Using Voice-Recording Technology to Investigate the Contributions of Mothers' Management Language to Children's Executive Functions

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Psychology)
in The University of Michigan
2012

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This dissertation is dedicated to my mother, Janeen Worzalla,
who has supported me throughout all of my educational pursuits,
and to my first academic mentor, Professor Ann Ellis.

Acknowledgements

First and foremost, I must acknowledge the constant guidance and support of my mentors, Fred Morrison and Pam Davis-Kean. Above all you have inspired me with your passion for research and taught me to think like a researcher. I would also like to thank Priti Shah and Alison Miller for their support in the dissertation process.

This dissertation would not have been possible without the additional support of my fellow graduate students and all of the members of the Pathways to Literacy and Family, Culture, and Development Labs. The project would also never have succeeded without my wonderful team of research assistants: Jenny Lee, Mahya Rahimian Mashhadi, Maggie O'Reilly Treter, Trisha Paul, Kriti Samaymantri, and Valerie Schroder. I would also like to thank Dave Childers and the Center for Statistical Consultation and Research for helping me make the most of these data.

Finally, I would like to thank my partner Noah Bindman for supporting me from near and far through every challenge of my degree.

Table of Contents

List of Tables

Table

List of Figures

Figure

Chapter I

Introduction

Extensive evidence documents that children's readiness for formal schooling and subsequent educational success depends not only on conventional literacy, math, and language skills, but also on several cognitive capacities necessary for regulating one's behavior (for a review, see Shonkoff & Phillips, 2000). In particular, investigators have highlighted the critical role of *executive functions* (EF), a set of core cognitive skills that enable children to ignore distractions and inhibit inappropriate behaviors (i.e., inhibition), hold and manipulate information in mind (i.e., working memory), and flexibly switch attention focus and strategies (i.e., cognitive flexibility or switching; Diamond, 2006). Together, these skills are essential for individuals' ability to manage their attention and behavior during everyday tasks. In school settings, they are needed for remembering and following teacher instructions, inhibiting the urge to talk out of turn or get out of one's seat, and solving problems by manipulating information in mind.

Because of their clear links to children's success in a number of arenas, research is currently focused on understanding how environmental factors shape EF skills early in life. Bronfenbrenner's bioecological model of development points to a number of interacting environmental factors that might affect children's EF development, including

caregivers, the school setting, and the larger cultural and socioeconomic contexts in which the family resides (Bronfenbrenner & Morris, 2006). In early childhood, caregiver-child interactions are a major source of *proximal processes*, direct interactions between the individual and the environment through which developmental change takes place. Indeed, it is clear that the effects of more distal factors (e.g., socioeconomic status) on child development are mediated by parenting (e.g., Bradley & Corwyn, 2003; Yeung, Linver, & Brooks-Gunn, 2002).

Likewise, research shows that in early childhood, parents are the most important environmental influence on children's cognitive and social development, even when compared with other experiences such as early child care (NICHD-ECCRN, 2004). Consequently, investigators have recently focused on parents' contributions to children's EF skills. The evidence that sensitive parenting (i.e., a combination of warmth, responsivity, and support for children's autonomy) can foster attention, memory, and self-control skills is abundant (e.g., Belsky, Pasco Fearon, & Bell, 2007; NICHD-ECCRN, 2003, 2005; Zhou, Eisenberg, Wang, & Reiser, 2004). Although this research is suggestive of the powerful role that parenting may play in the development of EF skills, it does not reveal which specific dimensions of parenting actually promote EF growth.

The current work seeks to investigate this topic more fully by using innovative voice-recording technology, the Learning ENvironment Analysis System (LENA), to gather data on parent-child conversations in the home and investigate their relations with children's EF skills. In the service of this overarching goal, the data provided by the LENA system are used to investigate three specific research aims. The first is to provide an account of preschoolers' home language environment including the amount and type

of conversation that occurs during different periods of the day and week. The second major aim is to use this new window into parent-child conversations to improve upon past coding schemes that capture parents' behavior management strategies, a parenting practice that is related to children's EF development. Finally, relations between parents' management practices and children's executive function skills will be investigated in detail.

Defining Executive Function

Evidence from numerous sources demonstrates the importance of EF skills for individuals' academic and social outcomes. However, a major challenge to the study of children's EF is defining and assessing EF in early childhood (Morrison & Grammer, 2012). Many interrelated constructs and definitions have been put forth and it is sometimes difficult to bring together the various constructs. Most researchers can agree that EF can be defined generally as a group of skills related to controlling, directing, and planning one's behavior.

The current research relies on a definition offered by Diamond (2006), which describes the three basic cognitive skills that support internal control of behavior: attention, inhibition, and working memory. These skills are thought to allow individuals to ignore distraction and flexibly switch attention, inhibit automatic responses, and hold and manipulate information in mind. This definition of EF is very similar to the definition of self-regulation provided by some developmental researchers when examining how this group of cognitive skills relates to different types of achievement in preschool, kindergarten and beyond (McClelland, Acock, & Morrison, 2006; Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005). At issue is whether or not the various

literatures are tapping the same construct but using different terms, but this problem is not the focus of the proposed work.

Blair and Ursache (2011) offer a useful framework for conceptualizing EF as it relates to self-regulatory capacities, broadly conceived. They place EFs under the general heading of self-regulation, which refers to "the primarily, but not necessarily, volitional management of attention and arousal, including stress physiology and emotional arousal, for the purposes of goal-directed action" (p. 305). They posit that EFs are psychological abilities that work together in an integrated manner to assist in the task of self-regulation, which requires other skills as well. For example, EFs do not dictate one's choice of the goal to pursue; self-regulation as a whole implies rational thought and good decision-making skills as well.

Although evidence from adults suggests that the component skills of EF are independent of one another and may be treated separately (Miyake et al., 2000), evidence regarding the structure of EF in early childhood is unclear. Many have suggested that EF tasks can be divided into those that tap "hot" EF, those that involve an affective component (e.g., desire for food, money, etc.) and "cold" EF, cognitive tasks that are not affectively salient. However, recent work using factor analyses to group the different types of measures suggests that these two domains are not different from one another (Allan & Lonigan, 2011). Further research on the components of EF in early childhood has mixed findings. Some suggests that the components of EF are a unitary construct that differentiates throughout childhood (e.g., Hughes, Ensor, Wilson, & Graham, 2010), whereas other studies have found that there are two or three weakly correlated factors that make up EF in young children (Matte-Gagné & Bernier, 2011; Smith-Donald, Raver,

Hayes, & Richardson, 2007). Indeed, in a recent review of the EF literature Hughes (2011) advises against making conclusions about the structure of EF in children. For this reason, the current work will examine the components of EF separately so that any divergent relations between parenting and individual components of EF will be revealed.

Other Relevant Constructs

Research and conceptualizations relevant to EFs come from a variety of sources as many researchers have been intrigued by individuals' ability to independently manage their attention and behavior. Likewise, many researchers have examined how parenting and the parent-child relationship shape children's capacity for self-regulation, broadly defined. The differences and similarities between the various conceptualizations and approaches are perhaps best understand with a small amount of historical context.

At the risk of over-generalizing, research that occurred before the 1990s can be characterized as focusing heavily on constructs pertaining to self-regulation in the context of social interactions, particularly within the mother-child relationship. In these cases, the focus was on how children internalize parents' demands and social norms and use internal control to direct their behavior (Kochanska, 1993, 1995; Kochanska, Coy, & Murray, 2001; Maccoby, 1980). For example, Baumrind's work on parenting styles was driven by the need to identify parenting practices that encouraged in children "behavior which while well socialized is also wilful (sic) and independent" (Baumrind, 1966, p.887).

Building on this foundation, during the 1990s, researchers' attention turned to the mental capacities that power self-regulation. This shift seems to be the result of two trends. Researchers studying effortful control seem to have been largely motivated by the

desire to understand the mechanisms through which parenting might lead to the later development of emotion regulation and externalizing problems. Effortful control offered a mediator between parenting and children's emotional and behavioral adjustment. At the same time, evidence from new neuroimaging techniques demonstrated that patients with damage to the prefrontal cortex emerged to show common deficits in attention, inhibition, and decision-making despite other intact cognitive functions (for a review see Zelazo, Carlson, & Kesek, 2008). Neurological evidence engendered the study of both EFs and, as described below, new perspectives on how attention processes in particular support self-regulation.

Effortful control. The former trend led to many studies on *effortful control*, which is probably the most relevant alternative conceptualization of self-regulation for the current study of parenting and child EF outcomes. The heart of effortful control, and the definition most often used in extant research is "the ability to suppress a dominant response to perform a subdominant response" (Kochanska, Murray, & Harlan, 2000; Rothbart & Bates, 2006, p. 220). The concept of effortful control comes from work on temperament and thus emphasizes the stability of self-regulatory capacities after their emergence in early childhood. In short, individual differences in effortful control are characterized by 1) observable consistencies in individuals' emotions and behavior, 2) stability that is apparent beginning early in life, and 3) links between inhibitory capacities and the individual's physiological make-up (Rothbart, Ellis, & Posner, 2011). According to this theoretical perspective, effortful control emerges and solidifies in early childhood as the relevant brain areas develop to support such functions. Tasks used to assess effortful control tap both hot and cold EF skills. The canonical battery of EC measures

includes Stroop-like tasks (inhibition), delay of gratification paradigms, and several other tasks that require the suppression of an automatic response (Kochanska et al., 2000).

In practice, there is very little about the definition of effortful control that is incompatible with current conceptualizations of EF. The only obvious difference is that researchers from the effortful control tradition do not study working-memory. Working-memory skills are certainly required for effortful control assessments, all of which require the child to hold instructions in mind to perform a challenging task, but the tasks do not directly assess the individual's working memory capacity. Researchers targeting effortful control have been more interested in behavioral adjustment than children's academic outcomes, so the ability to hold information in mind for problem-solving purposes has not been emphasized. Besides this potentially important difference, work on effortful control and parenting seems to differ from work on EF mainly in terms of emphasis: researchers from the temperament tradition focus primarily on the effects of parenting on children's inhibition skills before the age of three, and emphasize the stability of these skills after early childhood. EF researchers focus on the development of the neurological structures and cognitive skills that support self-regulation in a wider range of age groups, with little (at least until recently) attention to the effects of socialization on these skills (Lewis & Carpendale, 2009). On the whole, research findings from the effortful control perspective have much to offer for the study of parenting and child EF and will thus be used to provide background and hypotheses for the current work.

Executive attention. Meanwhile, the rise of neuroimaging technology led to studies of EF and an additional, similar construct, *executive attention*, which presents an

alternative perspective regarding the cognitive capacities that support self-regulation. The idea of a central executive system whose purpose is to direct other cognitive networks dates back to Baddeley's model of working memory (Baddeley, 1992). Likewise, researchers working from the attention literature emphasize the role of attention in monitoring and controlling other cognitive functions (Rueda, Posner, & Rothbart, 2011).

The attention model of self-regulation includes three neurologically and functionally separate attention networks, which have been revealed through the study of attention tasks using neuroimaging (Posner & Fan, 2008). The first, the *alerting network*, serves to create and maintain an alert state so that the individual is looking for incoming stimuli. The *orienting network* serves to direct attention to specific sensory and internal events, allowing the individual to focus in on something in particular. The executive attention network serves to monitor and coordinate other brain networks and resolve conflicts when they arise (Rothbart, Sheese, & Posner, 2007). For example, the commonly used Stroop task requires the executive network to resolve the conflict between color information and written information. Executive attention is thus posited to control other brain networks to facilitate self-regulation (Rueda et al., 2011). In this way, the role of executive attention closely parallels that of EF in regulating cognition and behavior.

Researchers working from the attention perspective have argued that the development of self-regulation during infancy, toddlerhood, and the preschool years is supported by the development of the executive attention network (Rothbart, Sheese, Rueda, & Posner, 2011). Indeed, the emergence of executive attention has recently been posited to support effortful control (Rothbart et al., 2007). Genetic and environmental contributions to this transition have been identified, but research on parenting experiences and the

development of executive attention is limited. In sum, the construct of executive attention is very similar to EF but the extant literature on executive attention does contributes limited findings related to parent-child interactions and child EF. It does, however, provide a complementary perspective on the definition and development of EFs.

Work-Related Skills. Finally, additional perspectives focus on the entire self-regulatory process as it occurs in everyday contexts such as the classroom. One construct, which comes primarily from the education literature, is *work-related skills*: one's ability to use self-regulation to manage one's learning in a classroom setting. It includes skills in areas such as organizing one's work, cooperating with others, staying on task, following directions (McClelland, Morrison, & Holmes, 2000). Teacher-reported measures of children's work-related skills at the beginning of kindergarten have been linked to children's achievement during kindergarten and the rate of their academic growth from kindergarten to second grade (McClelland et al., 2000). Assessments of children's work-related skills are relatively imprecise in that they tap many components of self-regulation including EF, motivation, and social skills. However, they are predictive of children's success in school and might be thought of as everyday manifestations of EF.

The Importance of Executive Function for Children's Academic and Behavioral Success

Executive function skills have been linked to a number of dimensions of children's academic and behavioral adjustment. Strong EF skills at the beginning of kindergarten predict faster growth and better achievement in math and reading throughout elementary school (Blair & Razza, 2007; McClelland et al., 2006). During the preschool years, there are also strong associations between children's EF skills and their problem behaviors

(Hughes & Ensor, 2008). Indeed, strong EFs in kindergarten and elementary school appear to protect children from developing externalizing problems (e.g., NICHD-ECCRN, 2003). Further, the effects of parenting on both children's externalizing problems and academic achievement are likely mediated at least in part by children's EF development (e.g., Belsky et al., 2007; Valiente et al., 2006; Valiente, Lemery-Chalfant, & Reiser, 2007).

EF skills, namely delay of gratification abilities in preschool, have also been found to predict a number of aspects of long-term success. Mischel and colleagues found that preschoolers with strong delay of gratification skills have better outcomes 10 years later in adolescence. They were reported by parents to have stronger academic and social competence, and they were better able to manage their attention, behavior, and responses to stress and frustration (Mischel, Shoda, & Peake, 1988; Shoda, Mischel, & Peake, 1990). Perhaps even more importantly, a study using a more comprehensive collection of self-control ratings from the child, parent, and teacher found this group of skills to predict key outcomes including physical health indicators, income and credit problems, and criminal convictions well into adulthood (i.e., age 32) (Moffitt et al., 2011).

Despite the clear importance of EF skills and other self-regulatory capacities at the start of formal schooling, teachers report that many children come to kindergarten without adequate skills (Rimm-Kaufman, Pianta, & Cox, 2000). Young children from low-socioeconomic status backgrounds are especially prone to poor EF skills (for a review see Hackman & Farah, 2009). Research suggests that insufficient EF skills may be a key factor in achievement gaps between low-SES children and their middle-SES peers (e.g., Evans & Rosenbaum, 2008). In sum, EF skills can be considered a key

mediator between children's early experiences (e.g., parenting and socioeconomic factors) and their success throughout schooling and early adulthood (NICHD-ECCRN, 2003).

Environmental and Genetic Contributions to Executive Functions

EFs are shaped by a complex interplay between child characteristics and environmental influences (De Bellis, 2001; Rueda et al., 2011; Schore, 1996). One important factor is the child's genetic make-up (Rothbart & Bates, 2006). For example, research with identical twins (adolescents and adults) demonstrates the heritability of executive attention (Fan, Wu, Fossella, & Posner, 2001). Research has also uncovered several links between the alleles of specific genes (e.g., *dopamine DR4* (DRD4), *monoamine oxidase a* (MAOA), *catechol-O-methyltransferase* (COMT) and both the executive attention network and executive functions (for a review, see Dickinson & Elvevag, 2009; Rothbart et al., 2007).

It is also clear that the environment in which children reside, including the parenting, schooling, and socioeconomic contexts, plays a role in the development of EF (Burrage et al., 2008; Farah et al., 2008; Hackman & Farah, 2009). Research using a variety of methods reveals that in humans the neurological structures that support EF skills (namely those in the prefrontal cortex) mature relatively late in development and are thus open to environmental experience throughout early childhood (e.g., Blair, 2006; Casey, Giedd, & Thomas, 2000; Diamond, 1990; Giedd et al., 1999; Zelazo et al., 2008). Indeed, studies of EF and SES also present strong evidence that these skills are open to experience (Ardila, Rosselli, Matute, & Guajardo, 2005; Noble, McCandliss, & Farah, 2007; Noble, Norman, & Farah, 2005). This is in contrast to other areas of the brain: the

lateral/prefrontal/working memory and anterior cingulate/cognitive control areas of the brain show associations with socioeconomic status in kindergarten but not the Occipitotemporal/Pattern vision and Parietal/Spatial cognition areas (Farah et al., 2006).

