 months did not influence directly the rate of change in children's cognition.

Comparison of Proposed Models

Table 11 presents model fit indices for each model, as well as comparisons among the models hierarchically or alternatively. Model 0 and Model 0a are measurement models, and Model 0a added autocorrelations between measurement errors to Model 0; thus Model 0 was nested within Model 0a. Model 1, Model 2a, and Model 3 are related hierarchically, as are Model 1, Model 2, Model 4, and Model 5. Model 2 and Model 2a are alternative models. According to these fit indices in Table 11, values of CN for all six models were higher than 200, and those of RMSEA were close to .05. The values of GFI and CFI were above .90, and

Table 11

Comparison of Models (N = 400)

Model	χ^2	Df	$\Delta\chi^2$	Δdf	GFI	AGFI	PGFI	NFI	CFI	RMSEA	CN
Model 0 (w/o corr)	1263.34	290			.79	.76	.70	.72	.77	.098	111.47
Model 0a	1107.52	275	155.82 [a]	15	.80	.77	.68	.76	.81	.095	120.78
Model 1	607.19	259	500.33 [b]	16	.91	.88	.72	.87	.92	.056	207.91
Model 2	580.28	256	26.91 [c]	3	.91	.89	.72	.87	.92	.054	215.23
Model 2a	606.75	256	.44 [c]	3	.91	.88	.72	.87	.92	.056	205.88
Model 3	579.98	253	-.30 [d]	3	.91	.89	.71	.87	.92	.055	213.06
Model 4	558.14	254	22.14 [d]	2	.91	.89	.71	.88	.93	.053	222.15
Model 5	553.54	252	4.60 [e]	2	.92	.89	.71	.88	.93	.053	222.40

Note. [a] Comparison with Measurement model without correlations among measurement errors

[b] Comparison with Model 0a, which relaxed correlations among measurement errors in the Model 0

[c] Comparison with Model 1

[d] Comparison with Model 2

[e] Comparison with Model 4

those of AGFI and NFI were higher than .80. These fit indices for the models indicate acceptable ranges. However, there was only a small magnitude of change in chi-square statistics ($\Delta\chi^2/\Delta$ df = 4.6/2) achieved by adding more paths from Model 4 to Model 5, whereas there was a statistically significant magnitude of change in chi-square statistics ($\Delta\chi^2/\Delta$ df = 22.14/2) when more paths from Model 2 to Model 4 were added. These changes indicated that adding the paths from Model 2 to Model 4 made the overall model a better fit to the data whereas adding the paths from Model 4 to Model 5 did not show a statistically significant improvement for model fit. The best model should fit the data parsimoniously. Therefore, the overall fit indices supports the determination that Model 4 represents the best fit the data. Model 4 estimated the stability of maternal supportiveness and children's task-approach behaviors, the cross-lagged effects of maternal supportiveness on children's task-approach behaviors, as well as the direct effect of maternal supportiveness and children's task-approach behaviors at 14 month on the initial level of children's cognition, and the direct effects of children's task-approach behaviors at 14, 24, and 36 months of age on the rate of change in children's cognition (see Figure 4).

Hypothesis Testing

Hypothesis tests were conducted with the best fitting model, Model 4. All paths of the relations between constructs are presented in Figure 4, and Table 12 presents estimates of squared multiple correlations for the latent constructs. Maternal supportiveness during mother-child interactions and children's task-approach behaviors were stable across the three different time points. There were the cross-lagged effects of maternal supportiveness during mother-child interactions on children's task-approach behaviors.

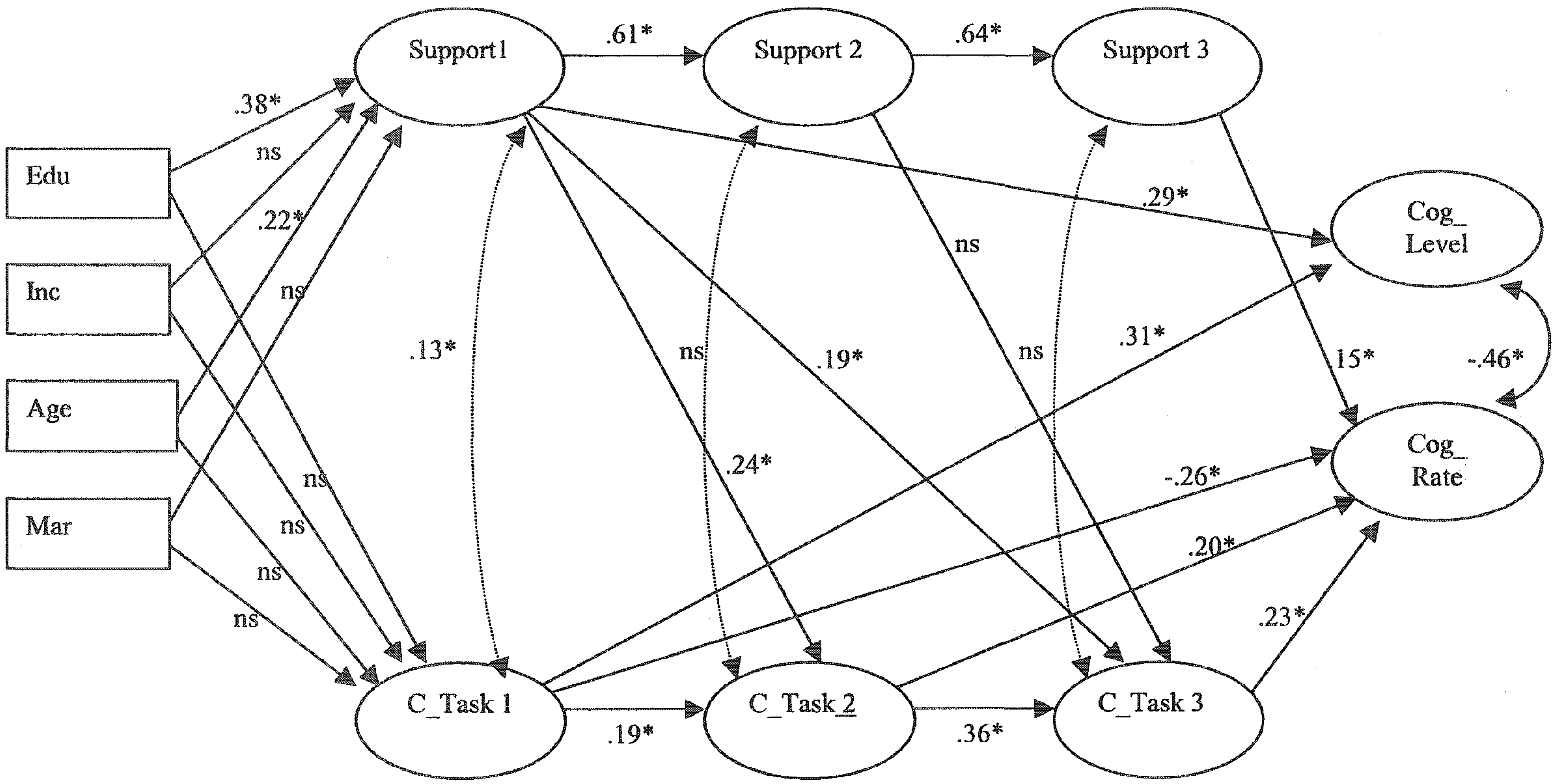

Figure 4. Direct effect of child task-approach behavior model (Model 4).