Several types of training programs have been successful in improving EF skills. The first were able to train preschool children to improvements in inhibitory control performance on a Go No-Go task by teaching children increasingly complex rule systems (Dowsett & Livesey, 2000; Kloo & Perner, 2003). A seminal study by Rueda and colleagues (Rueda et al., 2005) used a video game program to improve children's EF and subsequently, their scores on intelligence tests. The 4-year-olds were essentially trained to perform like more advanced 6-year-olds. Finally, a handful of studies have successfully trained working memory in older adults (Morrison & Chein, 2011; Richmond, Morrison, Chein, & Olson, 2011).

Comprehensive early childhood interventions also show initial success in improving children's EF skills (Bierman, Domitrovich et al., 2008; Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008). In particular, the Head Start REsearch-Based, Developmentally Informed (REDI) program has employed two strategies for fostering children's EF skills: 1) social interactions and modeling and 2) directly targeting EF skills through specially-designed tasks (Bierman, Nix et al., 2008; Rueda et al., 2005). The REDI program was shown to benefit children's EF skills and in this way, foster improvements in academic achievement.

Interplay between Parenting and Child Genes and Temperament

When considering the effects of experiences like parenting style and practices on children's development, one major issue that needs to be taken into account is the role that the child's characteristics and behaviors play in parent-child interactions.

To start, it is clear that children with different genetic and temperamental predispositions are affected by parenting experiences in different ways. Research on these *child by parenting interactions* is in its beginning stages with regards to EF but there is much evidence to suggest that the importance of parenting for children's self-regulation development, broadly conceived, varies depending on the child (Belsky, Bakermans-Kranenburg, & van Ijzendoorn, 2007). For example, work by Kochanska, Philibert, and Barry (2009) reveals that mother-child attachment security at age 15 months is related (positively) to self-regulation only for children who have at least one short allele of the 5-HTTLPR serotonin transporter gene (i.e., those at risk for poorer regulatory skills). The current work will examine this issue by examining how child temperament might moderate the relations between everyday parenting practices to children's EF skills.

Child characteristics and proclivities may also cause parents and other caregivers to change how they behave towards individual children. The transactional model posits that parents and children affect one another in a bidirectional manner (Sameroff, 2009). More specifically, parents react to children's characteristics and changing skill levels by making changes to their parenting strategies and behaviors. For example, Belsky and colleagues (2007) found longitudinal evidence that children's executive attention skills predict subsequent parenting behaviors at several time points during the early elementary school years. It is beyond the scope of the current work to directly examine transactional processes as they pertain to children's EF development. However, it is important to keep

in mind that child by parenting interactions and transactional processes are both at play throughout development (Kiff, Lengua, & Zalewski, 2011).

Executive Function Development as a Sociocultural Process

Many researchers and theorists have hypothesized that the primary mechanism through which EFs develop is in the context of social interactions, especially caregiver-child interactions (Lewis & Carpendale, 2009). Historically, Vygotsky's sociocultural theory posited that cognitive skills develop through a transformation from basic to higher order skills through cultural tools (language, symbols) and social interactions (for a review see Diaz, Neal, & Amaya-Williams, 1992). Indeed, EF skills are thought to develop in the context of social interactions between children and more skilled individuals (Vygotsky, 1978, see also Luria, 1961). This process, termed scaffolding, occurs when more skilled individuals provide tailored guidance that allows children to participate in tasks that they would be unable to complete independently (Rogoff, 2003; Vygotsky, 1978). For example, when playing a board game, parents may scaffold children's working-memory skills by providing reminders and instructing children to use repetition to hold an important rule in mind. Likewise, interactions with caregivers help infants and toddlers regulate their attention and behavior as their own abilities emerge. For these reasons, self-regulation researchers have characterized the development of self-regulation as a shift from "other-regulation" to "self-regulation" (Karreman, van Tuijl, van Aken, & Dekovic, 2008; Kopp, 1982).

However, several researchers have argued that the role of social interaction in EF development needs more in-depth investigation (Bernier, Carlson, Deschênes, & Matte-Gagné, 2011; Carlson, 2009; Lewis & Carpendale, 2009). Interactions with parents and

other caregivers, teachers, as well as siblings and peers may all play a role in young children's EF development. The current study focuses on the role of parent-child interactions, which have been identified as one of the most important factors during the preschool years, even when compared with school and peer influences (NICHD-ECCRN, 2004, 2005).

Defining Parenting

Before reviewing research on the relations between parenting and child EF outcomes, it is necessary to delineate the dimensions of parenting that may be important. There are many ways to conceptualize the major dimensions of parenting. Morrison, Bachman and Connor (2005) provide a useful 3-part model outlining the aspects of parenting that are key for children's achievement. The first dimension is the Home Learning Environment that parents create using books, conversation, games, and other learning experiences. More broadly conceived, this dimension includes the cognitive stimulation (i.e., learning materials and efforts to teach children) that parents provide during daily interactions. The second dimension is the degree of Warmth and Responsiveness parents use when interacting with their children. Warmth and Responsiveness encompasses both affective warmth (e.g., physical affection, positive reinforcement) and appropriate responses to the child's needs and bids for attention (Morrison & Cooney, 2002; NICHD-ECCRN, 2004). The final dimension is Autonomy Support vs. Control, the way that parents manage and guide children's behavior and activities. This dimension of parenting can be conceptualized as a continuum (Grolnick & Pomerantz, 2009). At one end, parents support children's autonomy by taking their perspectives and growing abilities into account and encouraging them to take an active role in joint endeavors. At the other end,

parents hamper children's participation in joint decisions by using pressure and dominance to promote parental goals.

Factor analyses have shown that this model accurately depicts variation in parenting behavior (Hindman & Morrison, 2010; Morrison & Cooney, 2002). However, the dimensions are intercorrelated and have been combined to create indices of sensitive parenting (NICHD-ECCRN, 1999). Some have argued that composite measures of parenting are more efficient and accurate than fine-grained measures of individual parenting dimensions (Egeland, Kalkoske, Gottesman, & Erickson, 1990). For example, several studies by the NICHD Early Childcare Research Network (ECCRN) have employed a composite measure of sensitive parenting drawn from observations of mothers and their children interacting during structured play tasks in the home. The composite includes all three major dimensions of parenting: cognitive stimulation, positive/negative regard and responsivity, and autonomy support/intrusiveness. Cronbach's alphas for the supportive parenting scale ranged from .70 to .78 throughout infancy, toddlerhood and the preschool years (NICHD-ECCRN, 1999). Findings related to the individual components of the 3-part model as well as research on more general measures of supportive parenting are reviewed below.

The Contributions of Parenting to Children's Executive Function and Related Outcomes

Despite the clear importance of EF skills for many aspects of children's success, only a handful of studies have examined relations between parenting and children's EF skills as currently defined. Indeed, some researchers have claimed that we know almost nothing about how parenting and child EF are related to one another. However**,** a body of relevant

findings can be gathered from other approaches to self-regulation. Literature examining effortful control (i.e., temperament characteristics relevant for self-regulation) and executive attention is highly relevant. These diverse approaches have all addressed relations between parenting and children's self-regulatory capacities and thus shed light on relations between parenting and child EF.

As described above, it can be difficult to bring together research from different theoretical approaches. The various literatures rely on different and sometimes incompatible definitions of the construct under study. Further, the plethora of measures used to study self-regulatory skills vary drastically in their validity and psychometric properties for assessment of children of different ages. Together these factors make it challenging to bring together findings from these diverse approaches into coherent conclusions about the role of parenting in child EF (Morrison & Grammer, 2012). Nevertheless, there are several robust themes that emerge from extant work.

General Measures of Sensitive Parenting

Although little is known about how parenting shapes EF per se, there is much evidence to suggest that sensitive parenting, broadly conceived, promotes children's EF skills. Sensitive parenting has been measured in multiple ways in the literature but encompasses several dimensions of parents' behavior including responsiveness to the child's needs and abilities, positive affect and warmth, and sometimes the amount of cognitive stimulation that parents provide. Sensitive parenting is thought to promote children's ability to manage their own attention and behavior by providing children with both affective and behavioral resources (Pomerantz & Thompson, 2008). For example, parents who express positive emotions and warmth provide children with the emotional

security to engage in challenging tasks. Parents who are responsive to children's needs and abilities also provide children with effective strategies and practice for solving problems.

Many studies from the effortful control literature support this idea. For example, a seminal study by Kochanska and colleagues (2000) brought together findings from a number of sources to create a comprehensive battery of direct assessments to measure EC in very early childhood (ages 22 and 33 months). The battery, now canonical in the field, taps delay of gratification, as well as a number of facets of inhibition including slowing down motor activity, lowering voice, and suppressing activity to signal. Mothers' responsiveness to children's signals and needs was observed in the home during everyday activities. The results showed that mother's responsiveness in terms of her promptness, sensitivity and acceptance of the child's needs predicted higher EC skills at 33 months, accounting for initial levels at 22 months.

Several studies have corroborated these findings using a variety of methods and age groups. Many studies of children's effortful control have examined as a mediator of the relations between parenting and children's development of externalizing problems. The vast majority found that indeed, sensitive parenting predicted higher subsequent EC skills, were a protective factor against behavior problems (Eisenberg, Cumberland, & Spinrad, 1998). Sensitive parenting predicts stronger effortful control outcomes at age 2 years (controlling for EC skills one year earlier) (Eiden, Colder, Edwards, & Leonard, 2009; Spinrad et al., 2007). These patterns were robust in early childhood (ages 4-6 years, Eisenberg et al., 2001), middle childhood (ages 6-10 years, Valiente et al., 2006), and early adolescence (ages 9-13 years, Eisenberg et al., 2005). Likewise, mothers' positive

and negative reactions to children's displays of negative emotion were similarly associated with 7- to 12-year-olds' effortful control skills (Valiente et al., 2007).

Findings drawn from work on more specific constructs related to EF affirm the trends from the effortful control work. A set of studies of the NICHD Study of Early Child Care and Youth Development (SECCYD) examined sustained attention and impulsivity (stop automatic response) outcomes. The SECCYD is a large, comprehensive, longitudinal study of childcare, parenting (and other environmental factors) on a diverse sample of American children's social and cognitive development. The composite measure of sensitive parenting, observed and measured at child age 3 years and younger, predicts children's sustained attention and inhibition skills on the continuous performance task at both 54 months and first grade (Belsky et al., 2007; NICHD-ECCRN, 2003, 2005).

The Moderating Role of Child Temperament

As discussed above, the effects of parenting on children's EF development may vary considerably depending on child characteristics. In particular, there is much evidence that genes and temperament moderate how children are affected by parental sensitivity. Taking child characteristics into account is crucial for obtaining an accurate understanding of how parenting relates to children's EF development (Pluess & Belsky, 2010).

According to one current hypothesis, certain biological predispositions place children at a higher risk than others of experiencing negative outcomes as a result of insensitive parenting (i.e., *the genetic vulnerability hypothesis* or the *diathesis-stress model*)(Belsky, 2005). Some research on children's self-regulation and related outcomes supports this hypothesis. For example, Sheese, Voelker, Rothbart, and Posner (2007) found that only

children with the seven repeat allele of the dopamine 4 receptor gene are vulnerable to insensitive parenting in terms of their activity level and impulsivity (though this relation was not present for children's effortful control). The literature also suggests that children who are predisposed to have higher levels of negative emotionality in infancy are more open to the negative effects of insensitive parenting (for a review see Belsky et al., 2007).

A second current hypothesis posits that children with genetic or temperamental risk factors also stand to benefit disproportionately from sensitive caregiving compared to children who are not at risk (i.e., the *differential susceptibility hypothesis*)(Belsky, 2005). Evidence for the differential susceptibility hypothesis has also been found with regards to older children's openness to the effects of both parenting and childcare quality (Pluess & Belsky, 2010). Sensitive parenting was more strongly linked to academic achievement and social skills in 10- and 11-year-olds who were rated as having a "difficult" temperament (i.e., high levels of activity, negative emotion, and low adaptibility to new people and situations) as infants (Pluess & Belsky, 2010). Likewise, findings from Blair's (2002) study of the effects of a comprehensive early intervention for impoverished, low birth weight infants shows that children who were rated as having high levels negative emotionality in infancy experienced notably greater benefits to their behavioral and intellectual outcomes than children without the negative emotionality risk factor. At this time, there is substantial evidence to support both the genetic vulnerability and differential susceptibility hypotheses. Further research is needed to clarify which provides the best fit for the relations between parenting and children's EF development.

Although the current study design does not permit the assessment of children's temperament in infancy, we will examine the role of child temperament (as rated by

mothers during preschool) as a moderator of the relations between parenting and child EF outcomes. Three major dimensions of temperament will be probed as potential moderators: effortful control, negative affectivity, and surgency/extraversion.

The primary focus of the current analysis is effortful control because as explained above, it has the most direct conceptual relation to EFs. Effortful control is conceptualized as children's ability to inhibit an automatic response across different situations. Children who are rated as being relatively high or low in this ability can thus be expected to react differently to parenting in terms of their EF development. Children high in this dimension may be better able to attend to and internalize parents' guidance. They may also have a stronger foundation of EF skills on which to build when given parental input.

Based on past research, negative affectivity may also serve as a moderator of the effects of parenting on children's EF development. Overall, high levels of negative emotionality in infancy seem to make children more vulnerable to parenting quality (Pluess & Belsky, 2010). Therefore, management language may be more strongly related to EF in children who are high in this dimension. On the other hand, the patterns from past work may not be replicated because past work has focused exclusively on temperament in infancy. Further, there is evidence to suggest that negative emotionality is not stable during early childhood, declining substantially as children go through toddlerhood into the preschool years (Partridge & Lerner, 2007). The role of negative affect during the preschool years thus may not be the same as it is in infancy.

The findings of this initial exploration of the role of child temperament will be useful for guiding further study of the role of child temperament as it relates to children's EF development.

Specific Dimensions of Parenting

Despite claims that the role of social interaction in children's EF development is "*terra incognita"* (Hughes & Ensor, 2010, p. 36), much is known about how sensitive parenting relates to children's effortful control and other skills that are nearly identical to EFs. The next step in this program of research is to identify more specific parenting dimensions and practices that foster children's EF development.

The general conclusions about sensitive parenting and children's EF-related skills are limited in their usefulness for several reasons. First, not all studies of composite measures of sensitive parenting are consistent. For example, Razza and colleagues (2010) examined this issue using a large sample (n = 1046) of low-income families and found just one association between maternal sensitivity and children's performance on a continuous performance task: lack of maternal hostility at age 3 significantly, positively predicted children's focused attention at age 5, a pattern that was present for "near-poor" children, but not those in poverty. As the authors explain, the lack of findings may be due to measurement issues, including the details of the continuous performance task used, which differed substantially from the one used in the SECCYD. However, these findings could also indicate that for very low-income children, quality of parenting is not relevant for the development of EF skills. Likewise, a study by Eisenberg and colleagues (2010) took into account the stability of both parenting quality and children's effortful control. This study also failed to find relations between a general measure of maternal sensitivity

and young (18, 30, 42-month-old) children's effortful control. It is unclear why some studies have failed to replicate the general trends regarding sensitive parenting and children's EF and effortful control skills.

A second issue is that composite measures of parenting don't reveal the mechanisms through which any aspects of parenting promote or hinder children's EF development. In order to provide parents with clear and specific recommendations on how foster children's EF skills, we must identify which parenting practices are most important. Some dimensions may be more effective than others, and those dimensions should be emphasized in interventions and programs involving parents and other caregivers.

With this ultimate goal in mind, the current study investigates a specific set of parenting behaviors within the dimension of autonomy support and control: *management language*, the statements, questions, and suggestions that parents use to guide children's behavior. As explained below, autonomy supportive parenting, and management language in particular, are strong candidates for specific aspects of parenting that may be targeted to support children's EF development.

Autonomy Support vs. Control

One dimension of parenting that has strong potential to affect children's EF development is autonomy support vs. control. At its core, autonomy support refers to parenting that allows and promotes children's active participation and input whenever possible (Grolnick & Pomerantz, 2009; Grolnick & Ryan, 1989). Autonomy supportive parents are willing to take children's point of view and follow their pace and interests rather than imposing their own agenda during joint tasks. Conversely, controlling parents promote their own goals and points of view, often issuing directives and commands; they

do not encourage children to take an active role in decision-making. Examples of autonomy-supportive parenting practices include permitting children to have a say in decisions that affect them (as opposed to ignoring their perspective) and allowing children to generate strategies for solving problems instead of directing them in doing so.

On the most basic level, parents who support children's autonomy (e.g., by encouraging children to participate actively in decision-making regarding their own activities and learning) provide children with opportunities to practice the EF skills. Conversely, parents who are controlling prevent children from exercising their decision-making skills and learning to function independently. Practicing EF during everyday situations could provide children with effective strategies and confidence when approaching future EF tasks.

Another way that autonomy support (as opposed to control) may promote children's EF skills is by fostering autonomous (vs. controlled) motivation in children. Self-Determination theorists have argued that when parents support children's autonomy via such practices as permitting children to make choices and using child-centered explanations, children experience their daily endeavors as driven by their own personal investment and interest rather than pressure from parents and others (e.g., Grolnick, Ryan, & Deci, 1991). Children with autonomy-supportive parents may come to view even difficult, tedious activities that require EF skills as personally important and even interesting. Thus, they may spend more time working on such activities; in fact, they may find it easier to focus and exert the effort necessary to successfully complete them (Muraven, Gagné, & Rosman, 2008). In essence, EF may become less taxing. Conversely, when parents are controlling and impose their own agenda on children,

children may be driven largely by controlled forces (e.g., avoiding punishment or attaining praise). Children's efforts to complete difficult activities may not only be taxing, but also abandoned when there is no pressure. Consequently, their EF skills may not be as developed as those of children with autonomy supportive parents (for another perspective on parents' autonomy support and children's EF skills, see Bernier et al., 2010).

Evidence from several sources suggests that autonomy supportive parenting fosters EF development. Of most relevance, recent work by Bernier, Carlson, and colleagues reveals positive associations between this dimension of parenting and very young (12-26 months) children's subsequent EF skills over and above mothers' education and children's early cognitive skills (Bernier, Carlson, & Whipple, 2010; Matte-Gagné & Bernier, 2011). Notably, when compared to maternal responsiveness and *mind-mindedness* (reference to mental states when talking to the child), autonomy support was the strongest predictor of children's EF (Bernier et al., 2010). Research on effortful control corroborates these findings (Kochanska & Knaack, 2003). For example, several studies suggest that decreased power assertion is positively linked to children's effortful control (Gilliom, Shaw, Beck, Schonberg, & Lukon, 2002; Karreman et al., 2008; Kochanska & Knaack, 2003).

Management Language

The current study focuses on management language, a parenting practice that conveys autonomy support and control on an everyday basis. Management language consists of several types of commands, suggestions, and statements that parents use to guide children's behavior (Worzalla, Hindman, Bowles, & Morrison, 2012). Management

language takes place in the home everyday, regardless of the activity, and it provides a readily quantifiable aspect of parents' everyday interactions with their children. Through management language, parents may offer children opportunities to give input into the flow of the activity. By counting the number of times that parents use commands, which do not provide choice, and other types of suggestions and questions that solicit the child's input, we can quantify the number of opportunities that parents provide for their children to actively participate in determining the flow of the activity.

Management language has been studied in many contexts. The vast majority of studies contrast directives (i.e., commands) with indirect requests, suggestions and explanations. Management language has generally been used as a way to investigate differences in control between mothers with different characteristics. For example, early work by Kochanska and colleagues examined control strategies and their effectives for mothers with and without depression. The first study sought to describe and analyze control strategies of mothers with and without depression, and to look at changes in strategies used as children grew older (Kuczynski, Kochanska, Radke-Yarrow, & Girnius-Brown, 1987). The results revealed several developmental trends as children got older: 1) a shift from physical to verbal control strategies; 2) increases in bargaining and reasoning (persuasive strategies); and 3) increase in reprimands. A second study showed that all mothers used more "unclear" commands and fewer reprimands and positive incentives for older children (5 years) than younger children (ages 1½ to 3½) (Kochanska, Kuczynski, & Maguire, 1989). Mothers with depression seemed less able to tailor their strategies to children's developmental stage: when children were toddlers, well mothers used more directives and reprimands than depressed mothers, whereas when

children were 5 years old they used fewer directives than depressed mothers. In a similar vein, work by Winsler and colleagues explored differences in management language used by parents of children with and without ADHD (Winsler, Diaz, McCarthy, Atencio, & Chabay, 1999). Parents of children with ADHD used more negative control, less praise, and less withdrawal of physical control as children developed than parents of children without ADHD.

Only a couple of studies have examined management language in terms of children's EF outcomes and the findings are inconsistent. As described earlier, controlling parenting is associated with poorer compliance and self-regulation outcomes. Likewise, directive strategies have been found to lead to children's direct resistance (i.e., defiance) of mothers' requests (Kuczynski et al., 1987). Work by Landry, Smith, and colleagues is among the only work to examine this type of language in conjunction with children's EF skills. Their work contrasted directives (commands) with "scaffolding" language, which was defined broadly as any utterance that provides the child with information or hints about relations between objects and ideas (Landry, Miller-Loncar, Smith, & Swank, 2002). Although the measures of EF were not conventional, the findings showed that directives (i.e., commands) support EFs at early (2 years) but not later (3½ and 4½) ages.

With so few studies having examined associations between management language and EF or related constructs, further research is needed. The current study uses a combination of naturalistic observation methods and several measures of children's EF skills to examine this topic in depth.

Methods for Studying Parenting

One of the greatest obstacles to fully understanding parents' impact on EF is

finding ways to study everyday parent-child interactions. Extant research has employed a variety of methods for collecting information about parenting, each with its own set of strengths and weaknesses.

Many studies have used survey methods to collect information on parent's behaviors with children (Morrison & Cooney, 2002). Parents are asked to indicate how often they engage their children in certain activities (e.g., going to the museum) and to rate statements about their parenting practices and interactions with their children (e.g., "Once I decide on a punishment, I always follow through," or "I have warm intimate moments with my child"). These sorts of surveys have been useful for pointing out which aspects of parenting might important for children's EF development. For example, the findings of Hindman and Morrison (2009) suggest a relation between parent control behaviors and other learning-related social skills such as cooperation and self-control. However, parent-report methods are subject to social desirability bias and thus may provide an inaccurate picture of parenting.

A second popular method of studying parenting is to carry out short, in-home observations (Caldwell & Bradley, 1984), which can be used to collect information about the physical environment (e.g., number of books) and the quality of mothers' interactions with their children (e.g., warmth, responsiveness). This method has revealed strong relations between different aspects of the home environment and children's cognitive development (Bradley, Corwyn, Burchinal, Pipes McAdoo, & Garcia Coll, 2001). Though useful for describing behaviors in the home and relatively fast and easy to administer, these measures do not capture the full extent of variability in parenting across different activities and they do not provide nuanced data for describing interactions

between parent and child.

Our own work has sought to improve upon these initial studies by exploring new methods of studying the parenting behaviors that relate to children's EF skills. One project assessed parents' use of *management language*, the verbalizations parents use to guide and control children's behavior (Worzalla et al., 2012). Using videotapes of 127 parents and their preschool children interacting during an in-home, pretend birthday party task, I have identified two major types of management language: (1) Direction, directive statements that express commands and (2) Suggestion, questions or comments that put forth a possible action but give the child a degree of choice. The two types of management language correspond to varying levels of parent control with Direction indicating high parent control, and Suggestion designating low levels of parent control.

The study examined the frequency of the two types of management language during the pretend birthday as predictors of children's EF skills at age 3, and growth in these skills across the transition to kindergarten. Overall, the results indicate that all children demonstrate substantial EF growth during this time, but parents who use many Direction utterances tended to have children with lower EF at age 3. However, higher levels of Direction are associated with faster EF growth as children enter kindergarten and first grade. Conversely, a higher amount of Suggestion is positively related to children's EF at age 3, but negatively associated with growth. This suggests that during preschool, parents adjust their management language to their child's level of EF. Children with low levels of EF receive more commands, and children with high EF skills are given more questions and comments that allow them to participate in the decision-making process. In terms of growth, it seems that commands do not hinder children's

development of EF skills. The management language coding system has great potential for examining a ubiquitous aspect of everyday parent-child interactions that contributes to the development of children's EF skills. However, this initial exploration of management language was limited by the structured play context in which it was studied; the task was enjoyable for both parents and children, so the full range of management language needed for less enjoyable or stressful tasks was not displayed.

A few other studies have used methods that are more naturalistic to investigate this issue. For example, the work of Kochanska and Landry and colleagues relies on live coding carried out by a research assistant, who followed the mother and child around the house during everyday chores and play activities. A much more intensive technique was used by Lareau (2003), who sent trained researchers into the home for extended periods of time until families became accustomed to their presence. Lareau's work revealed qualitative differences in the way parents socialize their children to negotiate. Most recently, the UCLA Center on Everyday Lives of Families collected more than 800 hours of video footage of working families' home lives and is currently analyzing them to describe daily activities of working parents (Good, 2010).

It is clear that one of the most important steps in furthering our understanding of the effect of parent-child interactions on children's cognitive development will be to find new methods for studying everyday parent-child interactions in a naturalistic setting. The current study seeks to extend this work by developing a new method for studying parent-child interactions in the home so that the relations between parent-child conversations and children's EF development can be investigated.

The Learning ENvironment Analysis (LENA) System

One promising avenue is to use voice-recording technology to study parenting through the conversations parents and children have in the home. Once adapted for use with families, this approach could provide a new window into the everyday workings of parent-child interactions.

One voice-recording system that is particularly well suited to the task of investigating parent-child conversations is the Language ENvironment Analysis System (LENA). LENA is a voice-recording device that was developed so that parents, pediatricians, speech language pathologists and researchers could obtain information about a child's language environment and language development. It records conversations using a pager-sized Digital Language Processor (DLP) that children and adults wear in the pocket of custom-made clothing or other carrying device. The LENA DLP has the digital memory capacity to record language continuously for 16 hours. The audio file is transferred to a computer where the LENA System software automatically analyzes it. The resulting reports provide information about the number of words that were spoken to/near the child each hour as well as the number of hourly turn-taking interactions that the child engaged in with an adult. The LENA System can also estimate the number of child vocalizations (i.e., words or attempted words) produced each day. In addition to the data provided by the LENA software, the raw .wav sound file can be exported for more in-depth analysis of the content of parent-child conversations.

The current study uses the LENA System in both ways: 1) to collect information about young children's language environment, vocalizations, and conversational turns, and 2) to examine the content of mother-child conversations to see how it relates to children's concurrent EF skills. Because this is a time-intensive study that explores new

methodology, we focused only on mothers. Mothers are typically children's primary caregivers and there is evidence to suggest that mothers and fathers differ qualitatively in their parenting practices and behaviors toward the child (Parke, 2002). Because we will only be able to collect data on a maximum of 50 families and plan to focus on differences by socioeconomic status, we will not be able to include fathers as an additional comparison.

Family Routines and Rituals

The current study focuses on two daily routines: getting the child ready in the morning and bedtime. Although family routines are not the primary focus of the current research, this study will provide new information about preschoolers' daily routines in the home.

Research shows that family routines are important for the psychological and physical health of parents and children alike (for a review, see Fiese, Tomcho, Douglas, Josephs, Poltrock, & Baker, 2002). For example, structured bedtime routines are associated with improvements in children's sleep patterns as well as increased social competence (Keltner, 1990; Seymour, Brock, During, & Poole, 1989). Moreover, communication and structure during shared mealtimes can be helpful for reducing anxiety and encouraging adherence to diet and medication for children with a variety of clinical diagnoses (e.g., diabetes, asthma) (Fiese et al., 2002; Patton, Dolan, & Powers, 2008). Finally, regular family routines seem to have benefits for parents. Mothers who have more consistent family routines when their children are infants also tend to feel more competent and more satisfied with their roles as parents (Sprunger, Boyce, & Gaines, 1985). As one of the

first studies to capture preschoolers' daily routines using voice recorders, the current work will provide new data about these important family processes.

Researchers studying family routines face several conceptual and methodological challenges, some of which will be addressed by using the LENA voice-recording system to study family interactions in the home. Because the content of routines varies depending on the individual, family, and culture in question, there are many possible definitions of family routines (Fiese et al., 2002; Henderson & Jordan, 2010). The current definition outlined by Fiese and colleagues (2002) distinguishes routines based on the necessity and goal-driven nature of the tasks involved. Routines usually include communication about what needs to be done, and routines carry little symbolic meaning for family members; once the requisite tasks have been performed family members tend not to think about the routine again. Because so many different definitions are possible, the content of these measures varies greatly across studies and it is difficult to bring together the findings (Henderson & Jordan, 2010).

Finding ways to study family interactions in the home presents the same methodological challenges as studying parent-child interactions in the home, but with the added challenge of trying to capture how all individuals in the family interact with one another. Past research has employed a variety of methods including parent diaries, surveys and checklists, and in-home observations to study family routines (Henderson & Jordan, 2010). Each method is subject to unique limitations including reporter fatigue (diary methods), reporter bias (interview and questionnaire methods), and inconsistent coding procedures (observational methods). The LENA system offers a new method of

studying family routines by using voice recordings to analyze conversation during everyday activities.

The current study will investigate variability in parent-child interactions across different daily routines, which is a new question in the study of family routines as most research has focused on between-family differences. First, the amount of conversation and how it differs across morning and bedtime routines will be examined. We will also investigate within-family variability in mothers' management language across these activities. The current work will also provide information regarding the feasibility of using voice recorders to answer a variety of additional research questions about family routines in the home.

Aim 1: Variability in Parent-Child Conversation in the Home

The first set of research questions will use the language counts provided by the LENA to conduct a preliminary examination of how parent-child interactions might vary by time of day, day of the week, and several family background variables.

Research Questions

1. How do the language counts provided by the LENA software (i.e., adult word count, child conversational turns, and child vocalizations) vary during two daily routines (i.e., getting child ready in the morning vs. getting child ready for bed)? How do they vary depending on the day of the week (weekday vs. weekend)?
2. Does the amount of conversation and language stimulation vary depending on family background factors including maternal education, child gender, and the number of siblings in the home?

Aim 2: Coding Management Language in the Home

Next, the LENA technology will be used to improve upon past management language coding systems. First, the original management coding scheme, which was developed for coding the birthday party task, will be adapted for coding everyday interactions from the LENA recordings. The improved coding system will then be used to continue the exploration of variability in parenting across different times of the day and week. Demographic influences on management language use will also be examined.

Research Questions

1. How does mothers' use of the different types of management language vary across different daily routines and days of the week?
2. How do background factors (i.e., maternal education, child gender, and the number of siblings in the home) relate to how often mothers use the different types of language?

Aim 3: Examining Links Between Management Language and Children's Executive Function

The final set of research questions will provide an in-depth examination of the associations between mother's use of management language and children's EF outcomes. The moderating roles of both maternal education (an indicator of socioeconomic status) and child temperament are both examined.

Research Questions

1a. Does the amount of each type of management language used by mothers predict children's concurrent EF performance?

1b. Does variability and stability in management language use relate to children's EF skills?

2. Does child temperament moderate relations between management language and children's EF skills?

Chapter II

Method

Participants

The sample included 42 typically developing children ages 4 and 5 (M = 54.79 months, SD = 6.07, min. = 39.47, max. = 70.10) and their mothers. Table 2.1 displays descriptive statistics for child age, maternal education levels, and household income. All children attended preschool during the study with exception of one child, who was expected to resume preschool in the following months when his mother went back to work. Families were recruited from several federally-funded (i.e., Head Start), state-funded (i.e., Great Start Readiness Program), and tuition based preschools in Southeast Michigan. Families were recruited through fall parent orientations, backpack mailings with postage-paid business reply envelopes, fliers, and word-of-mouth from families who had already participated. Parents either returned a signed consent form to their child's teacher, mailed it to the researchers using a self-addressed stamped envelope, or completed a card to be contacted for the study. The recruitment success rate was lower than expected at about 5% or lower.

Families were screened by phone and invited to participate if the child was 4 or 5 years old and had no diagnosed disabilities, delays, or serious illness. Families were dropped from the study if they were unable to schedule the first home visit.

As reported by the mother, two-thirds (n = 28) of children were White, 8 were African-American, 4 were multiracial, and 1 was Hispanic (1 mother did not report). The sample was diverse in terms of socioeconomic status. Mothers had on average 15.43 (*SD* = 2.33, min. = 10, max. = 18) years of education, with is almost equivalent to a bachelor's degree. Average household income ranged from $13,000 to $200,000 (SD = $52,015.95) with a median of $78,000 (5 families did not report income). As indexed by income-to-needs ratio, six families were Near Poverty and five were considered to be in Poverty. A father was present in 33 of the 42 homes and one household had two mothers, one of whom participated in the study.