Table 12

Estimations of Squared Multiple Correlations (R^2) for the Endogenous Constructs for the Model4 (N = 400)

Variables	R^2
Supp1	.21
Supp2	.37
Supp3	.41
C-Task1	.02
C-Task2	.11
C-Task3	.18
Cog-Level	.22
Cog-Rate	.19

Maternal supportiveness during mother-child interaction and children's task-approach behaviors at 14 and 36 months of age were related to the initial level of children's cognition and the rate of change in children's cognition, respectively. Children's task-approach behaviors at 14 and 24 months of age were related to the rate of change in children's cognition after controlling for the effects of maternal supportiveness and children's task-approach behaviors at 36 months of age. Additionally, maternal education and age were related to maternal supportiveness during mother-child interactions when the children were 14 months old.

The current study found that some anticipated relations were not supported. There were not statistically significant cross-lagged effects of children's task-approach behaviors on maternal supportiveness during mother-child interactions. Maternal supportiveness during mother-child interactions when children were 14 and 24 months of age were not related to the rate of change in children's cognition. Maternal characteristics were not associated with children's task-approach behaviors at 14 months of age, and marital status with the child's biological father and family income were not related to maternal supportiveness during mother-child interactions when children were 14 months old.

Decomposition of Effects

Decomposition of direct and indirect effects is useful to examine whether the effect of each explanatory variable on responsive latent constructs is direct or indirect through other variables by comparing the significance and magnitude of direct and indirect effects. Table 13 summarizes the results of total, direct, and indirect effects in the best-fitting model (Model 4). Results indicated the indirect effects of maternal education and age on maternal supportiveness when children were 24 and 36 months of age were statistically significant. Maternal education influenced the initial level of children's cognition and the rate of change in cognition indirectly. Children's task-approach behaviors at 14 and 24 months of age influenced the rate of change in children's cognition directly, as well as indirectly. The direct effect of children's task-approach behaviors at 14 months of age on the rate of change in children's cognition was negative, and the indirect effect of children's task-approach behaviors was positive. There were statistically significant indirect effects of maternal education and age on children's task-approach behaviors through maternal supportiveness.

Summary

The current study used structural equation modeling analyses to identify several aspects of longitudinal relations among maternal supportiveness, children's task-approach behaviors, and cognitive development when children were 14 through 36 months old. The

Table 13

Decomposition of Total, Direct, and Indirect Effects among Variables in the Best-fitting Model (N = 400)

Variable		Effect		
Responsive	Explanatory	Total (*t*)	Direct (*t*)	Indirect (*t*)
Sup1	Edu	.38 (7.54)*	.38 (7.48)*	--
	Inc	.03 (.48)	.03 (.49)	--
	Age	.22 (4.31)*	.22 (4.31)*	--
	Mar	.08 (1.59)	.08 (1.59)	--
C-Task1	Edu	.09 (1.60)	.09 (1.60)	--
	Inc	-.03 (-.44)	-.03 (- .44)	--
	Age	.09 (1.70)	.09 (1.70)	--
	Mar	.08 (1.40)	.08 (1.40)	--
Sup 2	Edu	.23 (6.53)*	--	.23 (6.53)*
	Inc	.02 (.48)	--	.02 (.48)
	Age	.13 (4.11)*	--	.13 (4.11)*
	Mar	.05 (1.58)	--	.05 (1.58)
	Sup1	.61 (12.34)	.61 (12.34)*	--
C-Task2	Edu	.11 (4.07)*	--	.11 (4.07)
	Inc	.00 (.08)	--	.00 (.08)
	Age	.07 (3.39)*	--	.07 (3.39)
	Mar	.04 (1.90)	--	.04 (1.90)
	Sup1	.24 (4.28)*	.24 (4.28)*	--
	C-Task1	.19 (3.29)*	.19 (3.29)*	--
Sup 3	Edu	.15 (5.94)*	--	.15 (5.94)*
	Inc	.01 (.48)	--	.01 (.48)
	Age	.08 (3.95)*	--	.08 (3.95)*
	Mar	.03 (1.57)	--	.03 (1.57)
	Sup1	.39 (9.37)*	--	.39 (9.37)*
	Sup2	.64 (13.23)*	.64 (13.23)*	--

Table 13 (continued)

Variable		Effect		
Responsive	Explanatory	Total (*t*)	Direct (*t*)	Indirect (*t*)
C-Task3	Edu	.10 (3.90) *	--	.15 (3.90)*
	Inc	.00 (.32)	--	.01 (.32)
	Age	.06 (3.28)*	--	.08 (3.28)*
	Mar	.03 (1.76)	--	.03 (.76)
	Sup1	.24 (4.23)*	.19 (2.56)*	.06 (1.20)
	Sup2	-.05 (-.70)	.05 (-.07)	--
	C-Task1	.07 (2.97)*	--	.07 (2.92)*
	C-Task2	.36 (6.37)*	.36 (6.37)*	--
Cog-Level	Edu	.14 (4.44)*	--	.14 (4.44)*
	Inc	.00 (-.02)	--	.00 (-.02)
	Age	.09 (3.46)*	--	.09 (3.46)*
	Mar	.05 (1.92)	--	.05 (1.92)
	Sup1	.29 (5.38)*	.29 (5.38)*	--
	C-Task1	.31 (4.60)*	.31 (4.60)*	--
Cog-Rate	Edu	.04 (2.34)*	--	.04 (2.34)*
	Inc	.01 (.67)	--	.01 (.67)
	Age	.02 (.97)	--	.02 (.97)
	Mar	.00 (-.22)	--	.00 (-.22)
	Sup1	.16 (5.25)*	--	.16 (5.25)*
	Sup2	.08 (2.33)*	--	.08 (2.33)*
	Sup3	.15 (3.00)*	.15 (3.00)*	--
	C-Task1	-.21 (-3.07)*	-.26 (-3.84)*	.05 (2.77)*
	C-Task2	.28 (5.29)*	.20 (3.54)*	.08 (3.58)*
	C-Task3	.23 (4.27)*	.23 (4.27)*	--

Note. Direct and indirect effects may not sum to the total effect due to rounding.
* t-ratio > 2

participants were mothers and their children with developmental risks and from low-income families.

In the measurement model, sensitivity, stimulation, and positive regard showed appropriate indicators of the latent construct of maternal supportiveness. Sensitivity/activity level, adaptation/cooperation, and attention/persistence represented appropriate indicators of the latent construct of children's task-approach behaviors. Most measurement error variances for each indicator of maternal supportiveness and children's task-approach behaviors at one time point were associated with those of each indicator at the other time points. Concurrent correlations between maternal supportiveness and children's task-approach behaviors at 14 and 24 months were statistically significant but those at 36 months were not. In the growth-curve model using raw scores for the Bayley Mental Scale, correlation between variances of the initial level of raw scores for the Bayley Mental Scale and the rate of change in these raw scores was negative, indicating that children whose initial raw scores were higher showed a tendency to have slower developmental rates in their raw scores than did children who initially had lower raw scores at 14 months. The general increment of children's raw scores for the Bayley Mental Scale might not be linear.

This study compared six proposed models. Model 1 tested stabilities in maternal supportiveness and children's task-approach behaviors across time. Model 2 examined the transactional effects of earlier maternal supportiveness on later children's task-approach behaviors. Model 2a tested transactional effects of children's earlier task-approach behaviors on later maternal supportiveness. Model 3 examined both the transactional effects of earlier maternal supportiveness on children's later task-approach behaviors and of children's earlier task-approach behaviors on later maternal supportiveness. Model 4 includes the direct effects of earlier children's task approach behavior on rate of change in children's cognition, and Model 5 includes the direct effects of earlier maternal supportiveness on rate of change in children's cognition. Among these six models, Model 4 was found to be the one that best fit the data based on results of the series of model comparisons.