Materials

The Language ENvironment Analysis System (LENA) consists of a pager-sized Digital Language Processor (DLP) that children and adults wear in the pocket of custom-made clothing or other carrying device. The LENA DLP has the digital memory capacity to record language continuously for 16 hours. The raw audio file is transferred to a computer where the LENA System software automatically analyzes it using specially developed algorithms. The resulting reports provide estimates about the amount of conversation that took place in the home: 1) Adult Word Count, the number of words that were spoken to or near the child; 2) the number of words (or attempted words) spoken by the child wearing the recorder; and 3) the number of turn-taking interactions that the child engaged in with an adult. The raw audio file can also be exported as a .wav sound file and analyzed on its own.

Children in the current study wore the LENA DLP in specially made t-shirts with snap pockets on the front. Gender neutral t-shirts in blue, red, and green were purchased

from the LENA foundation. Due to children's apparent preference for gendered clothing, additional t-shirts and polo shirts in pink, yellow, blue, gray, and green were made for the study. In order to assure that conversations between mothers and children were fully captured, mothers wore DLPs as well. Mothers wore the recorders in a breakaway lanyard neck pouch similar to a passport holder or a small waist pack made for running.

Procedure

Initial home visit. After phone screening, the researchers scheduled a home visit with the mother and child. For safety reasons, and for the purpose of keeping any siblings occupied if needed, one graduate student and one undergraduate research assistant attended every home visit. Mothers usually returned the consent form to the researchers prior to the first home visit, but some completed the consent form at the beginning of the visit. During the visit, the graduate student explained the recording system and helped the mother complete the questionnaires. The research assistant completed the assessments with the child. The visits generally lasted just over an hour.

Appendix A includes a complete list of the points of information covered with the mother and child during the home visit. Both mothers and children were encouraged to examine the LENA DLPs and clothing during the visit. Operation of the recorder was explained and children were asked for their verbal assent to wear the special t-shirt and LENA recorder. Families were encouraged to wear the recorder as much as possible on the assigned days and to leave the recorder running at all times to prevent them from forgetting to turn it back on. Mothers who worked outside of the home (n = 20) were asked to wear the recorder in the morning before work and to put it back on as soon as they get home in the evening. Families schedules were discussed and accommodated so

that all families participated regardless of how much time they were able to record. Mothers were instructed to record on one early weekday, Monday or Tuesday; one late weekday, Thursday or Friday; and one weekend day, Saturday or Sunday. The recording days were chosen to provide a sampling of the major transitions involved in full workweek of a family with children. A step-by-step user's manual (obtained from the LENA foundation and adapted for the current study) for the LENA was provided along with a laminated reminder card that the family could post somewhere in the house to help them remember to use the recorders. Finally, mothers were informed that any recordings could be erased if desired by the family. Mothers were asked to complete one End-of-Day questionnaire for each day of recording, tracking her and her child's daily activities and using checkboxes to indicate whether the family was comfortable sharing the recordings with the study team.

After their orientation to the LENA recorders, children were asked for additional verbal assent to complete assessments with the research assistant. The child assessments took approximately 30-40 minutes to complete. The order of administration was predetermined and randomized except that the Theory of Mind battery and the Gift Delay always took place second-to-last and last, respectively. The Theory of Mind battery was not of primary interest and we wanted to maximize the response rate for the other assessments (in case the child was fatigued or unable to complete all assessments near the end of the session). Gift Delay was administered last because it was framed as a thank-you gift for participating and may have been distracting if it occurred earlier in the session.

Pick-up visit. During the pick-up visit, mothers completed one additional

parenting questionnaire. The parenting questionnaire was administered after the recordings were completed in the hopes that mothers would not be biased by the questions in the survey when completing the recordings. Children were allowed to choose a thank-you gift. In addition to the small gifts for the child, mothers were mailed a thank-you letter with study contact information and a $50 check to thank them for their family's participation in the study. All mothers who completed the first home visit received the check regardless of how many recordings they produced for the study.

Measures

Working memory. The Operation Span task (Blair & Willoughby, 2006) requires children to remember a series of animals while processing distracting color information. Each page of the task flipbook contains between one and four houses, each with a color drawing of an animal inside and a circle of color at the top. The researcher asks the child, "What color is this?", waits for the child's answer, and then asks "What animal is this?" for each house. The researcher then turns to the next page, which has the same number of houses without animals or colors. After two seconds, the researcher asks the child to say the animals from each house, in order. The task starts with one animal and increases to 4 animals for a total of 19 trials.

Inhibition. Children completed the Head-Toes-Knees-Shoulders task (Ponitz, McClelland, Matthews, & Morrison, 2009), a measure of EF that requires children to inhibit a prepotent response. This task also taps children's ability to focus on (attention) and remember (working-memory) instructions. Children must do the opposite of what the researcher tells them, touching their head when told to touch their toes, and vice versa on ten trials. Children are given two points for a correct response, one point for a self-

correct, and zero points for an incorrect response. A more difficult version, for children who succeed or self-correct on at least 8 of the first trials, involves adding ten more items including "knees" and "shoulders" to the test in addition to head and toes, for a total of 40 possible points. This task has demonstrated inter-rater reliability and convergent and construct validity, though test-retest reliability has not been examined (Ponitz et al., 2008).

Delay of gratification. Children's ability to delay gratification was assessed using a Gift Wrap task developed by Kochanska, Murray, and Harlan (2000) and scripted by Alison Miller. During the first trial children are told that the researcher has a present for them, but it's not yet wrapped. The child is positioned so that he or she is facing away from the researcher, who tells the child not to peek at the gift. The researcher noisily wraps the gift and uses a timer to for 1 minute, recording the time (in seconds) at which the child peeks (i.e., the child's eyes could have seen the gift), if at all. After 1 minute has passed, the researcher tells the child that he or she forgot the bow and must look for it before the present will be ready. During the second trial the child is told to wait again while the researcher goes to the other side of the room to get the bow. Again the researcher times the number of seconds before the child peeks. After the second minute has passed, the child gets to open the gift. As expected based on prior work (Kochanska et al., 2000), performance on the two trials was highly correlated ($r = .993$, $p < .001$) and the child's score is calculated by average the number of seconds that the child waited on the two trials.

Early math and reading skills. Children's early counting and simple addition and subtraction skills were assessed using the Applied Problems subscale of the

Woodcock-Johnson III Tests of Achievement (Woodcock, McGrew, & Mather, 2001). W-scores, which are standardized scores calculated using item difficulty, were used to compare children. Alphabet and early decoding skills were assessed using the Letter-Word subscale. Test-retest and split-half reliability for these subtests is greater than .90.

Receptive vocabulary. Children's vocabulary skills were assessed using the Peabody Picture-Vocabulary Test-III (Dunn & Dunn, 1997), a measure of receptive vocabulary skills. For each word the researcher says, children are asked to choose among four options and point to the picture that best corresponds with the word. Test-retest and split-half reliability for these subtests are greater than .90.

Child and family demographic variables. During the home visit, mothers completed a 10-minute Background Questionnaire regarding parent education levels as well as several family variables including child age, gender, ethnicity, and childcare and preschool experience.

Child temperament. Three major dimensions of children's temperament (effortful control, negative affectivity, and surgency/extraversion) were assessed using the Very Short version of the Child Behavior Questionnaire (CBQ; (Putnam & Rothbart, 2006). This questionnaire asks parents to rate 36 statements (e.g., "My child is full of energy, even in the evening") on a scale from 1 = "extremely untrue of my child" to 7 = "extremely true of my child". The internal consistency (alpha) values calculated using three difference samples range from .62 to .78 for the three dimensions of temperament.

Child social skills. Parents rated children's social skills using the Social Skills Rating System – Parent Version (SSRS; (Gresham & Elliott, 1990). This assessment includes 50 items that require parents to rate their agreement with statements about child

behaviors on a scale from 0 (not at all like my child) to 2 (often true). In order to tap learning-related social skills, the current study focused on three of the available four subscales for preschool children: cooperation/compliance (e.g., "Helps you with household tasks without being asked"), self-control (e.g., "Follows your instructions") and problem behaviors. Internal consistency reliabilities for the social skills scale and problem behaviors scale are .90 and .73, respectively. The test-retest reliabilities are .85 and .84, respectively.

Parenting practices. The parenting questionnaire (Morrison & Cooney, 2002) includes 50 items tapping three practices on three dimensions of parenting: the home learning environment, (HLE, e.g., "I teach my child about reading words" and "I read books with my child"), responsivity (RS, e.g., "I encourage my child to explore the world"), and management (MN, e.g., "I talk the problem over and reason with my child when he/she misbehaves"). For most items, parents used a 5-point Likert-type scale which generally translated to 1=not at all like me, 2=slightly like me, 3=somewhat like me, 4=a lot like me, and 5=very much like me. Other items require a raw number (i.e., number of books in the home, frequency of storybook reading with caregivers). Several items regarding parents' achievement attributions and expectations for their children's educational attainment have been added to provide a broader picture of parents' beliefs and involvement in children's early education. Research has found Cronbach alpha reliabilities for the scales of .75 (HLE), .81 (RS), and .91(MN).

Processing the Recordings

LENA processing. After the pick-up visit, the LENA DLPs were brought back to the lab and uploaded to a computer with the LENA software installed. Uploading takes

approximately 2-5 minutes per DLP, but the LENA software takes up to the length of the raw sound file to process the file, parsing it into utterances and conversational turns from different speakers (i.e., target child, other child, adult male and female). If a family requested that a full day of recording be erased, the DLP could also be "purged" before any information is transferred to the computer. After processing, the reports can be viewed within the LENA program or they can be exported into Excel for analysis. The three language counts can be calculated in 5-minute, 1-hour, or 1-day intervals.

Because some families requested that only part of a day of recording be erased, some of the .wav sound files were altered using Audacity software (http://audacity.sourceforge.net/). The times that families did not want to share were replaced with blank space to preserve the time stamps for the rest of the recording.

In terms of compliance, most families (n = 33) recorded on all three days as instructed. However, there were several families (n = 7) who were unable to record on the weekend. One family recorded on only one day and two families recorded on two days. There were four families who, despite our instructions, did recordings four different days.

Listening task. In order to identify segments of the recordings (times of the day) to focus on, trained research assistants listened to the recordings and took notes on what was happening during each 20-minute period. The notes focused on the activities and conversations of the mother and target child, but other family events and activities were noted as well. The research assistants listened and took notes from the time the mother's LENA was turned on in the morning for at least 1 hour. For evenings, 4:40 pm was located within the recording and the research assistants listened from that time to the time

that the child went to bed. The listening task was first used to analyze one, randomly chosen weekday for each family. One weekend day was also analyzed for each family.

Using the notes from the listening task, 15-minute segments were chosen for each of the times of interest: morning (getting ready) and bedtime for the weekend and weekdays. The times were chosen to coincide with whole 5 minute intervals in clock time (e.g., 8:00 am, 8:05 am, 8:10 am, etc.). The segments thus could be matched up with 5-minute counts from the LENA program, which also align with whole 5 minute intervals in real time. The 15-minutes of morning were chosen by trying to locate the first time the mother interacted with the child and then locating the next 5-minute mark to use as the start time. At Bedtime, the time when the child went to sleep was first located, and the previous 5-minute mark was used to anchor the end of the preceding 15-minute segment.

Table 2.1.

Descriptive statistics for girls' and boys' executive function outcomes, temperament dimensions, and management language codes

		Boys	**Girls**	**Total**		
Measure	**N**	*M*(SD)	*M*(SD)	*M*(SD)	Min.	Max.
Inhibition	40	17.32(13.60)	9.50(13.58)	14.97(13.90)	0	38
Working Memory	40	9.93(4.21)	10.00(5.56)	9.95(4.58)	1	18
Delay of Gratification	38	43.28(19.11)	48.14(13.83)	44.68(17.70)	11	60
Effortful Control	40	5.74(1.43)	5.93(0.70)	4.82(0.85)	3.17	6.58
Negative Affect	40	3.95(0.98)	3.96(1.24)	5.59(0.67)	4.17	6.83
Surgency/Extraversion	40	4.93(0.85)	4.59(0.84)	3.95(1.05)	1.75	6.58
Direction	40	12.98(6.15)	11.28(5.85)	12.47(6.03)	6.00	27.00
Suggestion	40	5.30(3.88)	4.33(3.63)	5.01(3.78)	0.50	16.00
Reprimand	40	0.90(1.17)	0.29(0.61)	0.72(1.06)	0.00	4.25
Praise	40	1.56(1.21)	1.35(1.51)	1.50(1.29)	0.00	4.50
Reasoning	40	2.71(1.83)	1.74(1.22)	2.42(1.72)	0.25	6.00
Bargaining	40	1.10(0.96)	0.80(0.66)	1.01(0.88)	0.00	3.50
Total	40	24.40(10.00)	19.80(10.57)	23.02(10.26)	8.50	47.00

Appendix A.

Mother and Child LENA Training: Points to Cover

- We are interested in learning about how mothers and their children talk to each other when they're doing everyday things at home.
- We would like both of you to wear this small voice recorder - you turn it on and wear it, and later, we can hear what you said (show the LENA, let child hold it if they want to).
- For you, (the child), we have a t-shirt with a special pocket, you can wear it all day - it's just like a regular t-shirt.
- Present three shirts, and let the child choose size and color for up to two of the shirts (with help of parent).
- The LENA will record everything you say, and then you can turn it off at the end of the day.
- Keep the LENA in the special t-shirt. You can wear it outside but it can never get wet!!
- We would like you to leave it on in the morning before you leave your house, and after you get home from preschool, but you don't wear it in the car or when you go to your friend's house.
- Your mom will be wearing one, too, in a special carrying case (present the two cases for the mom).
- Ask if child has questions.
- Verbal Assent: "Do you think you want to wear the LENA and the special t-shirt for three days?"
- Show mother how to turn it off and on - it's fine if it gets left on for the whole time (each LENA can record for 16 hours).

- The mother's carrying case (show) - should be worn under clothing if possible.
- We would like it to be worn at all times when you might be talking with the child (best if you do not take it off).
- Put it on yourself in the morning, then go put it on the child, but take it off when you leave the home, same in the evening.
- It's okay if other people are recorded - we will ignore all except mother and child.
- Important not to wear it in the car, and reiterate: do NOT get it wet!!
- Discuss reminder procedures: we can call, text, or e-mail them in the a.m. and/or p.m.
- Schedule a time to pick up the LENA's and complete the last parent questionnaire, and give the mother a business card from the lab with our contact number.

Chapter III.

Variability in Parent-Child Conversation in the Home

As noted in the introductory chapter, a major advantage of the Learning ENvironment Analysis (LENA) system is that the accompanying software automatically provides three indices of language that occurs in the home. For every 5-minutes, hour, or day recorded, the LENA system produces a estimate of 1) the number of words spoken by adults in the child's immediate vicinity (Adult Word Count), 2) the number of words spoken or attempted by the child wearing the recorder (Child Vocalization Count), and 3) the number of Conversational Turns (i.e., when the parent speaks and child answers, or vice versa) that took place. Together these measures provide a relatively complete and unbiased picture of the child's language environment at different times and in different situations. The current chapter seeks to explore variability in these three conversational indices as they occur during different daily routines and times of the week in families with different demographic characteristics. The following analyses will use the data provided by the LENA system to take a preliminary look at how parent-child interactions vary across different situations and family demographics. This chapter will thus provide a foundation for the explorations of management language and child EF that follow.

The importance of conversation in the home during early childhood has been clearly established (for a review see Hoff, Laursen, & Tardif, 2002). The seminal Hart and

Risley (1995) study generated a number of findings about variability in language in the home as well as the consequences of early language input for children's later language skills and academic achievement. The study included hour-long observations of talk, conducted in the early evening, in the homes of low-, middle-, and upper-middle SES families. There were vast differences in the amount of language provided by parents in low-SES families (i.e., those on welfare; approximately 600 words per hour), working-class families (approximately 1,250 words per hour), and upper-middle class families (approximately 2,150 words per hour). How much parents talk in the home was related to children's IQ, language abilities, and academic achievement at age 3 and beyond. Finally, the amount of language that children were exposed to in the 0-3 years also predicted their academic skills at ages 9 and 10 (Hart & Risley, 1995).

More recently, the Learning ENvironment Analysis (LENA) Foundation conducted a large-scale study of language experience before age 4 to replicate and extend the findings of the Hart and Risley study using the newly-developed digital recorder (Gilkerson & Richards, 2009). The LENA Natural Language Study included 329 children (ages 2-48 months) from a wide variety of socioeconomic backgrounds. The findings show that the average number of words children were exposed to each hour varies greatly throughout the day with a stable, moderate number of words (approximately 1,100 words per hour) throughout the morning, a sharp decrease in the early afternoon (less than 800 words per hour at 1 pm), and a large increase through late afternoon and evening (about 1,400 words per hour at 5 pm) (Gilkerson & Richards, 2009).