Based on the best-fitting structural model, Model 4, maternal supportiveness and children's task-approach behaviors were somewhat stable across time. Stability in maternal supportiveness was moderate, and the magnitude of stability in maternal supportiveness between the times the children were 14 and 24 months old was similar to that between the times when they were 24 and 36 months old. Stability of children's task-approach behaviors was weak especially, the magnitude of stability between children's task-approach behaviors at 14 and 24 months of age, which was weaker than that between 24 and 36 months of age. Stability of children's task-approach behaviors became stronger as children grew older, which indicates that children are establishing their own task-approach behavior during this age period.

There were cross-lagged effects of maternal supportiveness when the children were 14 months old on children's task-approach behaviors at 24 and 36 months. However, there were not statistically significant cross-lagged effects of children's task approach behavior on maternal supportiveness. Children's task-approach behaviors across time influenced the initial levels of children's cognition and the rates of changes in children's cognition, whereas maternal supportiveness at 14 and 36 months influenced the initial level of children's cognition and the rate of change in children's cognition, respectively.

Decomposition of direct and indirect effects of each explanatory variable on responsive latent constructs revealed that maternal education influenced the initial level of children's cognition and the rate of change in cognition indirectly. Children's task-approach behaviors at 14 and 24 months of age influenced the rate of change in children's cognition directly, as well as indirectly. Children's task-approach behaviors at 14 months of age had a direct negative effect on the rate of change in children's cognition and a positive influence on the rate of change in children's cognition through the initial level of children's cognition. Earlier maternal supportiveness influenced the rate of change in children's cognition indirectly. There were statistically significant indirect effects of maternal education and maternal age on children's task-approach behaviors through maternal supportiveness.

CHAPTER 5. CONCLUSIONS

Discussion

This study investigated longitudinal relations among maternal supportiveness, task-approach behavior, and cognitive development for low-income children with developmental risk indicators when they were 14 months old through 36 months old. The children who participated in this study received or were likely eligible for Part C services or had suspected developmental delays. This longitudinal investigation, which was conducted with a relatively large national sample of children who have developmental risks, can help to generalize knowledge about relations among mother-child interaction behaviors, children's task-approach behaviors, and children's cognition across time to the population of low-income children with developmental risks.

To understand children's cognitive development across time, this study used growth-curve model analyses rather than autoregressive analyses (e.g., Krishnakumar & Black, 2002; Wijnroks, 1998) or comparison of scores measured at two different time points (e.g., Croft et al., 2001). Growth-curve model analyses provide information about patterns of cognitive development for individual children. In the present study, the initial levels of children's cognition and the rates of cognitive development were estimated with raw scores for the Bayley Mental Scale at three different time points. This study found that the rate of cognitive development for these children was not linear, but having only three data points limited the ability to find any specific nonlinear patterns. These findings suggests the need for future studies that enable collection of more than three data points, which should facilitate understanding of whether children's rates of cognitive development is represented by a quadratic pattern.

Among these children with developmental risks, their rates of cognitive development were associated with their initial levels of cognition; however, this relation was negative. These findings contrast with those of Hauser-Cram et al. (2001), who examined child and parental characteristics, parent-child interaction, and mastery motivation in an effort to explain developmental outcomes for children with disabilities. Hauser-Cram et al. found positive relations between the initial level of children's cognition and the rate of developmental growth. They examined children who were older than those in the current study (e.g., 3, 5, and 10 years old). Limited numbers of studies examining these longitudinal relations with growth-curve models make it hard to draw conclusions regarding the nature of these relations. Most earlier studies that have used autoregressive analyses have found that children's earlier cognition predicted their later cognition, and regression coefficients in autoregressive analyses have been positive due to the stability of scores (e.g., Cohen & Parmelee, 1983; Krishnakumar & Black, 2002; Wijnroks, 1998). Thus, it is unclear whether the negative relation that this study identified between children's initial levels of cognition and their rates of cognitive development appears only among children with developmental risks or if this relation could be generalized to all children. One explanation of the negative relation between the initial cognitive levels and the rate of cognitive development may be that the majority of children without visible physical disabilities follow typical developmental patterns early, and their developmental delays appear only later. Future research with children who do and do not face specific developmental risks is needed to identify how relations between initial levels of cognition and rates of cognitive development may differ for these two groups of children. The other explanation of this negative relation between the initial level of cognition and the rate of cognitive development may be that correlations between individual scores at two different timepoints tend to decrease. This phenomenon, called regression toward the mean, often occurs in examinations of longitudinal data.

Many previous researchers have found relations between parent-child interactions and children's cognition. Some researchers have found concurrent relations between parent-child interaction and children's cognition (Ayoun, 1998; Poehlmann & Fiese, 2001; Tzurie & Weiss, 1998; van Bakel & Riksen-Walrave, 2002, etc.). Others have found that earlier parent-child interaction predicted children's later cognition (Cohen & Parmelee, 1983; Croft, et al., 2001; Wijnroks, 1998). The current study also found positive relations between maternal supportiveness and children's cognition. This study found that maternal supportiveness when children were 14 months old was related to children's initial levels of cognition, and that maternal supportiveness when children were 36 months old was related to their rates of cognitive development. Hauser-Cram et al. (2001) found that earlier parent-child interaction predicted the initial level of child cognition, as well as the rate of cognitive development. However, Model 5 in the current study, which includes paths predicting the rate of children's cognitive development with any earlier maternal supportiveness while controlling for the influence of later maternal supportiveness, was not an appropriate one to fit these data. According to the decomposition of effects, there were positive indirect effects of earlier maternal supportiveness on the rate of children's cognitive development through later maternal supportiveness and children's task-approach behaviors.

Croft et al. (2001) found that parents interacted less positively with their adopted children when they had developmental delays. Also, Shonkoff et al. (1992) reported that rates of interaction between mothers and their infants who had disabilities were lower than those reported for the normative population. However, the current study examined relations between maternal supportiveness and cognitive development only for children with developmental risks; thus, this study cannot explain whether maternal supportiveness for children with developmental risks is different from that for typically developing children or whether specific type of disability was a predictor of children's cognitive development, as Hauser-Cram, et al. (2001) found.

Maternal supportiveness was moderately stable across the time points when children were 14, 24, and 36 months of age. This stability in maternal behavior during mother-child interaction is consistent with findings of other researchers (Pettie & Bates, 1984; Owen, et al., 1998; Weinfield, Ogawa, & Egeland, 2002), with the exception of the study conducted by Crockenberg and McCluskey (1986), which used different measures of maternal behavior between three months and 12 months of child age. Overall, maternal interaction behavior tends to be stable across time but is predicted by familial risk factors and children's developmental risk factors. Previous researchers investigating relations between familial risk factors and maternal interaction have found that family risk factors related negatively to parental interaction. Researchers have used family income, maternal education, marital status, maternal depression, and maternal separation anxiety to represent family risk factors (NICHD ECCRN, 1999; Parent, et al., 2000; Pauli-Pott, et al., 2000). This study found that maternal education and age were related to maternal supportiveness, but they were not associated with children's task-approach behaviors.

Mastery motivation is one child characteristic that influences children's cognition. The current study used children's task-approach behaviors to represent mastery motivation and found that task-approach behaviors were weakly stable across time, but stability in task-approach behaviors became strong as children got older. Maslin-Cole et al. (1995) also found moderate stability in mastery motivation. Previous studies have found statistically significant concurrent relations between children's mastery motivation and cognition (Jennings, et al., 1984; Niccols, et al., 2003; Turner & Johnson, 2003). However, relations between earlier mastery motivation and later cognition are not consistent. For example, Jennings et al. (1984) found a positive relation between one dimension of infants' mastery motivation and cognition at age three only for girls. Messer et al. (1986) found that early mastery motivation was negatively related to children's later cognition. The current study showed that earlier task-approach behavior related to initial levels of cognition, as well as the rate of cognitive development, whereas previous studies have predicted children's later cognition with earlier mastery motivation. Results indicated that children's task-approach behaviors at the three time points influenced the rate of cognitive development. However, children's task-approach behaviors at 14 months related negatively to the rate of cognitive development. This result is consistent with findings that initial levels of children's cognition influence their rates of cognitive development negatively even though the relation between children's mastery motivation at 14 months of age and the level of cognitive development is positive. The current study indicates that the longitudinal relation between children's task-approach behaviors and the rate of cognitive development becomes stronger as children get older. This shift in the relation may occur between the ages of 14 and 24 months. This might be one explanation for the inconsistencies among findings of other researchers who have examined relations between cognition and mastery motivation. In order to verify this explanation, more longitudinal studies of relations between mastery motivation and cognition are necessary.

In the current study, earlier maternal supportiveness influenced children's later task-approach behaviors. Previous researchers have also found that mother-child interaction influenced children's mastery motivation (Kelley, et al., 2000; Maslin-Cole, et al., 1993; Turner & Johnson, 2003). There are concurrent relations between mother-child interaction and children's mastery motivation at early ages, and these relations become weaker over time. Earlier parent-child interaction behavior is related to children's later mastery motivation (Kelley, et al., 2000; Maslin-Cole, et al., 1993), but it appears that these relations may be different across time. There is a need for more investigation of these longitudinal relations. Other researchers have identified gender effects on relations between mastery motivation and cognition (Hauser-Cram, et al., 2001; Jennings et al., 1984; Messer, et al., 1986). However, this study did not examine gender differences in this phenomenon since the Hauser-Cram et al. and Messer et al. studies did not find statistically significant gender effects.

Children are also active agents in creating their social environments and influencing their cognitive development. However, few empirical studies have been conducted to investigate whether children's mastery motivation influences parent-child interaction behavior even though a couple of studies have investigated transactional relations between children's temperament and parental interaction. Previous findings on the transactional relations between parent-child interaction and children's temperament are not consistent. For example, the NICHD Early Child Care Research Network (1999) found that earlier child irritability predicted later parental interaction, but Crockenberg and McCluskey (1986) and Owens, et al. (1998) have not found any transactional relations between these two variables.

Similarly, this study did not support transactional relations of earlier task-approach behaviors on later maternal supportiveness.

Relations between children's risk factors, including disability status, and children's cognition have been supported by previous research, which has shown that children's risk factors (e.g., developmental risk and neonatal birth risks) are related to parent-child interaction (NICHD ECCRN, 1999; Parent, et al., 2000) and children's cognition (Halpern, et al., 2001; Hauser-Cram, et al., 2001; Poehlmann & Fiese, 2001). Results have shown that these relations were mediated by parent-child interaction (Poehlmann & Fiese, 2001), or that children's risk factors moderated relations between parental interaction and developmental outcomes (e.g., Halpern, et al., 2001; Hauser-Cram, et al., 2001). These findings on relations between children's risk factors and other variables are not consistent. Several researchers examining children's mastery motivation have focused on samples of children with disabilities (e.g., Hauser-Cram, 1996; Niccols, et al., 2003; Vlachou & Farrell, 2000) or risk factors (e.g., Turner & Johnson, 2003). Some researchers have found different relations between mastery motivation and cognition for children with and without disabilities (Niccols, et al., 2003; Vlachou & Farrell, 2000), but others have not found differences in these relations (Hauser-Cram, 1996). Even though these findings are not consistent and have used relatively small samples, children's risk factors, including disability status, may moderate the relations between mastery motivation and cognition or between maternal interaction and cognition. Rather than investigating the effect of children's risk factors, the current study investigated the relations among maternal supportiveness, children's task-approach behaviors, and cognition with children facing a variety of developmental risk factors. Therefore, this study did not provide conclusive findings regarding the relations between children's risk factors and other variables, such as parent-child interaction, mastery motivation, and cognition.

Methodologically, previous studies examining longitudinal relations among parent-child interaction behavior, mastery motivation, and cognition have used different dimensions of mastery motivation at different time points and have been conducted with small samples. The current study used the same measures of maternal supportiveness, children's task-approach behaviors, and cognition across time to examine longitudinal relations among these constructs with a relatively large sample. This study used multidimensional scales to capture children's task-approach behaviors and maternal supportiveness and analyzed these multidimensional scales using structural equation models. These procedures account for measurement error variances and consider multicollinearity issues among indicators of each construct, representing an improvement over multiple regression analyses techniques. Future studies of child development using structural equation modeling and growth-curve modeling analyses are recommended.

Implications

Parent-child interaction is an important environmental influence on the development of children who face developmental risks. Specifically, supportive parent-child interactions can buffer the effects of developmental risks on children's cognitive development. This study provides evidence that maternal supportiveness influences initial levels of cognition, as well as rates of cognitive development for children who have developmental risks. Maternal supportiveness is related to children's cognitive development, as well as their mastery motivation. Earlier maternal supportiveness may influence children's rates of cognitive development through their later task-approach behaviors and later maternal supportiveness rather than directly influencing children's rates of cognitive development. While maternal supportiveness is quite stable, it is influenced by maternal education and age. This indicates that mothers who are young (e.g., teen mothers) and have less education are less likely to engage their children in supportive interactions. These young and less-educated mothers from low-income families may need additional support. However, current intervention programs that focus on parenting and parent involvement, as well as child development, such as Early Head Start, serve children and families based on their income eligibilities. Therefore, it may be more important to target interventions designed to enhance mothers' interactions with their children at mothers who are young and have less education, especially when their children have identified developmental risks. This becomes very challenging, indeed, because developmental delays are often underidentified among very young children, especially those from vulnerable populations (e.g., teen mother, family living in poverty).

The current study provides evidence that among children with developmental risks, children's task-approach behaviors directly influence initial cognitive levels and rates of cognitive development. Children's task-approach behaviors become more stable as they get older (e.g., higher stability between 24 and 36 months of age than between 14 and 24 months of age). These results indicate that the period between 14 and 24 months of age may be a critical point to facilitate development of children's task-approach behaviors. More research using longitudinal data is necessary to confirm these findings, and further, to determine when children's task-approach behaviors stabilize.

Among these children with developmental risks, the relation between the initial level of cognition and the rate of cognitive development was negative. This relation suggests that it might be very difficult to identify children who have developmental delays or disabilities at very early ages, especially when children do not have physical disabilities. Based on the notion that starting intervention earlier is generally more effective for children who have developmental delays or moderate disabilities, this study suggests that researchers need to improve early diagnosis capabilities to screen children with developmental risks, and interventionists need to consider more sensitive criteria, some of which may be related to early interactions, when making decisions regarding eligibility for services. Since children who have developmental risks and who come from low-income families are more likely to show developmental delays, it is especially important to direct service provided to be vigilant in monitoring the development of these children.