The Natural Language Study replicated the Hart and Risley findings by showing significant correlations between the amount of language (i.e., the Adult Word Count)

children were exposed to and children's receptive and productive vocabulary skills between 24 and 48 months. In terms of SES differences, parents who had at least a bachelor's degree talked significantly more than parents who did not have bachelor's degrees. Additionally, this study showed that mothers talk about 10% more to daughters than to sons and further, that first-born children are exposed to more language than non-first-born children.

In the current study, variability in conversation will be examined during two daily routines: getting the child ready in the morning and going to bed at night. These two routines, common to all families, are examined on one weekday and one weekend day to provide a picture of differences across times of the week. The current work will build on past findings in several ways. First of all, whereas past work has studied children from ages 0 to 4, the current work looks at variability in the language environments of 4- and 5-year-olds. Second, the current study will produce new knowledge about how the home language environment, and children's participation in it, varies within specific routines rather than at different hours of the day. Moreover, this will be the first study to compare in-home conversation on weekdays and weekends to see how language varies across the weekly routines of the family. Previous findings on SES and child gender differences in language from parents will be replicated, but an additional, as yet unexamined background factor will be examined: the number of siblings in the home.

Research Questions

1. How do the language counts provided by the LENA software (i.e., adult word count, child conversational turns, and child vocalizations) vary during two daily routines

(i.e., getting child ready in the morning vs. getting child ready for bed)? How do they vary depending on the day of the week (weekday vs. weekend)?

Hypotheses. No prior research is available for child conversational turns or vocalizations, but it is expected that the amount of parent-child conversation, including adult language as well as the two child variables will vary greatly at different times of the day, following the pattern described in the Natural Language Study: evening (in this case bedtime) will have more conversation than morning. There is no extant information on how language will vary by Weekday and Weekend, but it is expected that families will have more time for interaction on the weekend, and thus that we will see higher levels of all three language indicators on weekends as opposed to weekdays.

2. Does the amount of conversation and language stimulation vary depending on family background factors including maternal education, child gender, and number of siblings in the home?

Hypotheses. Using maternal education as an indicator of family SES, it is expected that all three language indicators will be lower in lower SES families than high SES families. Based on extant findings from the LENA Natural Language study as well as a meta-analysis by Leaper, Anderson, and Sanders (Leaper, Anderson, & Sanders, 1998), it is expected that mothers will talk significantly more to girls than boys. Because mothers talk slightly more to girls than boys, girls are also expected to participate more in conversation in terms of the number of words they speak and the number of conversational turns they engage in. Finally, although no information is available on patterns of language use in households with different numbers of children, work on family size suggest that children with more siblings will receive less attention and

resources from parents, and likely participate in fewer adult-child conversations, in households with more siblings (Blake, 1989; Downey, 2001).

Taken together, this preliminary analysis of the three LENA language outcomes will set the stage for a more in-depth examination of variability in parenting (and parent-child interactions) across different situations and demographics, which will be examined in more depth in the chapters that follow. By replicating and extending past findings, the current chapter establishes the need to look at how parent-child interactions might differ depending on time and situation.

Analysis Plan

Investigating predictors of the three language indicators. The major goal of this Chapter was to investigate how the amount of conversation in the home varies according to the time of day and day of week (i.e., segment coded) as well as background characteristics (i.e., child gender, maternal education, and number of siblings). Maternal employment status (i.e., full-time, part-time, or no employment) was also examined for relations with the language outcomes but was not a significant predictor of language in the home.

There were two major issues to consider in analyzing the above relations. The first is that there is a nontrivial amount of missing data (16%) in the four segments of interest. If a repeated-measures ANOVA were used to examine differences in the amounts of conversation used during the four segments of interest, list-wise deletion would reduce the sample to 21 families. For this reason, the analysis needed to be able to accommodate missing data in some way.

The second issue is that each family was observed at four times, or segments, which

means that the segments are nested within families. If a regular regression model were used to model the effects of time of day and day of the week on management language use within each segment, the independence assumption would be violated; the four segments from each family can be expected to correlate with one another. Thus, the analysis also needs to be able to account for family-level variation in management language.

Both of these issues can be addressed with a basic version of the multilevel model, a *linear mixed model* (Gelman & Hill, 2007). The term "mixed" indicates that the model contains a combination of fixed effects and random effects. In contrast to fixed coefficients, which model the same coefficient for all individuals, random effects coefficients are allowed to vary by group, in this case by family. The current work uses a *varying-intercept model* in which the intercept is allowed to vary by family, thus accounting for any family-level variability in the amount of management language used and restoring independence in the outcome variable. Put another way, the varying-intercept model has one intercept for each group, or family (Gelman & Hill, 2007).

The differences between the four coded segments are examined with three estimates, each using weekday morning as the reference group. For example, the varying intercept model predicting the Adult Word Count would thus be as follows:

Let i = observation, j = family, $\alpha_{j(i)}$ = the intercept for family j which contains observation i

$$AWC_i = \alpha_{j(i)} + \beta_1 childgender_j + \beta_2 maternaled_j + \beta_3 weekdaybedtime_i + \beta_4 weekendmorning_i + \beta_5 weekendbedtime_i + \beta_6 siblings_j + \varepsilon_i$$

Because the language outcomes in these models are count variables, a generalized

linear mixed model with the Poisson distribution is more appropriate than using a model with the normal distribution. However, using the Poisson distribution can exaggerate the significance of the predictors when there is over-distribution (i.e., the observed variation of the outcome exceeds what would be predicted by the model)(Gelman & Hill, 2007). All of the planned linear mixed models showed problems with over-distribution when estimated using the regular Poisson distribution, so the Quasipoisson distribution was used to avoid this problem. Poisson regression uses a log link, so the regression coefficients must first be transformed using the exponential transformation (e^coefficient). Once transformed, the coefficient estimates are expressed in terms of percent change in the dependent variable (rather than absolute change). Thus, the results listed below can be interpreted as estimates of the percent increase or decrease in management language use for each mother instead of indicators of the absolute amounts of language she uses.

Results

Descriptive statistics for the three language counts (i.e., Adult Word Count, Child Word Count, and Conversational Turns) are displayed in Table 3.1. One mixed model regression was created for each language outcome.

Adult Word Count

See Table 3.2 for the linear mixed model results for Adult Word Count. As predicted, weekday bedtime was associated with a 43% increase in adult words when compared to weekday morning ($b = 0.36$, $p = .026$). There was not a significant difference between weekend morning and weekday morning ($b = 0.05$, $p = .781$), nor was there a significant difference between weekend bedtime and weekday morning ($b = 0.14$, $p = .447$).

There were no significant relations between maternal education or child gender and adult word count (b = 0.04, p = .403; b = -0.21, p = .282, respectively). The results did not support our hypotheses that girls (as opposed to boys) and children with mothers who had higher education levels (as opposed to lower education levels) would be exposed to more linguistic input from adults.

Finally, there was a marginally significant relation between the number of siblings the child had and the amount of adult language children were exposed to. Each additional sibling was associated with a 19% decrease in adult word count (b = -0.21, p = .080). Although this finding is consistent with the prediction that children in homes with more siblings would be exposed to less language input from adults, it did not reach conventional significance levels.

Child Word Count

Both weekday and weekend bedtime were associated with decreases in child word count when compared to weekday mornings (See Table 3.3). There was 27% less language from the target child during weekday bedtimes (b = -0.46, p = .040) and there was 40% less during weekend bedtimes (b = -0.51, p = .038). There was not a significant difference between weekend morning and weekday morning (b = 0.01, p = .946).

There were also no significant relations between maternal education (b = 0.03, p = .432), child gender (b = -0.14, p = .497), or number of siblings (b = -0.09, p = .468) and the number of words spoken by the child. These findings run contrary to the predictions that girls and children whose mothers had more years of education would produce significantly more language than boys and children whose mothers had fewer years of education.

Conversational Turns

There was a significant difference in the amount of adult-child conversational turns between weekday bedtime and weekday morning (See Table 3.4), with weekday bedtime having about 43% fewer conversational turns than weekday morning (b = -0.57, p = .023). There was also a 48% decrease in conversational turns during weekend bedtime as compared to weekday morning (b = -0.65, p = .020). Contrary to expectations, there were no significant relations between conversational turns and maternal education (b = -0.01, p = .783), child gender (b = -0.04, p = .841), or number of siblings (b = -0.01, p = .954). Our hypothesis that girls and children with mothers who had higher levels of education would participate in more conversational turns that boys and children with mothers with lower levels of education was not supported.

Summary

The current chapter sought to replicate and extend past findings on patterns of variability in parent-child conversation in the home. As predicted, children were exposed to more language from adults in the evening (i.e., bedtime) than in the morning. However, contrary to expectations, children did not actually participate more in conversation at bedtime than in the morning. Child vocalization counts and adult-child conversational turns were both significantly lower at bedtime than in the morning. Also contrary to expectations was the finding that there was not a significant difference in adult word counts on weekdays and weekend days. Further, whereas we predicted that there would be more adult-child conversation on weekends than weekdays, there were actually fewer child vocalizations during weekend bedtime compared to weekday mornings.

We hypothesized that children with mothers who had higher levels of education would be exposed to and participate in more conversation in the home. However, we did not find any relations between maternal education and any of the language outcomes. Likewise, though we expected boys to both receive less linguistic input and to produce less linguistic output than girls, there were no significant differences by child gender. Finally, there was only one marginally significant finding for the number of siblings in the home, but it was in the predicted direction: greater numbers of siblings in the home tended to be associated with lower Adult Word Counts.

Table 3.1. Average language counts for each segment.

Segment	Adult Word Count	Child Word Count	Conversational Turns
Weekday Morning	439.84 (300.50)	21.43 (18.50)	63.24 (50.12)
Weekday Bedtime	617.14 (521.05)	13.14 (14.54)	35.14 (42.90)
Weekend Morning	468.35 (374.16)	22.03 (14.03)	79.55 (53.70)
Weekend Bedtime	506.96 (561.98)	12.79 (18.37)	33.04 (47.95)

Table 3.2. Quasipoisson regression predicting Adult Word Count by maternal education, child gender, and time of day and day of week (Segment).

	Estimate	SE	df	*t*	sig.
(Intercept)	6.07	0.15	90	40.90	***
Maternal Ed. (centered)	0.03	0.04	35	0.63	
Child Gender	-0.19	0.20	35	-0.95	
Weekday Bedtime	0.36	0.16	90	2.27	*
Weekend Morning	0.05	0.18	90	0.28	
Weekend Bedtime	0.14	0.18	90	0.76	
Siblings (centered)	-0.21	0.12	35	-1.81	+

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 3.3. Quasipoisson regression predicting Child Word Count by maternal education, child gender, and time of day and day of week (Segment).

	Estimate	SE	df	*t*	sig.
(Intercept)	3.08	0.15	90	20.19	***
Maternal Ed. (centered)	0.03	0.04	35	0.80	
Child Gender	-0.14	0.21	35	-0.69	
Weekday Bedtime	-0.46	0.22	90	-2.08	*
Weekend Morning	0.01	0.20	90	0.07	
Weekend Bedtime	-0.51	0.24	90	-2.10	*
Siblings (centered)	-0.09	0.12	35	-0.73	

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 3.4. Quasipoisson regression predicting Conversational Turns by maternal education, child gender, and time of day and day of week (Segment).

	Estimate	SE	df	*t*	sig.
(Intercept)	4.16	0.16	90	26.65	***
Maternal Ed. (centered)	-0.01	0.04	35	-0.28	
Child Gender	-0.04	0.19	35	-0.20	
Weekday Bedtime	-0.57	0.24	90	-2.32	*
Weekend Morning	0.23	0.20	90	1.13	
Weekend Bedtime	-0.65	0.27	90	-2.38	*
Siblings (centered)	-0.01	0.11	35	-0.06	

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Chapter IV.

Management Language Use in the Home

The previous chapter provides foundational evidence that parent child-interactions in the home, as indexed by the amount of conversation and language that preschoolers are exposed to, vary substantially across times of the day and days of the week. Moreover, the findings validate the usefulness of the LENA recording system for capturing differences in parent-child interactions in the home based on situational and family characteristics. We now seek to extend those findings by examining mothers' *management language*, the verbal strategies that mothers use to guide and control children's behavior, to see how it varies according to the same set of situational and demographic factors.

The current work uses a coding system developed by Worzalla and colleagues (2012). Six different types of management language were coded, which factor analyses reduced to 2 main factors. The first was Direction, which consists of Explicit Direction, or commands (e.g., "Put the plates on the table."), and Qualified Direction, commands with a qualifying tag question at the end (e.g., "I want you to help me now, ok?"). The Direction management language offered children little choice and input into the course of activity. The second dimension was Suggestion, which includes four kinds of utterances that provide the child with some degree of choice: 1) Ambiguous Suggestion, questions

which may either offer the child a choice or function as commands (e.g., "Can you set the table?"); 2) Simple Suggestions, wherein the parent puts forth a possibility but does not command the child to do something in particular (e.g., "You could try using the pencil."); Choice, the parent puts forth one or more options for the child to choose from (e.g., "Do you want to try pouring the milk or do you want me to do it?"); and Transfer, the parent offers control of the situation to the child, generally by using a question such as "What should we do next?". All Suggestion language offered the child the opportunity to make choices related to the activity or the child's behavior. The two major types of management language were ultimately found to predict children's EF from age three through the transition to kindergarten (Worzalla et al., 2012).

The current chapter will build on the previous work by directly examining variability in mothers' management language as it occurs in the home. The bulk of research on parenting and its implications for child development rests on the implicit assumption that individual differences in parenting styles and practices are stable across all situations. However, as Morrison (2009) argues, there are many reasons to believe that parenting might change in different situations and that this variability may be important for children's development. Parents may change their styles and practices depending on the mood or physical status of the child, the domain of the activity (e.g., homework assignments versus playing outside on the weekend), and the immediate history of the parent-child relationship. There is little work examining whether and how parents change and adapt their behavior to different situations. The current study will examine this issue directly by investigating variability in management language as it occurs during different daily routines and different times of the week.

The first step in this investigation was to adapt the management language coding system for use with recordings of daily parent-child interactions gathered in the home. Most studies of management language have focused primarily on parents' use of commands (Hess & McDevitt, 1984; Landry et al., 2002; Landry, Smith, Swank, & Miller-Loncar, 2000). The work by Worzalla and colleagues (2012) contributed to the literature by examining alternatives to commands: different types of suggestions. The current study will build the coding system further by adding codes that capture daily negotiations and feedback regarding the child's behavior. New codes are drawn from work by Kochanska and colleagues, which sought to capture mothers' physical and verbal management strategies in the context of everyday routines in a lab "apartment" setting (Kochanska et al., 1989; Kuczynski & Kochanska, 1990; Kuczynski et al., 1987). The Kochanska work provides several additional codes related to feedback and negotiation. The current chapter describes the process used to create a coding system for capturing variability in parents' management language during everyday activities. Next, we examine how often each code is used depending on a number of factors: times of day, day of the week, child gender, maternal education, and number of siblings in the home.

Specific Aims

1. Adapt the management language coding scheme, originally developed for coding the birthday party task, for coding everyday interactions from the LENA recordings.

   Hypothesis. Additional codes will be needed to capture the negotiation and behavior management strategies that mothers use during everyday interactions with their children.

2. Explore how mothers' use of the different types of management language varies across different daily routines and days of the week.

Hypotheses. It is unclear how mothers' management language might differ across morning and bedtime routines, so this aim is partly exploratory. It is expected that families' activities will be less structured on the weekend and that mothers will use less management language of all types during weekend days than on weekdays.

3. Investigate whether background factors (i.e., SES, child gender, and number of siblings in the home) relate to how often mothers use the different types of language.

Hypotheses. Based on past work, mothers with fewer years of education are expected to use more Direction than their more highly educated counterparts (Hoff et al., 2002). Low-SES mothers tend to emphasize compliance from their children rather than negotiating and offering choices (Lareau, 2003). Conversely, mothers with more education are expected to use relatively more Suggestion than mothers with less education.

Findings for child gender are expected to show that boys receive more Direction than girls. A meta-analysis by Leaper and colleagues (1998) found that mothers of sons tend to be more directive than mothers of daughters. Boys also tend to have weaker EF skills than girls at the time they reach kindergarten (Matthews, Ponitz, & Morrison, 2009), and parents seem to use more Direction with children with poor EF skills than with children who have strong high EF skills (Worzalla et al., 2012).