Limitations

This study investigated longitudinal relations among maternal supportiveness, children's task-approach behaviors, and cognitive development for children with developmental risks when they were 14, 24, and 36 months old. One of the important issues in longitudinal studies is how to retain participants for a long period, and the high rate of attrition is one of the biggest barriers to conducting longitudinal studies. The participants in this study were not different from those who were not included in the study due to attrition in terms of family income, maternal age, quality of parent-child interaction, or children's cognition. However, there were differences in the level of maternal education and children's task-approach behaviors at 14 months between the children and mothers who were and were not included in this study. One possible explanation of maternal education differences between theses groups may be that mothers who had higher educational levels were more likely to have completed their training or education and have also taken new jobs. Moving or taking new jobs may make them difficult to keep in the study later. Mothers of children who had a difficult time (e.g., fussy, upset, or crying, etc.) during any assessment or videotaped play sessions at 14 months were more likely to decline further participation of study. Thus, interpretation and generalization of these research findings need to be done carefully.

Results of this study indicated that the rate of children's cognitive development might not be linear and may be quadratic. In order to test whether the rate of children's cognitive development is quadratic or not, more than three observational data points across time are required, but in this study, children's cognitive development was measured at only three time points, making it impossible to examine quadratic changes. Even though three longitudinal data points provide more information than two data points, future studies must collect data at more time points to provide a more complete understanding of children's cognitive development and relations among the rates of cognitive development and other influential variables.

The current study employed structural equation modeling analyses to test a series of models. Structural equation modeling analyses do not allow for examination of cause-effect relationships but rather test the relations between latent constructs based on variances and covariances among observed variables. Therefore, even though this study examined the directions of relations between variables, these results do not give evidence of real causal relations between variables. However, cross-lags effect models give insight regarding causal relations between variables. Carefully designed conceptual models based on theories and empirical evidence will facilitate further understanding of cause-effect relations. Thus, this study suggests a need for more theoretical and empirical research to examine the relations among parent-child interaction, children's mastery motivation, and cognitive development.

REFERENCES

Administration for Children and Families U.S. Department of Health & Human Services. (1999, December). Leading the way: Characteristics and early experiences of selected Early Head Start programs Volume I: Cross-Site Perspectives. Retrieved November 23, 2004, from http://www.mathematica-mpr.com/publications/PDFs/Leadvol1.pdf.

Administration for Children and Families U.S. Department of Health & Human Services. (2002, June). Making a Difference in the Lives of Infants and Toddlers and Their Families: The Impacts of Early Head Start Volume I: Final Technical Report. Retrieved November 23, 2004, from http://www.acf.hhs.gov/programs/core/ongoing_research/ehs/impacts_vol1/impacts_vol1.pdf.

Administration for Children and Families U.S. Department of Health & Human Services. (2003, April). Early Head Start benefits children and families. Retrieved November 23, 2004, from http://www.acf.hhs.gov/programs/core/ongoing_research/ehs/ehs_intro.html.

Ayoun, C. (1998). Maternal responsiveness and search for hidden objects and contingency learning by infants. *Early Development and Parenting, 7,* 61-72.

Bacharach, V. R., & Baumeister, A. A. (1998). Direct and indirect effects of maternal intelligence, maternal age, income, and home environment on intelligence of preterm, low-birth-weight children. *Journal of Applied Developmental Psychology, 19* (3), 361-375.

Barocas, R., Seifer, R., Sameroff, A. J., Andrews, T. A., Croft, R. T., & Ostrow, E. (1991). Social and interpersonal determinants of developmental risk. *Developmental Psychology, 27,* 479-488.

Barrett, K. C., Morgan, G. A., & Maslin-Cole, C. (1993). Three studies on the development of mastery motivation in infancy and toddlerhood. In D. J. Messer (Ed.), Mastery motivation in early childhood: Development, measurement and social processes (pp. 83-108). London: Routledge.

Bayley, N. (1993). *Bayley Scales of Infant Development* (2nd ed.). San Antonio, TX: The Psychological Corporation.

Belsky, J. (1984). The determinants of parenting: A process model. *Child Development, 55,* 83-96.

Belsky, J., Rha, J. H., & Park, S. Y. (2000). Exploring reciprocal parent and child effects in the case of child inhibition in US and Korean samples. *International Journal of Behavioral Development, 24*, 338-347.

Benasich, A. A., & Brooks-Gunn, J. (1996). Maternal attitudes and knowledge of child-rearing: Associations with family and child outcomes. *Child Development, 67,* 1186-1205.

Black, M. M., Hess, C. R., & Berenson-Howard, J. (2000). Toddlers from low-income families have below normal mental, motor, and behavior scores on the revised Bayley scales. *Journal of Applied Developmental Psychology, 21*, 655-666.

Bradley, R. H. & Corwyn, R. (1999). Parenting. In C. Tamis-LaMonda & L. Balter (Eds), *Child psychology: A handbook of contemporary issues* (pp. 339-362). NY: Garland.

Bradley, R. H. & Whiteside-Mansell, L. (1998). Home environment and children's development: Age and demographic differences. In M. Lewis & C. Feiring (Eds.), *Families, risk, and competence* (pp. 133-157). Mahwah, NJ: Lawrence Erlbaum.

Bradley, R. H., Caldwell, B. M., & Rock, S. L. (1988). Home environments and school performance: A ten-year follow-up and examination of three models of environmental action. *Child Development, 59,* 852-867.

Bradley, R. H., Crowyn, R. F., McAdoo, H. P., & Coll, C. G. (2001). The home environments of children in the United States part I: Variations by age, ethnicity, and poverty status. *Child Development, 72,* 1844-1867.

Bradley, R.H. & Caldwell, B.M. (1995). Caregiving and the regulation of child growth and development: Describing proximal aspects of caregiving systems. *Developmental Review, 15*, 38-85.

Bradley, R.H. & Caldwell, B.M. (1995). The acts and conditions of the caregiving environment. *Developmental Review, 15*, 92-96.

Bradley, R.H. (1995). Environment and parenting. In M. Bornstein (Ed.), *Handbook of parenting,* Vol. 2 (pp. 235-262). Hillsdale, NJ: Lawrence Erlbaum.

Brady, C. L., O'Brien, C., Berlin, L., & Ware, A. (1999). Child-Parent Interaction Rating Scales for the Three Bag Assessment.

Bronfenbrenner, U. (1989). The ecology of the family as a context for human development: Research perspectives. *Developmental Psychology, 22,* 723-742.

Bronfenbrenner, U., Morris, P. A. (1998). The ecology of developmental processes. In W. Damon & R. M. Lerner (Ed.), *Handbook of child psychology (5th ed.), volume one,* New York, NY: Wiley, 993-1027.

Brownell, C. A., & Kopp, C. B. (1991). Common threads, diverse solutions: Concluding commentary. *Developmental Review, 11*, 288-303.

Caldwell, B. M., & Bradley, R. H. (1984). *Home Observation for Measurement of the Environment*. Little Rock, AR: University of Arkansas at Little Rock.

Cohen, S. E., & Parmelee, A. H. (1983). Prediction of five-year Stanford-Binet scores in preterm infants. *Child Development, 54*, 1242-1253.

Crockenberg, S. (1987). Predictors and correlates of anger toward and punitive control of toddlers by adolescent mothers. *Child Development, 58,* 964-975.

Croft, C., O'Connor, T. G., Keaveney, L., Groothues, C., Rutter, M., & the English and Romanian Adoption Study Team. (2001). Longitudinal change in parenting associated with developmental delay and catch-up. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 42,* 649-659.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*, 257-273.

Fagot, B. L., & Gauvain, M. (1997). Mother-child problem solving: Continuity through the early childhood years. *Developmental Psychology, 33(3)*, 490-488.

Fagot, B. L., Gauvain, M., & Kavanagh, K. (1996). Infant attachment and mother-child problem-solving: A replication. *Journal of Social and Personal Relationship, 13*(2), 295-302.

Gauvain, M., & Fagot, B. L. (1995). Child temperament as a mediator of mother-toddler problem solving. *Social Development, 4*(3), 257-273.

Halpern, L. F., Carcia Coll, T. G., Meyer, E. C., & Bendersky, K. (2001). The contributions of temperament and maternal responsiveness to the mental development of small-for-gestational-age and appropriate-for-gestational-age infants. *Applied Developmental Psychology, 22,* 199-224.

Hauser-Cram, P., Warfield, M. E., Shonkoff, J. P., & Krauss, M. W. (2001). Children with disabilities: A longitudinal study of child development and parent well-being. *Monographs of the Society for Research in Child Development, 66*(3), 1-131.

Heckhuasen, H. (1992). The development of mastery and its perception within caretaker-child dyads. In D. J. Messer (Ed.), *Mastery motivation in early childhood: Development, measurement, and social processes* (pp. 55-79). London: Routledge.

Hooper, S. R., Burchinal, M. R., Roberts, J. E., Zeisel, S., & Neebe, E. C. (1998). Social and family risk factors for infant development at one year: An application of the cumulative risk model. *Journal of Applied Development Psychology, 19,* 85-96.

Jennings, K. D., Yarrow, L. J., & Martin, P. P. (1984). Mastery motivation and cognitive development: A longitudinal study from infancy to 3½ years of age. *International Journal of Behavioral Development, 7,* 441-461.

Kelley, S. A., Brownell, C. A., & Campbell, S. B. (2000). Mastery motivation and self-evaluative affect in toddlers: Longitudinal relations with maternal behavior. *Child Development, 71*, 1061-1071.

Kelly, J. F. & Barnard, K. E. (2000). Assessment of parent-child interaction: Implications for early intervention. In J. P. Shonkoff, & S. J. Meisels (Eds.), *Handbook of early childhood intervention* (2nd ed.). Cambridge, United Kingdom: Cambridge University Press.

Kivijärvi, M., Voeten, M. J. M., Niemelä, P., Räihä, H., Lertola, K., & Piha, J. (2001). Maternal sensitivity behavior and infant behavior in early interaction. *Infant Mental Health Journal, 22,* 627-640.

Kline, R. B. (1998). *Principles and practice of structural equation modeling*. New York: The Guilford Press.

Krishnakumar, A, & Black, M. M. (2002). Longitudinal predictors of competence among African American children: The role of distal and proximal risk factors. *Applied Developmental Psychology, 23,* 237-266.

Landry, S. H., Smith, K. E., Miller-Loncar, C. L., & Swank. P. R. (1997). Predicting cognitive-language and social growth curves from early maternal behaviors in children at varying degrees of biological risk. *Developmental Psychology, 33,* 1040-1053.

Linver, M. R., Brooks-Gunn, J., & Kohen, D. E. (2002). Family processes as pathways from income to young children's development. *Developmental Psychology, 38,* 719-734.

Lynch, M., & Cicchetti, D. (1998). An ecological transactional analysis of children and context: The longitudinal interplay among child maltreatment, community violence, and children's symptomatology. *Development and Psychopathology, 10,* 235-257.

MacTurk, R. H., Morgan, G., A., & Jennings, K. D. (1995). The assessment of mastery motivation in infants and young children. In E. R. MacTurk, & G. A. Morgan, (Eds.), *Mastery Motivation: Origins, conceptualizations, and applications. Vol. 12. Advances in Applied Developmental Psychology* (pp. 19-56). Norwood, NJ: Ablex Publishing Corp.

Magill-Evans, J., & Harrison, M. (2001). Parent-child interactions, parenting stress, and developmental outcomes at 4 years. *Children's Health Care, 30*, 135-150.

Magnuson, K. A., & Duncan, G. J. (2002). Parents in poverty. In M. H. Bornstein (ed.), *Handbook of parenting: vol. 4: Social conditions and applied parenting* (2nd Ed.) (pp. 95-121). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Maslin-Cole, C., Bretherton, I., & Morgan, G. A. (1993). Links with attachment security, maternal scaffolding and family climate. In D. J. Messer (Ed.), *Mastery motivation in early childhood: Development, measurement and social processes* (pp. 205-229). London: Routledge.

McCarthy, D. (1972). *McCarthy Scale of Children's Abilities*. New York: The Psychological Corporation.

McLoyd, V. C. (1990). The impact of economic hardship on black families and children: Psychological distress, parenting, and socioemotional development. *Child Development. Special Issue: Minority children, 61*(2), 311-346.

Messer, D. J., McCarthy, M. E., McQuiston, S., MacTurk, R. H., Yarrow, L. J., &Vietze, P. M. (1986). Relation between mastery behavior in infancy and competence in early childhood. *Developmental Psychology, 22*(3), 366-372.

Molfese, V. J., DiLalla, L. F., & Lovelace, L. (1996). Perinatal, home environment, and infant measures as successful predictors of preschool cognitive and verbal ability. *International Journal of Behavioral Development, 19,* 101-119.

Morgan, G. A., MacTurk, E. R., & Hrneir, E. J. (1995). Mastery motivation: Overview, definitions, and conceptual issues. In E. R. MacTurk, & G. A. Morgan, (Eds.), *Mastery Motivation: Origins, conceptualizations, and applications. Vol. 12. Advances in Applied Developmental Psychology* (pp. 1-18). Norwood, NJ: Ablex Publishing Corp.

Morgan, G. A., Maslin-Cole, C., Harmon, R. J., Busch-Rossnagel, N. A., Jennings, K. D., Hauser-Cram, P., & Brockman, L. (1993). Parent and teacher perceptions of young children's mastery motivation: Assessment and review of research. In D. J. Messer

(Ed.), *Mastery motivation in early childhood: Development, measurement and social processes* (pp. 109-131). London: Routledge.

Murray, L., Fiori-Cowley, A., & Cooper, P. (1996). The impact of postnatal depression and associated adversity on early mother-infant interactions and later infant outcomes. *Child Development, 67,* 2512-2526.

Niccols, A., Atkinson, L., & Pepler, D. (2003). Mastery motivation in young children with Down's syndrome: Relations with cognitive and adaptive competence. *Journal of Intellectual Disability Research, 47*(2), 121-133.

NICHD Early Child Care Research Network. (1997). Poverty and patterns of child care. In G. J. Duncan, & J. Brooks-Gunn (Eds.), *Consequences of growing up poor.* New York: Russell Sage Foundation.

NICHD Early Child Care Research Network. (1999). Child care and mother-child interaction in the first 3 years of life. *Developmental Psychology, 35,* 1399-1413.

Overton, W. F. (1997). Marching toward the millennium. *Human Development, 40,* 102-108.

Owens, E. B., Shaw, D. S., Vondra, J. I. (1998). Relations between infant irritability and maternal responsiveness in low-income families. *Infant Behavior & Development, 21,* 761-778.