Finally, based on research and theory on family size, children who have more siblings are expected to receive less management language. According to the Resource Dilution model, only children receive the most from parents in terms of financial resources, the quality of the home learning environment, and parents' attention and instruction. With the birth of additional siblings, these finite resources are spread more thinly among children

in the home (Blake, 1989; Downey, 2001).

Management Language as a Proportion of Mothers' Total Language

A final caveat is that prior work has not considered management language in relation the total amount of language that mothers produce during their interactions with children. It is clear that mothers vary greatly in the sheer amount of language they provide for their children (Hart & Risley, 1995). These differences in general talkativeness may be important to consider when exploring management language use. For example, 10 Direction utterances (i.e., commands) may carry a different meaning depending on whether they occur throughout a conversation in which the mother speaks 30 utterances to the child as opposed to just 12. Moreover, the ratio of management language to all language used may be different depending on what time of day it is, whether it is a weekday or a weekend, and a number of family characteristics.

One way to explore this issue is to analyze management language as a proportion of total verbalizations produced by the mother during a given interaction. In this chapter, each type of management language coded will also be considered as a proportion of the total number of utterances mothers' make during a given segment of interaction. Examining the different types of management utterances as a proportion of other language complements the past work by addressing questions about how management language relates to the use of language in general. The proportion of management language to total language spoken by the mother may ultimately prove to be meaningful for children's EF development.

Method: Adapting the Management Language Coding System

Transcripts of full days of recordings from the three pilot families (two girls and

one boy, 2 days of recording each, collected in June of 2010) were first examined. These full-day transcripts capture a wealth of interactions; some are joint activities that have been examined in past work (e.g., reading a storybook), and some are "around-the-house" situations (e.g., telling the child to turn the lights off when leaving a room). The transcripts were inspected to see what kinds of utterances the mothers used to manage their children's behavior on an everyday basis. With the help of the Pathways to Literacy and the Family, Child, and Development lab groups, new trends in mothers' management language were identified.

There were major differences between the management language in the birthday party and that in everyday situations. As expected, more negotiation took place in the home than during the birthday party activity. Indeed, some mothers rarely said "no" in the context of everyday activities; instead of using refusals and directing the child's behavior, parents may explain why the child should comply with the adult's wishes. For example, when a child asked his mother if they could go to a playground in the afternoon, the mother did not refuse but answered by saying "Shouldn't we wait until your dad gets home so he can come too?". Or, mothers bargained with the child by making a concession to the child's wishes. For example, when a child asked to play outside right before dinner, his mother told him that he could go outside after finishing his meal. These forms of negotiation seem to be an important part of everyday socialization in many households.

Another major difference between the contrived and everyday situations is that feedback regarding child behavior, whether positive or negative, seemed to carry more meaning in the home. Negative feedback from parents was very rare in the birthday party

situation, but occurred fairly often in the home as apparent attempts to discourage bad behavior. Likewise, praise was a casual part of the pleasant atmosphere of the birthday party task, but it seemed to play a more important role in everyday situations as reinforcement for good behavior. For example, whereas mothers were likely to say "Good!" or "Thank you!" during the birthday party, in the home praise focused more on reinforcing good behavior (e.g., "You have been such a good older brother today."). Parents seemed to use it in an attempt to encourage appropriate behavior and compliance in the future.

For the reasons described above, I adapted several codes from Kochanska and colleagues' (Kochanska et al., 1989; Kuczynski et al., 1987) system, which was designed for the purposes of examining relations between mothers' behavior management strategies (both verbal and physical) and children's compliance. These codes are well suited for naturalistic recordings as they were developed for analyzing mother-child interactions in a structured lab "apartment" setting. The four codes that were added include Reprimands, negative feedback about the child's behavior (e.g., "That was not very nice!"); Praise, positive feedback about the child's behavior (e.g., "Very good!"); Reasoning, explanations for why the child should comply with the parent's requests or social norms (e.g., "It hurts when you do that."); and Bargaining, attempts to form a compromise with the child either by a) making a concession to his or her wishes (e.g., "We can't watch TV now but we can watch a show later.") or b) asking the child to make a concession to the parent's wishes (e.g., "If you finish your food then you can go play"). Each code was updated with new examples and instructions for coding. Both of the feedback codes (i.e., Reprimand and Praise) were refined to focus on language related to

the child's behavior rather than the child's character, as the management language system is focused on actions and the course of the activity. Together, the new codes capture daily parent-child negotiations and feedback.

Challenges to coding in-home recordings. The management language coding was completed by listening to the recordings and using pencil and paper to track the times (in hours, minutes, and seconds) at which the different codes occurred. Coding directly from audio recordings that were gathered in the home was different from coding from videotapes in a few key ways. Audibility is a major concern when coding from recordings of any kind. Sound quality was an issue with the older birthday party videos but was relatively good from the LENA, a newer, digital technology, when the mother wore it properly. However, understanding the exact words being spoken was difficult when there was noise nearby. The recorder picks up sounds from dishes, pots and pans, crying children, and running water, all of which can obscure conversation. Although we took steps to minimize the sounds from the mother walking, there were still often sounds when the mother was moving around. With regards to audibility, the videotaped birthday party interactions had a slight advantage in that one could observe the dyad's activity and often see the words being spoken, making them easier to understand. However, this was balanced out by the increased quality of the sound from the digital LENA recorders.

We considered transcribing segments of the conversations before coding to improve inter-rater reliability, but that would have been very time-consuming. We found that it took at least 1.5 hours to transcribe one 15-minute segment. Fortunately, adequate inter-rater reliability was achieved without the aid of transcripts.

A second challenge, and perhaps the most difficult to address without the benefit of video, was that during everyday interactions it can be impossible to tell who the mother is speaking to or to what she is referring. When coding management language our goal was to capture all utterances directed at the target child. This was difficult occurred mainly when there were siblings in the home. At times it was not possible to determine which child(ren) the mother was speaking to. In families with multiple children, mothers sometimes used the child's name, which aided greatly in coding. When the mother did not use the child's name, we used our best guess and discussed any questions as a group in coding meetings.

Management language coding system. A team of 2 research assistants and the graduate student conducted development of the coding system, reliability, and coding for the project. Several iterations of the original coding system from the birthday party were tested by having the group code short segments from the pilot family transcripts. A summary of the codes is included in Table 4.1. The complete, final coding guide is included in Appendix A.

After the coding system was solidified, one research assistant moved on to a different project, leaving three coders to do approximately one third of the coding each. A sample of more than 25% of the 15-minute segments was coded by all coders for reliability. The random sample of reliability segments included equal numbers of segments from weekday morning, weekday bedtime, weekend morning, and weekend bedtime. Reliability testing took place throughout the period of coding, which lasted about one year. Inter-rater reliability was calculated using Intraclass correlations, which are appropriate for continuous variables (Shrout & Fleiss, 1979). As illustrated in Table 4.2,

the ICCs for each code were well over .8 with the exception of Transfer and Bargaining, which were .711 and .788, respectively. The lowered ICCs in these two cases were likely due to the infrequency of the codes.

Note about reliability. It should be noted that two of the management language codes, Qualified Direction and Simple Suggestion had very low reliability. The poor reliability for both codes is due at least in part to the fact that they simply do not occur very often (range = 0-5, range = 0-4 for Qualified Direction and Simple Suggestion, respectively). As described below, these two codes were subsumed into combined code groupings for the purposes of the current analyses.

Utterance counts. The utterance coding system was designed to align with work by Hoff and colleagues, which quantifies and compares the amount of language that occurs in middle- and low-SES households (e.g., Hoff, 2003). In their system, a complete sentence is generally counted as one utterance, but may be counted as multiple utterances depending on pauses (E. Hoff, personal communication, June 15, 2011). Incomplete sentences are also counted as utterances if they express a complete idea. The sole difference between the current system and that used in Hoff's work is its treatment of tag questions (e.g., "You slept very well last night, *didn't you?*" or "Help me with this, *ok?*"). Hoff's group treats tag questions as separate utterances because of problems achieving reliability. We did not follow Hoff's convention because we had no problems with reliability; tag questions were counted as one utterance if they directly followed the utterance in question, but if there was a pause of 1 second or more, it was counted as a separate utterance. The complete guidelines for coding utterances are included in Appendix B.

A trained research assistant completed all of the utterance coding for the project. A second coder, the graduate student, re-coded 20% of the segments, which were randomly selected so that there would be an equal number of segments for each day of the week and time of the day (i.e., weekday morning, weekday bedtime, weekend morning, weekend bedtime). The only major challenge to achieving reliability was storybook reading. Because many children's books are not written or read aloud in complete, regular sentences, it was difficult to reliably parse the language into utterances. We addressed this problem by attempting to determine where the sentence breaks were in the book and/or where the complete ideas began and ended. The inter-rater reliability between the two coders was excellent, with an ICC of .982. Reliability was achieved at the beginning of the project and additional coding took place throughout to check for and correct drift.

Analysis Plan

Management language preprocessing. In order to reduce the number of analyses needed and to make the results directly comparable to those of previous work, the original 6 codes were combined into the two major management language types from Worzalla and colleagues' (2012) work: Direction and Suggestion. These two major types, plus the four new types of management language (i.e., Reprimand, Praise, Reasoning, and Bargaining), were used for all analyses that follow.

Testing predictors of management language use. In addition to creating a management coding system appropriate for capturing everyday interactions, a primary goal of this Chapter was to see whether mothers' use of management language is related to situational factors (i.e., time of day and day of week) or background characteristics

(i.e., child gender, maternal education, and number of siblings). Relations between child age, maternal employment, and management language use were also examined, but there were no significant relations and child age and maternal employment were dropped from the analyses for parsimony.

There were two major issues to consider in analyzing the above relations. The first is that there is a substantial amount of missing data (16%) in the four segments of interest. If a repeated-measures ANOVA were used to examine differences in the amounts of management language used during the four segments of interest, list-wise deletion would reduce the sample to 21 families. For this reason, the analysis needed to be able to accommodate missing data in some way.

The second issue is that each family was observed at four times, or segments, which means that the segments are nested within families. If a regular regression model were used to examine the effects of time of day and day of the week on management language use, the independence assumption would be violated because the four segments from each family can be expected to correlate with one another. Thus, the analysis also needs to be able to account for family-level variation in management language.

Both of these issues can be addressed effectively with a very basic version of the multilevel model, a *linear mixed model*(Gelman & Hill, 2007). The term "mixed" indicates that the model contains some combination of fixed effects and random effects. In contrast to conventional, or "fixed" coefficients, random effects coefficients are allowed to vary by group, in this case by family. The current work uses a *varying-intercept model* in which the intercept is allowed to vary by family, thus accounting for any family-level variability in the amount of management language used and restoring

independence in the outcome variable.

The differences between the four coded segments are examined with three estimates, each using weekday morning as the reference group. The varying intercept model predicting the amount of Direction use would thus be as follows:

Let *i* = observation, *j* = family, $\alpha_{j(i)}$ = the intercept for family j, which contains observation i

$$y_i = \alpha_{j(i)} + \beta_1 childgender_j + \beta_2 maternaled_j + \beta_3 weekdaybedtime_i + \beta_4 weekendmorning_i + \beta_5 weekendbedtime_i + \beta_6 siblings_j + \varepsilon_i$$

Because the management language outcomes in these models are count variables, the Poisson distribution is more appropriate for regression than the normal distribution. However, the Poisson distribution can exaggerate the significance of the predictors when there is over-distribution (i.e., the actual variability of the outcome exceeds what would be predicted by the model)(Gelman & Hill, 2007). All of the planned regression models showed problems with over-distribution when estimated using the regular Poisson distribution, so the Quasipoisson distribution was used to avoid this problem. Poisson regression uses a log-link to transform the variables, so the regression coefficients must first be transformed using an exponential transformation (e^coefficient). The coefficient estimates are expressed in terms of percent change in the dependent variable (rather than absolute change). Thus, the results listed below should be interpreted as estimates of the percent change in management language use for each mother, regardless of the absolute amounts of language she uses.

Results

1. Adapting the Management Language Coding System

Table 4.3 displays descriptive statistics for all codes and total management language use during the four segments that were coded. We hypothesized that additional codes would be needed to capture the management language and negotiations that take place in the everyday home context. The four new codes (i.e., Reprimand, Praise, Reasoning, Bargaining) were used relatively infrequently and showed substantially less variability than Direction and Suggestion. There also appear to be differences in the amount of each type of language that was used during the four different segments.

2. Investigating Relations Between Management Language, Segment, and Family Background Characteristics.

Correlations between maternal education, number of siblings, and each of the six management codes are displayed in Table 4.4. One mixed model was created to predict each type of management language, with an additional model predicting total management language. The predictors in each model were child gender, maternal education (years), and the three predictors indexing the differences between weekday bedtime, weekend morning, and weekend bedtime and the reference group, weekday morning.

Differences by day: Weekday vs. weekend segments. See Tables 4.5-4.11 for the regression results. We predicted that there would be more management language used on weekdays than weekends. This hypothesis was supported by several significant differences in management language use between weekday and weekend segments. First, there were significant decreases (37%, b = -0.46, p = .005 and 34%, b = -0.42, p = .008, respectively) in total management language use during both of the weekend segments (morning and bedtime) as compared to weekday mornings. In line with our hypothesis,

mothers used less management language on weekends than they did on weekday mornings.

This difference in total management language can be accounted for in part by significant decreases in Direction, Suggestion, and Bargaining on weekends compared to weekdays. More specifically, there was a significant decrease (31%, b = -0.37, p = .042) in Direction on weekend mornings compared to weekday mornings. Suggestion showed decreases on the weekend morning and bedtime (43%, b = -0.56, p = .005 and 70%, b = -1.22, p < .001, respectively) compared to weekday morning. Weekend bedtime was also associated with a 53% (b = -0.76, p = .035) decrease in Bargaining compared to weekday morning. Finally, there were marginally significant decreases in Praise and Reasoning as well: 41% (b = -0.52, p = .060) and 41% (b = -0.52, p = .072) for Praise at morning and bedtime, respectively, and a 36% (b = -0.45, p = .080) decrease in Reasoning at weekend morning compared to weekday mornings. Mothers used significantly more total management language as well as more Direction, Suggestion, and Bargaining during weekday mornings than during weekend mornings and bedtimes.

Differences by time: Morning vs. bedtime. Mothers were expected to use more management language during weekday morning routines than weekday bedtime routines. This hypothesis was not supported by the findings for total management language use; the total amount of management language was not significantly different between weekday mornings and weekday bedtimes (b = -0.11, p = .404). However, the use of Suggestion and Reprimand language differed significantly between weekday bedtime and weekday morning. There was a 51% (b = -0.71, p < .001) decrease in Suggestion language for weekday bedtime and a large, 123% (b = 0.80, p = .003) increase in

Reprimands during weekday bedtime as compared to weekday mornings. Although there was not a difference in total management language, mothers used fewer Suggestions and substantially more Reprimands during weekday bedtimes than they did during weekday mornings.

Differences by child gender, maternal education, and number of siblings. It was expected that girls would receive fewer Directions than boys. However, there were very few significant associations between child gender and management language use. Girls received 76% (b = -1.42, p = .020) fewer Reprimands than boys. Girls also received about 35% fewer Reasoning utterances than boys, but this finding was only marginally significant (b = -0.43, p = .097). Although these results do not directly support our hypothesis about child gender and use of Direction, the findings show that mothers used significantly more Reprimands with boys than girls.

Mothers with fewer years of education were expected to use more Direction utterances overall. Conversely, mothers with higher education levels were expected to use more Suggestion language. The findings did not support these hypotheses as there were no significant associations between maternal education and any of the types of management language. However, in line with the hypothesis regarding Suggestion, higher maternal education was associated with a marginally significant increase Suggestion (11%, b = 0.10, p = .065). Higher maternal education was also marginally associated with increases in Praise (13%, b = -0.12, p = .063).

Finally, it was expected that children with more siblings would receive less management language, regardless of type. In support of this hypothesis, each additional sibling in the home was associated with a 12% decrease in the total amount of

management language used (b = -0.19, p = .029). This decrease can be accounted for significant decreases in Reprimands (49%, b = -0.68, p = 021) and Reasoning (29%, b = -0.34, p = .022) with additional siblings. There were also marginally significant decreases in Direction (16%, b = -0.17, p = .065) and Bargaining (29%, b = -0.34, p = .075) with additional siblings. There were no significant associations between the number of siblings and Suggestion (b = -0.05, p = .720) and Praise (b = -0.,29 p = .106).

Management language as a proportion of total language counts.