Parent, S., Gosselin, C., & Moss, E. (2000). From mother-regulated to child-regulated joint planning activity: A look at familial adversity and attachment. *Journal of Applied Developmental Psychology, 21,* 447-470.

Pauli-Pott, U., Mertesacker, B., Bade, U., Bauer, C., & Beckmann, D. (2000). Contexts of relations of infant negative emotionality to caregiver's reactivity/sensitivity. *Infant Behavior & Development, 23,* 23-39.

Piaget (1952). *The origins of intelligence in children*. New York: Norton.

Poehlmann, J, & Fiese, B. H. (2001). Parent-infant interaction as a mediator of the relation between neonatal risk status and 12-month cognitive development. *Infant Behavior & Development, 24,* 171-188.

Rogoff, B. (1990). *Apprenticeship in thinking.* New York: Oxford University Press.

Rogosa D. R., Brand, D., & Zimowski, M. (1982). A growth curve approach to the measurement of change. *Psychological Bulletin, 92,* 726-748.

Rubin, K. H., Nelson, L. J., Larry, J., Hastings, P., & Asendorpf, J. (1999). The transaction between parents' perceptions of their children's shyness and their parenting styles. *International Journal of Behavior Development, 23,* 937-958.

Rutter, M., & the English and Romanian Adoptees (ERA) study team. (1998). Developmental catch-up, and deficit, following adoption after global early privation. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 39,* 465-476.

Sameroff, A. J., & Mackenzie, M. J. (2003). Research strategies for capturing transactional models of development: The limits of the possible. *Developmental and Psychopathology, 15,* 613-640.

Sameroff, A. J., Seifer, R., Baldwin, A., & Baldwin, C. (1993). Stability of intelligence from preschool to adolescence: The influence of social and family risk factors. *Child Development, 64,* 80-97.

Sameroff, A. J., Seifer, R., Barocas, R., Zax, M., & Greenspan, S. (1987). Intelligence quotient scores of 4-year-old children: Social-environmental risk factors. *Pediatrics, 79*, 343-350.

Seifert, K. L. (1993). Cognitive development and early childhood education. In B. Spodek (Ed.), *Handbook of research on the education of young children* (pp.9-23). New York: Macmillan Publishing Company.

Shonkoff, J. P., Hauser-Cram, P., Krauss, M. W., & Upshur, C. C. (1992). Development of infants with disabilities and their families. *Monographs of the Society for Research in Child Development, 57*(6), v-153.

Sroufe, L. A. (2000). Early relationships and the development of children. *Infant Mental Health Journal, 21*, 67-74.

Sugland, B. W., Zaslow, M. J., Smith, J. R., Brooks-Gunn, J., Coates, D., Blumenthal, C., Moore, K. A., Griffin, T., & Bradely, R. (1995). The early childhood HOME inventory ad HOME-Short Form in differing racial/ethnic groups: Are there differences in underlying structure, internal consistency of subscales, and patterns of prediction? *Journal of Family Issues, 16,* 632-663.

Tesh, E. M., & Holditch-Davis, D. (1997). HOME inventory and NCATS: Relation to mother and child behaviors during naturalistic observations. *Research in Nursing & Health, 20,* 295-307.

Turner, L. A., & Johnson, B. (2003). A model of mastery motivation for at-risk preschoolers. *Journal of Educational Psychology, 95*(3), 495-505.

Tzuriel, D., & Weiss, S. (1998). Cognitive modifiability as a function of mother-child mediated learning strategies, mothers' acceptance-rejection, and children's personality. *Early Development and Parenting, 7*, 79-99.

van Bakel, H. J. A., & Riksen-Walraven, J. M. (2002). Parenting and development of one-year-olds: Links with parental, contextual, and child characteristics. *Child Development, 73,* 256-273.

Vlachou, M., Farrell, P. (2000). Object mastery motivation in pre-school children with and without disabilities. *Educational Psychology, 20*(2), 167-176.

Vygotsky, L. (1929). The program of the cultural development of the child. Retrieved May 23, 2004, from *http:www.marxists.org/archive/vygotsky/1929/cultural_develoment.htm.*

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, Mass: Harvard University Press. (Original work Published 1934).

Wachs, T. D., & Combs, T. T. (1995). The domains of infant mastery motivation. In E. R. MacTurk, & G. A. Morgan, (Eds.), *Mastery Motivation: Origins, conceptualizations, and applications. Vol. 12. Advances in Applied Developmental Psychology* (pp. 147-164). Norwood, NJ: Ablex Publishing Corp.

Watson, J.E., Kirby, R.S., Kelleher, K.J., & Bradley, R.H. (1996). The effects of poverty on the home environment: An analysis of three year outcome data for low birthweight premature infants. *Journal of Pediatric Psychology, 21,* 419-431.

Weinfield, N. S., Ogawa, J. R., & Egeland, B. (2002). Predictability of observed mother-child interaction from preschool to middle childhood in a high-risk sample. *Child Development, 73,* 528-543.

Whiteside-Mansell, L., & Bradley, R.H. (1996). Early home environment and mental test performance: A structural analysis. *Early Education & Development, 7,* 277-295.

Wijnroks, L. (1998). Early maternal stimulation and the development of cognitive competence and attention of preterm infants. *Early Development and Parenting, 7,* 19-30.

APPENDIX A

HUMAN SUBJECTS REVIEW COMMITTEE APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office of Research Compliance
Vice Provost for Research and
Advanced Studies
2810 Beardshear Hall
Ames, Iowa 50011-2036
515 294-4566
FAX 515 294-7288

TO: Hyun-Joo Jeon

FROM: Ginny Austin, IRB Coordinator

RE: IRB ID # 03-826
DATE REVIEWED: November 13, 2003

The project, "Longitudinal Relationships of Mother-Child Interaction and Child's Task-approach to Early Cognitive Development of Children with Developmental Risks," has been declared exempt from Federal regulations as described in 45 CFR 46.101(b)(4).

(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

To be in compliance with ISU's Federal Wide Assurance through the Office of Human Research Protections (OHRP) all projects involving human subjects, must be reviewed by the Institutional Review Board (IRB). Only the IRB may determine if the project must follow the requirements of 45 CFR 46 or is exempt from the requirements specified in this law. Therefore, all human subject projects must be submitted and reviewed by the IRB.

Because this project is exempt it does not require further IRB review and is exempt from the Department of Health and Human Service (DHHS) regulations for the protection of human subjects.

We do, however, urge you to protect the rights of your participants in the same ways that you would if IRB approval were required. This includes providing relevant information about the research to the participants. Although this project is exempt, you must carry out the research as proposed in the IRB application, including obtaining and documenting (signed) informed consent, if applicable to your project.