Differences by day: Weekday vs. weekend segments. See Tables 4.12-4.18 for regression results. It was expected that management language would make up a smaller proportion of total language on weekends than on during the week. In line with this hypothesis, total management language formed a smaller proportion of all language during weekend mornings (b = -0.098, p =.022) than weekday morning. Total management also formed a marginally smaller proportion of total language during weekend bedtimes (b = -0.076, p =.097). Suggestion language also made up a smaller proportion of all language during weekend mornings (b = -0.024, p =.043) and weekend bedtimes (b = -0.048, p < .001).

There was also marginally less Direction (b = -0.021, p =.098) and Reasoning (b = -0.013, p =.094) as a proportion of total language on weekend mornings compared to weekday mornings. There were no differences between weekday and weekend segments for Reprimand, Praise, and Bargaining.

Differences by time: Morning vs. bedtime. There were no concrete hypotheses for differences in the proportion of management language by time of day, but there were two main findings. During weekday bedtime, Suggestion made up significantly less of

total language than during weekday morning (b = -0.025, p = .030). Conversely, Reprimands made up a greater proportion of total language during weekday bedtime than weekday morning, but this finding was only marginally significant (b = 0.008, p = .070). There were not significant findings for Praise, Reasoning, Bargaining, and Total Management Language.

Differences by child gender, maternal education, and number of siblings. The general hypothesis for child gender was that boys would receive more management language, as a proportion of mothers' total language, than girls. This hypothesis was not supported except for the finding that for girls, Reprimands make up marginally less of total language than for boys (b = -0.008, p = .095). All gender differences were non-significant for Direction, Suggestion, Praise, Reasoning, Bargaining, and Total Management Language.

In terms of maternal education, we predicted that management language would make up a greater proportion of all language for mothers with fewer years of education. Although findings were non-significant for Suggestion, Reprimand, Praise, Reasoning, Bargaining, Total management, the proportion of Direction out of total language was found to be significantly smaller for mothers with more education (b = -0.012, p = .030).

Finally, relations between the number of siblings and the proportion of management language out of total language were exploratory. There were two major findings. Both Reasoning (b = -0.011, p = .002) and Bargaining *(*b = -0.004, p = .021) made up smaller proportions of mothers' language in homes with more siblings.

Two marginally significant findings were also present. Mothers who had more children in the home used less Praise (b = -0.004, p = .075) and less total management

language (b = -0.038, p = .055) as a proportion of their total language. No significant findings were found for Direction Suggestion, and Reprimand.

Summary

The purpose of the current chapter was to develop a new coding scheme for capturing management language in the home and to explore how often each code was used depending on the time of day, the day of the week, and characteristics of the family. In addition to the two major categories from prior work (i.e., Direction and Suggestion), four new codes were added to the coding scheme to capture the ways mothers negotiate with and provide feedback to children in the home: Reprimand, Praise, Reasoning, and Bargaining.

The results revealed many differences in management language use across different times of the day and days of the week. Some of the most striking differences were between Weekday Bedtime and Weekday Morning. Weekday Bedtime was characterized by increases in Reprimands and decreases in Suggestions. During the week, mothers seemed to be less willing to offer children choice and more likely to reprimand children for their behavior at bedtime than when getting children ready in the morning.

As hypothesized, weekends were associated with less management language than weekdays. This pattern was significant for Direction, Suggestion, Bargaining, and not surprisingly, total management language used. It seemed that overall mothers were less likely to manage children's behavior on weekends than on weekdays, when being on time and completing daily routines in an efficient manner may have been more important.

Contrary to expectations, child gender, maternal education, and family size were generally not related to mothers' management language use. The only significant finding

with regards to child and family characteristics was that sons received more Reprimands than daughters. Overall, child gender was not found to relate to management language use.

Table 4.1. Management language codes with descriptions and examples.

Category	Description	Examples
Explicit Direction	Straightforward command or statement regarding what should or will be done next	"Let's put the cups on the table now" "Stop that!" "Wait." "You should get out a book."
Qualified Direction	Command or request with a tag question such as "ok?" or "right" at the end	"We need to put your socks on first, right?" "Put the toy away, ok?"
Ambiguous Suggestion	Questions about the child's wishes or desires, invite a yes or no answer, but may not actually elicit the child's opinion	"Can you please help me?" "Do you want to come sit down next to me?" "Why don't you go choose a book?"
Suggestion	Statements that offer a possible course of action without begin directive	"We could add the milk first." "Maybe we should ask your sister if she wants to play."
Choice	Questions that provide two or more clearly defined options	"Do you want to play with legos or read a book?" "Would you like french toast, cereal, or oatmeal?"
Transfer	Statements or questions that elicit the child's input without explicitly providing a possible course of action - transferring control of the situation to the child	"What should we do next?" "Which color do you want?" "We can do anything you want."
Reprimand	Questions or statements that express that the child has broken a rule or identify a bad behavior	"You didn't wash your hands." "Are you drinking that milk when I told you not to?" "You're not listening."
Praise	Positive feedback about the child's behavior or character	"Excellent!" "You're being so nice to your brother." "Thank you!"
Reasoning	Explanations for why a child should follow a rule or a parent request	"You can't put those up there or they will fall and break." "You need to wait because I have to finish this first."
Bargaining	Negotiation; attempt to make a deal while taking into account the wishes of the mother and child	"We'll play outside after dinner." "You can have an apple instead of fruit snacks." "If you clean up, you can watch a show."

Table 4.2. Intraclass correlations for 3 coders on each management language code and the total amount of management language coded.

Variable	ICC
Explicit Direction	0.931
Qualified Direction	0.459
Ambiguous Suggestion	0.929
Suggestion	0.315
Choice	0.822
Transfer	0.711
Reprimand	0.878
Praise	0.858
Reasoning	0.830
Bargaining	0.788
Total Management Language	0.945

Note. The conventional cut-off for acceptable intraclass correlations is .80.

Table 4.3. Means and standard deviations for the management language counts during each segment.

Segment	N	Direction	Suggestion	Reprimand	Praise	Reasoning	Bargaining	Total
Weekday Morning	38	13.21(9.04)	8.03(7.69)	0.53(1.01)	1.82(2.12)	2.82(2.67)	1.05(1.37)	27.39(16.27)
Weekday Bedtime	36	13.64(11.61)	3.92(5.15)	1.25(2.35)	1.81(2.58)	2.31(2.64)	1.25(1.63)	24.17(19.41)
Weekend Morning	31	9.19(6.98)	4.58(3.78)	0.52(1.46)	1.10(1.22)	1.81(2.93)	0.87(1.46)	17.61(12.83)
Weekend Bedtime	29	10.90(8.62)	2.24(2.64)	0.45(0.87)	1.03(1.50)	2.41(2.16)	0.48(0.79)	17.52(11.95)

Table 4.4. Correlations between maternal education, number of siblings, and each management language code.

	1	2	3	4	5	6	7	8	9
1. Maternal Ed.	1								
2. Siblings	-.094	1							
3. Direction	.078	-.181*	1						
4. Suggestion	.175*	-.092	.330**	1					
5. Reprimand	.040	-.168	.376**	-.037	1				
6. Praise	.164	-.175*	.207*	.224**	.113	1			
7. Reasoning	.072	-.223**	.544**	.338**	.272**	.231**	1		
8. Bargaining	.125	-.188*	.363**	.304**	.324**	.260**	.312**	1	
9. Total Mgmt	.162	-.226**	.890**	.649**	.393**	.398**	.689**	.491**	1

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 4.5. Use of Direction as predicted by child gender, maternal education, segment, and number of siblings.

	Estimate	SE	df	*t*	sig.
(Intercept)	2.61	0.12	91	21.64	***
Child Gender	-0.17	0.16	36	-1.03	
Maternal Education (centered)	0.02	0.03	36	0.53	
Weekday Bedtime	0.04	0.15	91	0.27	
Weekend Morning	-0.37	0.18	91	-2.06	*
Weekend Bedtime	-0.17	0.17	91	-1.01	
Siblings (centered)	-0.17	0.09	36	-1.90	+

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.6. Use of Suggestion as predicted by child gender, maternal education, segment, and number of siblings.

	Estimate	SE	df	*t*	sig.
(Intercept)	2.03	0.15	91	13.82	***
Child Gender	-0.13	0.24	36	-0.53	
Maternal Education	0.10	0.05	36	1.91	+
Weekday Bedtime	-0.71	0.19	91	-3.65	***
Weekend Morning	-0.56	0.19	91	-2.89	**
Weekend Bedtime	-1.22	0.26	91	-4.70	***
Siblings	-0.05	0.13	36	-0.36	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.7. Use of Reprimand as predicted by child gender, maternal education, segment, and number of siblings.

	Estimate	SE	df	*t*	sig.
(Intercept)	-0.81	0.31	91	-2.62	*
Child Gender	-1.42	0.58	36	-2.44	*
Maternal Education	-0.17	0.11	36	-1.56	
Weekday Bedtime	0.80	0.26	91	3.04	**
Weekend Morning	-0.12	0.33	91	-0.36	
Weekend Bedtime	-0.22	0.35	91	-0.61	
Siblings	-0.68	0.28	36	-2.41	*

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.8. Use of Praise as predicted by child gender, maternal education, segment, and number of siblings.

	Estimate	SE	df	*t*	sig.
(Intercept)	0.46	0.20	91	2.26	*
Child Gender	-0.05	0.30	36	-0.15	
Maternal Education	0.12	0.06	36	1.92	+
Weekday Bedtime	0.01	0.22	91	0.04	
Weekend Morning	-0.52	0.27	91	-1.91	+
Weekend Bedtime	-0.52	0.28	91	-1.82	+
Siblings	-0.29	0.17	36	-1.66	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.9. Use of Reasoning as predicted by child gender, maternal education, segment, and number of siblings.

	Estimate	SE	df	*t*	sig.
(Intercept)	1.09	0.17	91	6.33	***
Child Gender	-0.43	0.25	36	-1.70	+
Maternal Education	0.01	0.05	36	0.22	
Weekday Bedtime	-0.20	0.23	91	-0.87	
Weekend Morning	-0.45	0.26	91	-1.77	+
Weekend Bedtime	-0.13	0.24	91	-0.56	
Siblings	-0.34	0.14	36	-2.40	*

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.10. Use of Bargaining as predicted by child gender, maternal education, segment, and number of siblings.

	Estimate	SE	df	*t*	sig.
(Intercept)	0.01	0.22	91	0.05	
Child Gender	-0.24	0.32	36	-0.74	
Maternal Education	0.08	0.06	36	1.21	
Weekday Bedtime	0.16	0.25	91	0.66	
Weekend Morning	-0.25	0.28	91	-0.86	
Weekend Bedtime	-0.76	0.35	91	-2.14	*
Siblings	-0.35	0.19	36	-1.84	+

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.11. Total management language use as predicted by child gender, maternal education, segment, and number of siblings.

	Estimate	SE	df	*t*	sig.
(Intercept)	3.34	0.10	91	31.90	***
Child Gender	-0.20	0.15	36	-1.35	
Maternal Education	0.04	0.03	36	1.38	
Weekday Bedtime	-0.12	0.14	91	-0.86	
Weekend Morning	-0.46	0.16	91	-2.92	**
Weekend Bedtime	-0.42	0.16	91	-2.64	**
Siblings	-0.19	0.08	36	-2.28	*

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.12. Direction as a proportion of total utterance count.

	Estimate	SE	*t*	sig.
(Intercept)	0.165	0.023	7.26	***
Child gender	-0.019	0.026	-0.74	
Maternal Ed. (centered)	-0.012	0.006	-2.20	*
Weekday Bedtime	-0.024	0.031	-0.77	
Weekend Morning	-0.053	0.032	-1.67	+
Weekend Bedtime	-0.021	0.034	-0.60	
Siblings (centered)	-0.008	0.015	-0.51	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.13. Suggestion as a proportion of total utterance count.

	Estimate	SE	*t*	sig.
(Intercept)	0.072	0.009	7.64	***
Child gender	-0.003	0.013	-0.21	
Maternal Ed. (centered)	0.004	0.003	1.52	
Weekday Bedtime	-0.025	0.011	-2.19	*
Weekend Morning	-0.024	0.012	-2.04	*
Weekend Bedtime	-0.048	0.012	-3.83	***
Siblings (centered)	-0.009	0.007	-1.28	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.14. Reprimand as a proportion of total utterance count.

	Estimate	SE	*t*	sig.
(Intercept)	0.009	0.004	2.50	*
Child gender	-0.008	0.005	-1.69	+
Maternal Ed. (centered)	-0.001	0.001	-1.09	
Weekday Bedtime	0.008	0.004	1.83	+
Weekend Morning	-0.001	0.005	-0.32	
Weekend Bedtime	0.005	0.005	0.96	
Siblings (centered)	-0.002	0.003	-0.58	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.15. Praise as a proportion of total utterance count.

	Estimate	SE	*t*	sig.
(Intercept)	0.015	0.003	4.64	***
Child gender	0.002	0.004	0.44	
Maternal Ed. (centered)	0.001	0.001	0.61	
Weekday Bedtime	0.000	0.004	-0.11	
Weekend Morning	-0.004	0.004	-0.97	
Weekend Bedtime	-0.006	0.004	-1.44	
Siblings (centered)	-0.004	0.002	-1.79	+

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.16. Reasoning as a proportion of total utterance count.

	Estimate	SE	*t*	sig.
(Intercept)	0.031	0.005	5.84	***
Child gender	-0.006	0.006	-1.01	
Maternal Ed. (centered)	-0.001	0.001	-1.13	
Weekday Bedtime	-0.003	0.007	-0.45	
Weekend Morning	-0.013	0.008	-1.69	+
Weekend Bedtime	-0.004	0.008	-0.56	
Siblings (centered)	-0.011	0.003	-3.07	**

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.17. Bargaining as a proportion of total utterance count.

	Estimate	SE	*t*	sig.
(Intercept)	0.009	0.002	3.76	***
Child gender	-0.002	0.003	-0.62	
Maternal Ed. (centered)	0.000	0.001	0.01	
Weekday Bedtime	0.002	0.003	0.82	
Weekend Morning	0.002	0.003	0.55	
Weekend Bedtime	-0.003	0.003	-1.00	
Siblings (centered)	-0.004	0.002	-2.34	*

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4.18. Total management language as a proportion of total utterance count.

	Estimate	SE	*t*	sig.
(Intercept)	0.300	0.030	10.06	***
Child gender	-0.034	0.035	-0.99	
Maternal Ed. (centered)	-0.010	0.007	-1.37	
Weekday Bedtime	-0.040	0.041	-1.00	
Weekend Morning	-0.098	0.042	-2.32	*
Weekend Bedtime	-0.076	0.045	-1.67	+
Siblings (centered)	-0.038	0.020	-1.94	+

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Appendix A.

Management Language Coding System

1. **Direction (dir)**

   A **Direction** makes a straightforward command or statement regarding what should or will be done next.

   Criteria:

   - Must be a statement (not a question!)
   - May be a command
   - Or may be a statement about what is going to happen, or what needs to happen, in the immediate future (within the same "state") of the task
   - Leaves no room choice for the child

   Examples of Management-Direction:

   - "Let's put the cups on the table now."
   - "Give that bag one."
   - "Stop that!" or "Watch out!"
   - "Hold on." or "Wait." or "Watch."
   - "Go ahead."
   - "Now we need to make the goody bags."
   - "You should put the plates out."
   - "You can set that down in the middle of the table."
   - "We will set the table next."
   - "Everyone needs a fork." or "Everyone gets a fork."

- "Next we want to/we don't want to . . ."

Note: Do not code mothers' explanations about how to do a certain task. For example, if a mother says "You turn the piece and that makes it fit in the puzzle," do not code this as management-direction.

2. Qualified Direction (qua)

Sometimes parents or children qualify a direction by adding a question at the end. A **Qualified Direction** is an utterance in which the speaker gives a command or request, with a question such as "ok?" or "right?" tacked on at the end.

Criteria:

- Must fit all the criteria for Direction, with some sort of question tacked on at the end
- There may be a pause between the Direction and the question, but the child cannot respond between the two

Examples of Qualified Direction

- "We need to make the gift bags next, *right?*"
- "Put the tablecloth away now, *ok?*"
- "We'll put these out first, *how about that?"*

3. Ambiguous Suggestion (amb)

Sometimes parents make suggestions <u>about what should happen</u> in the form of questions that could be interpreted as genuine suggestions, or as directions in the form of questions. We refer to these as **Ambiguous Suggestions** because they leave room for an answer, but it is unclear whether the parent is actually offering a choice. We do

not try to interpret the utterances one way or another. Ambiguous Suggestions almost always elicit a response of "Yes" or "No."