Any modification of this research should be submitted to the IRB on a Continuation and/or Modification form to determine if the project still meets the Federal criteria for exemption. If it is determined that exemption is no longer warranted, then an IRB proposal will need to be submitted and approved before proceeding with data collection.

cc: HDFS

ORIGINAL

For IRB Use Only		
	Review Date: ______	IRB ID: 03-826
	Approval Date: ______	Length of Approval: ______
	Approval Expiration Date: ______	FULL Committee Review: ______
	EXEMPT per 45 CFR 46.101(b): 4 Date: 11/13/03	Minimal Risk: ✓
	EXPEDITED per 45 CFR 46.110(b) ______	More than Minimal Risk: ______
	Category ______, Letter ______	Project Closed Date: ______

ISU NEW HUMAN SUBJECTS RESEARCH FORM

IRB
NOV 10 2003

SECTION I: GENERAL INFORMATION

Principal Investigator (PI): Hyun-Joo Jeon	Phone: 294-4205	Fax: 294-1765
Degrees: M.S.	Correspondence Address: 63 LeBaron Hall	
Department: Human Development & Family Studies	Email Address: hjjeon@iastate.edu	
Center/Institute: N/A	College: Family Consumer Sciences	
PI Level: ☐ Faculty ☐ Staff ☐ Postdoctoral ☒ Graduate Student ☐ Undergraduate Student		

Title of Project: Relationships
Longitudinal Relationships of Mother-Child Interaction and Child's Task-approach to Early Cognitive Development of Children with Developmental Risks
Project Period (Include Start and End Date): [*mm/dd/yy*][11/15/03] to [*mm/yy/dd*][5/10/04]

FOR STUDENT PROJECTS	
Name of Major Professor/Supervising Faculty: Carla A. Peterson	Signature of Major Professor/Supervising Faculty:
Phone: 294-4898	Campus Address: 58 LeBaron Hall
Department: Human Development & Family Studies	Email Address: carlapet@iastate.edu
Type of Project: (check all that apply) ☐ Research ☐ Thesis ☒ Dissertation ☐ Class project ☐ Independent Study (490, 590, Honors project) ☐ Other. Please specify:	

KEY PERSONNEL

List all members of the research team including the principal investigator, his/her degrees, their position at ISU (or other organization) and role on the project, their training and most recent date of their training if known. Please use additional space as necessary. For projects involving animals, please include the veterinary, animal caretakers and technical staff. For projects involving human subjects, please include anyone who will have contact with the subjects.

NAME & DEGREE(S)	POSITION AT ISU & ROLE/SPECIFIC DUTIES ON PROJECT	TRAINING & DATE OF TRAINING
e.g., *John Jones, MD, PHD*	*M.D. at Mary Greeley Medical Center, Co-Principal Investigator. For animal studies please list specific duties, e.g., will perform surgery, will perform blood draws, responsible for animal care, will perform biopsies, daily monitoring. etc.*	*ISU Human Subject Training, 10/15/02; Radiation Safety Training, 10/01/02; Blood Borne Pathogen Training, 11/13/02; Eleven years of laboratory use of blood borne pathogens.*
1. Hyun-Joo Jeon	M.S. Graduate Student at Iowa State University, Principal Investigator. For data analyses with raw data	ISU Human Subject Training, 9/28/00
2. Carla A. Peterson	Associate Professor at Iowa State	ISU Human Subject Training, 9/29/00

FOR IRB USE ONLY:

Initial action by the Institutional Review Board (IRB): 11/13/03

[X] Project approved. Date: 11/13/03 03-826

[ ] Pending further review. Date: ______

[ ] Project not approved. Date: ______

Follow-up action by the IRB:

Rick Sharp ______ 11/13/03 ______

IRB Approval Signature Date

APPENDIX B

OPERATIONAL DEFINITIONS FOR MATERNAL SUPPORTIVENESS BEHAVIOR

Maternal Sensitivity Scale:

1. **Very Low Sensitivity**. Interactions are characteristically adult-centered and/or the mother is unavailable and un-responsive to the child's signals, moods, interests and needs.
2. **Low Sensitivity**. There is little evidence of maternal sensitivity. Most of the interaction is adult centered and/or the mother is mostly not contingently responsive.
3. **Moderately Low Sensitivity**. Mother displays infrequent and/or weak indicators of sensitivity while the mother is sometimes sensitive, the balance is in the direction of insensitivity.
4. **Moderate Sensitivity**. The frequency and quality of the mother's sensitivity and insensitivity are about equal. It is this inconsistency, which prevents the mother from receiving a higher rating.
5. **Moderately High Sensitivity**. Mother displays more sensitivity than not. The mother demonstrates sensitivity in many interactions, but may show some insensitivity.
6. **High Sensitivity.** Maternal behavior is characterized by sensitivity but the mother may show minimal insensitivity by hesitating to respond to distress, "missing" a signal from the child or missing an opportunity to praise the child.
7. **Very High Sensitivity**. Mother is very sensitive and responsive throughout the interaction. Insensitivity is never striking. Interactions are the child-centered. Mother praises the child.

Maternal Cognitive Stimulation Scale:

1. **Very Low Cognitive Stimulation**. The mother provides no cognitive stimulation. No attempt is made to teach the child anything or to provide any cognitive stimulation. Mother is either totally uninvolved or fails to provide any information about the toys or situation.
2. **Low Cognitive Stimulation**. Mother provides infrequent or weak cognitive stimulation. The mother displays few conscious or purposeful attempts to engage in development-fostering experiences, or any stimulation s/he provides is not matched to the child's interest or ability.
3. **Moderately Low Cognitive Stimulation**. Mother provides some cognitive stimulation with some of the toys, or minimal-level cognitive stimulation, but most of the interaction is not characterized by cognitive stimulation that is suited to the child's interest or ability.
4. **Moderate Cognitive Stimulation**. Mother provides cognitive stimulation during much of the session, but overall does not engage in behaviors that stimulate a higher level of cognitive development in the child. Mothers with this rating may label and point out features of the toys or may model pretend play but no clear attempts to elaborate or teach are observed.
5. **Moderately High Cognitive Stimulation**. Mother provides cognitive stimulation throughout the session, some of which stimulates a higher level of mastery or sophistication, but there are some periods in which it is infrequent and does not exhibit features of the higher scores. This rating should be given to mothers who are characteristically stimulating, but could provide more frequent and/or higher quality

stimulation. Mother may attempt to engage the child in pretend play, but the effort are either unmatched to the child's interest or ability or are not as stimulating as those found in mothers rated "6."

6. **High Cognitive Stimulation**. Mother clearly seeks to stimulate a higher level of mastery, understanding or sophistication and does so during most of the session. Efforts to engage in pretend play must be evident.

7. **Very High Cognitive Stimulation**. Mother clearly seeks to stimulate a higher level of understanding, or sophistication (i.e., trying to engage in pretend play) and does so consistently throughout the session.

Maternal Positive Regard Scale:

1. **Very Low Positive Regard**. Mother displays no positive regard.
2. **Low Positive Regard**. Mother displays almost no positive regard. One or two fleeting instances of positive regard may be observed. These positive expressions (laughing, smiling), however, appear to be inappropriate to the situation or an inaccurate expression of mother's feeling. The mother may be expressionless, flat or negative.
3. **Moderately Low Positive Regard**. Mother displays infrequent and/or weak signals of positive regard. The intensity and frequency of positive regard are low.
4. **Moderate Positive Regard**. Mother displays some positive regard, but it is not predominant in the interaction. There may be signs of general enjoyment, warmth, and positive expressions but they are neither intense nor frequent. This mother may be positive to the child, but the mother gives no direct praise (or weak praise) or rarely retains eye contact with the child.
5. **Moderately High Positive Regard**. Mother frequ3ntly displays positive regard, which may include some praise of the child, or consistent, clear enjoyment of the child.
6. **High Positive Regard**. Mother frequently displays positive regard and praise. Some of these expressions are clearly enhancing of self-esteem and directed to the child's behavior or individual attributes/qualities.
7. **Very High Positive Regard**. Mother is very positive throughout the session in terms of facial and vocal expressiveness and behavior. Affect is positive and spontaneous. The mother shows a range of expressions and behaviors, which are all clearly positive. The mother's consistent expressions of positive regard are clearly enhancing of the child's self esteem.