Criteria:

- Must be a question
- Either asking the child to do something;
- Or asking child for permission/approval for the parent or the parent-child dyad to do something; (in this case it must be in future or present tense, not past tense)
- Or asking the child if he/she "wants" something

Examples of Ambiguous Suggestion

- "Can you find another pencil for this bag?"
- "Do you want to come sit down now?"
- "Why don't you go find another plate in the box?"
- "Can I fill this red bag?"
- "Should I fold the tablecloth for you?"
- "Do you want a piece of cake?"
- "How about the red bag now?" or "How about the hats?"
- "Should we make this with our fingers?" or just "With our fingers?"
- "Ready?" or "Are we ready?" or "Are we done?"
- "Do we/Does everybody need a fork?"

4. **Suggestion (sug)**

Statements that offer a possible action without directing the other person or asking a question will be coded as **Suggestions**. These statements usually contain the word "could" or "maybe".

Criteria:

- Must be a statement
- Must provide a possible action for the child
- Must not direct the other person

Examples of Suggestion

- "We could add the pencils first."
- "Maybe we should start the gift bags now."
- "You could try putting the cups on top of the plates."

5. **Choice (cho)**

In this system, we will code questions that provide explicitly stated choices as **Choices**. Suggestion questions differ from Closed Suggestions in that they provide *two or more* clearly defined options instead of asking for a "Yes" or "No" answer.

Criteria:

- May be a statement or a question
- Always outlines two or more explicit alternatives
- There may be a pause between the alternatives, but the child cannot respond between the alternatives

Examples of Suggestion

- "Do you want to sing 'Happy Birthday,' or do you want to skip it for now?"
- "Would you rather do the gift bags or set the table?"

6. **Transfer (tra)**

Statements or questions that elicit the child's input without explicitly providing any course of action are referred to as **Transfer**. We will code these types of utterances as Transfer because they transfer control of the activity from the parent to the child.

Criteria:

- May be an open-ended question related to an action in the current situation
- Must provide a choice about something
- Must not explicitly put limitations on the response (though it may be implied that there is a "correct" answer)
- Further, there must be more than one viable answer to the question

Examples of Transfer

- "What should we do next?"
- "Which color do you want?"
- "What could we do now?"

New Management Codes (adapted from Kochanska et al., 1987)

7. **Reprimand**

Questions or statements that imply that the child has broken a rule, or serves as a reminder of a rule. Identifies a bad behavior.

Criteria

- May be a statement, exclamation, or question
- Provides negative feedback about the child's behavior, but doesn't explicitly state what is expected now

Examples of Reprimands

- "You didn't wash your hands."
- "You did a terrible job."
- "You're not listening."

8. Positive Incentives (Praise)

Verbal evaluations of child's behavior or character (e.g., "Good girl!," "You are a good helper!," "Excellent!," "You did a terrific job!")

Criteria

- May be a statement or exclamation
- Provides positive feedback about the child's behavior, but doesn't explicitly state what is expected now

Examples of Positive Incentives

- "Good job!"
- "You are a good helper!"
- "Excellent!"

9. Reasoning

Explanations justifying compliance with reference to norms, or values, or to consequences to self, objects, or others (e.g., "This is too fragile to play with," "It hurts me when you do this.")

Criteria

- Usually a statement
- Gives an explanation related to what the child *should* (in a case where the mother is trying to get the child to do something)

- OR it explains why the child *should not* do something (in a case where the mother has to refuse the child's wishes)
- It does not explicitly state what is expected next (meaning it is not a Direction)

Examples of Reasoning

- "This is too fragile to play with"
- "It hurts me when you do this"

10. Bargaining

Verbal negotiation, attempt to make a deal while taking the child's wishes into account

Criteria

- Usually a statement
- Attempts to convince the child to do what the parent is asking by making some adjustment or concession to the child's wishes
- OR attempts to satisfy the child's wishes to do something by providing an alternative

Examples of Bargaining

- "A few more bites and you can go"
- "Just a couple more minutes"
- "You can play with it later"
- "You can have an apple instead of fruit snacks"

Tips for Coding Management Language

*** Go over every segment of the sound file twice to make sure you have caught all codes! ***

- Repeats: If a person repeats the *same exact utterance* two or more times in rapid succession without at least a one second break in between utterances, only code the utterance once. Also, if the parent repeats something the child has just said, do not code it. Most of the time, however, we will code utterances that are repeated.

  Example of parent repeating a child management utterance:

  Child: "I want to make the goody bags now."

  Parent: "Oh, you want to make the goody bags now?" (Do not code!)

  When a parent repeats his or her own management utterance *with at least a one second pause between each utterance*, code each of them separately. Usually this happens when a parent is ignored by the child and the parent repeats his or her request.

- Utterance boundaries: Sometimes parents speak in incomplete sentences, and it can be difficult to determine where one utterance ends and the next one begins.

  Examples:

  - "Put that fork down [pause] and can you help me fix the tablecloth?" (1 direction, 1 ambiguous suggestion)
  - "Ok put out the plates and we'll start the silverware." (1 direction)

  * See the STAR Coding guide for more information about utterance boundaries *

- Other children, researcher, etc.: If you can tell that the parent is using management language to speak to a sibling of the target child, another adult, or anyone else, DO NOT code it. We are only interested in management language that is directed towards the child who is participating in the study.

Appendix B.

Utterance Coding System

1. Count all utterances spoken by the mother, regardless of to whom they are spoken.
2. Always listen to the file and code for utterances at least 2 times.
3. When one word is spoken by itself, it is considered a single utterance. The only case when this does not apply is when the mother was going to continue into a longer sentence, but is interrupted.
    - Name (*"David!"*)
    - Command (*"Wait!"*)
4. If a sentence is interrupted for any reason, do not count it. If a sentence starts off one way, but then changes to a new sentence halfway through, count only the completed sentence.
    - *"Can you…Are you done with your waffle?"* (In this case, only count "Are you done with your waffle?" as one utterance. Disregard the "Can you…" part because it was interrupted or cut off)
5. Sentences that begin with a word and a comma will count as one utterance unless if there is a big pause between the word and the rest of the sentence.
    - *"Here, do you want a towel?"*
    - *"David, I want you to…"*
6. Sounds that are substitutes for words count as an utterance.
    - *"Hmmm?"* ("What?")
    - *"Uh huh"* ("Yes.")

7. If something does not sound clear or entirely audible, it still counts as an utterance. Just make a note when coding that it was unclear.
8. When one word is repeated many times in a row *without pauses in between the words*, it counts as one utterance.
    - *"No, no, no…"*
9. Finishing someone else's sentence or getting someone to finish the sentence counts as an utterance.
    - Mother: "Remember, that's called …" Child "A grapefruit!"
    - Child: "I didn't turn the light of because, because …" Mother: "You were going right back down?"
10. When there is counting, alphabet singing, spelling letters, or other series, the series counts as one utterance.
    - *"*One, two, three, four…"
    - "C-A-T spells 'cat'"
11. If a question comes before a statement, it will count as two utterances.

- "Why? Let me see."

12. Utterances that come just before and just after the specified interval of time do not count. Start counting at the first complete utterance within the given segment and stop after the last complete utterance the ends before the end of the segment.
13. The term *'small sound'* is used to describe something that is unclear when listening to the LENA.
14. When the mother says the name of the child at the start of a sentence, it is counted as one whole utterance.

- "David, here's what we're going to do next."

15. Don't count *umm*, or any other sounds that have no specific meaning.
16. If there is a one-second pause or more between complete ideas, count those as two utterances.

- "The boy turned none years old…(pause)…and he didn't want to come in for dinner."

Chapter V.

Examining Links Between Management Language and Children's Executive Function

The final aim of the current study was to use the LENA technology to examine links between mothers' management language and children's EF skills. There is much evidence to suggest that the types and amounts of management language that mothers use are related to children's EF skills.

In light of the previous chapter's striking findings regarding differences in management language across daily routines and days of the week, an additional issue is the potential import of variability in management language for children's EF skills. This issue will be investigating by creating an index of stability for each type of management language across the four segments that were coded: Weekday Morning, Weekday Bedtime, Weekend Morning, Weekend Bedtime.

One important caveat is that the effects of management language, and parenting in general, are likely different depending on the child's characteristics. The current work will explore this issue with regards to children's EF by examining whether three major dimensions of children's temperament moderate relations between mothers' management language and children's EF outcomes. The three temperament dimensions to be examined include effortful control, surgency/extraversion, and negative affectivity. Together these

three, independent temperament dimensions provide a concise summary of children's temperament (Putnam & Rothbart, 2006). As described earlier, effortful control refers to one's ability to inhibit a prepotent response or impulse. Surgency/extraversion includes low levels of shyness along with high ratings in terms of impulsivity, activity level, and high intensity pleasure. Negative affectivity is characterized by high amounts of fear, sadness, anger/frustration and discomfort.

Research Questions.

1a. Does the amount of each type of management language used by mothers predict children's concurrent EF performance?

Hypotheses. In line with findings from previous work, it is expected that Direction will be negatively associated with, and Suggestion positively associated with, children's concurrent EF skills (Worzalla et al., 2012). Because no prior work has examined Reprimands, Praise, Reasoning, and Bargaining in conjunction with EF or other self-regulatory capacities, these analyses will be primarily exploratory.

1b. Does variability and stability in management language use relate to children's EF skills?

Hypotheses. Because variability and stability in parenting have not been considered in past work, it is unclear whether stability (i.e., similar amounts of each type of language during each coded segment) or variability is more beneficial for children's EF development. The current work will provide the first empirical findings on this issue.

3. Does child temperament moderate relations between management language and children's EF skills?

Hypotheses. Past research on interactions between parenting and child temperament has focused almost exclusively on the moderating role of difficult temperament, which is assessed in infancy. There is not an equivalent measure of difficult temperament during the preschool years. However, effortful control is conceptually very similar to EF, so it is a likely candidate to moderate the effects of management language on EF. Based on findings demonstrating the importance of autonomy support for EF development as well as the Differential Susceptibility hypothesis, it is expected that children who are rated as having little effortful control, and thus at risk for poor EF outcomes, will be more sensitive to both the beneficial effects of autonomy-supportive language (e.g., Suggestion) and the detrimental effects of controlling language (e.g., Direction).

Analysis Plan

Management Language Predictors

In the current chapter, management language predictors of children's EF skills are examined in two different ways. First, the raw counts for each type of management language have been averaged together across the four segments to create raw management predictors. These counts of management language are used to predict child EF on their own, and in conjunction with child temperament. Second, in order to index variability in management language use, the standard deviation of the counts of each type of management language was calculated across the four coded segments. These standard deviation predictors are hereafter referred to as variability predictors, for example, Variability in Direction. The variability predictors are used to predict child EF in separate analyses.

Examining Management Language Predictors of Child Executive Function

Because the final sample included 40 children, there was not enough statistical power to simultaneously test multiple types of management language as predictors of children's EF skills. For this reason, each research aim includes a separate regression model for each type of management language and each EF outcome. Unlike the previous analyses, the outcomes in the current chapter were normally distributed and were thus analyzed using normal regression. The coefficients listed in the Results section can thus be interpreted in terms of absolute change in the dependent variable.

Because interaction effects were of interest in many of the analyses, all predictors were mean-centered. The intercept for each regression equation thus represents the predicted value for a child who has average values on all predictors (rather than zero values on all predictors). Significant interaction findings were probed using tools available at quantpsy.org (Preacher, Curran, & Bauer, 2006). This online module produces simple slopes tests indicating whether the slope of the regression line (management language predicting EF) is significant for particular values of the moderator variable (e.g., maternal education or child temperament), holding control variables constant. In all cases, values of one standard deviation above and below the mean were tested for the moderator variable.

The online module also produces syntax for graphing interactions using the R software (R Development Core Team, 2012). The attached graphs depict slopes for children who are one standard deviation above and below the mean on both the management language and temperament moderator variables.

Results

Descriptive statistics regarding the EF outcomes, temperament dimensions, and management language counts can be found in Table 5.1.

Raw Management Language Predictors of Child EF Skills

A separate regression model was used to examine the relations between each management language type and each of the child EF outcomes.

The regression analyses examining the raw management language predictors also included child age. Maternal education was not significantly associated with any of the outcomes in these analyses, so it was dropped for parsimony. Contrary to our hypotheses, none of the average counts of management language significantly predicted children's inhibition or delay of gratification skills. However, several types of management language were found to predict children's working memory (See Tables 5.2-5.8). It was predicted that Suggestion language would be positively associated with children's EF skills. However, both Suggestion language and Bargaining were significant, negative predictors of children's working memory skills (b = -0.37, p = .046 and b = -2.44, p = .001, respectively). Likewise, Total Management Language was a negative predictor of children's working memory skills (b = -0.16, p = .016).

The pattern of findings was similar for both Direction and Reasoning, which were both negatively associated with children's working memory skills, but these findings were only marginally significant (b = -0.22, p = .060 and b = -0.68, p = .099, respectively). The findings for Direction are in line with the prediction that directive language would be negatively associated with EF. Reprimand (b = -0.54, *ns*) and Praise (b = -0.15, *ns*) were not significant predictors of children's working memory skills.

Regression results for the inhibition (HTKS) and delay of gratification (Gift Delay) outcomes are displayed in tables 5.9-5.22.

Variability in Management Language Use

Descriptive statistics for the standard deviation predictors are included in Table 5.23. The regression equations examining the variability predictors included child age, maternal education, and a management variability*maternal education interaction term. There were no concrete hypotheses regarding the relations between variability in management language use and child EF. There were just two significant findings. First, there was a significant interaction between Variability in Suggestion and maternal education (b = -0.63, p = .011), which indicated that the effect of Suggestion was moderated by maternal education (See Table 5.24). As illustrated in Figure 5.1, variability in Suggestion was positively related to Inhibition only for children whose mothers had low levels of education. A simple slopes analysis showed that the slope for highly educated mothers was not significantly different from zero (t(35) = -0.14, *ns*). However, the slope for mothers with less education was positive and significantly different from zero (t(35) = 3.46, p = .002).

There was also a significant interaction between Variability in Reasoning and maternal education (b = -1.76, p = .036; See Table 5.25). As shown in Figure 5.2, Variability in Reasoning was negatively related to children's inhibition scores in families with high maternal education. Conversely, Variability in Reasoning was positively related to inhibition in families with low maternal education. Although these two slopes are significantly different from one another, a simple slopes analysis demonstrated that neither slope was significantly different from zero (t(35) = -1.45, *ns* for high maternal

education and $t(35) = 1.74$, *ns* for low maternal education). It should be noted that the low maternal education slope was marginally significant at $p = .091$.

There were no other significant findings for Suggestion and Reasoning, and variability in the other types of management language did not predict children's EF performance.

The Moderating Role of Child Temperament

Table 5.1 contains descriptive information for the three dimensions of child temperament assessed by the Child Behavior Questionnaire (i.e., effortful control, negative affectivity, and surgency/extraversion). Table 5.26 presents the bivariate correlations between children's scores on the EF assessments and the three dimensions of temperament. There were no significant correlations between the EF scores and the temperament ratings, but the correlation between delay of gratification and the effortful control ratings was marginally significant ($r(38) = .300$, $p = .068$).

As with the previous set of analyses, each type of management language was examined separately as a predictor of child EF skills, controlling for child age. Additional predictors for the respective dimensions of child temperament (separately) and the management language by temperament interactions are included. All predictors, including child age, are mean-centered for interpretability of the interaction terms.

Effortful control. Results showed that, in support of the hypotheses, the effects of Direction, Bargaining, and Total Management Language on children's inhibition skills were all moderated by children's effortful control (See Tables 5.27 – 5.29). There was a significant Direction * effortful control interaction ($b = 1.43$, $p = .016$). As illustrated by Figure 5.3, increases in Direction were beneficial for children's Inhibition only if the

child had high effortful control. Children with low effortful control showed worse inhibition performance with increases in direction. A simple slopes analysis showed that both the slopes for high and low effortful control children were significantly different from zero ($t(35) = 2.13$, $p = .040$; $t(35) = 2.45$, $p = .019$, respectively). These findings are in agreement with the prediction that children with low effortful control would be more sensitive to the negative effects of Direction. However, we did not anticipate that Direction would be beneficial for children with high effortful control.

There was also a significant Bargaining * effortful control interaction ($b = 6.09$, $p = .014$), which showed that Bargaining was positively related to inhibition only for children with high effortful control (See Figure 5.4). For children with low effortful control, Bargaining was negatively related to inhibition. The simple slopes test showed that the slope for high effortful control children was significantly different from zero ($t(35) = 2.53$, $p = .016$) but not for low effortful control children $t(35) = -1.50$, *ns*).

The Total Management * effortful control interaction was significant ($b = 0.78$, $p = .009$) and showed that Total Management was positively related to inhibition for children with high effortful control (See Figure 5.5). Total management language was negatively related to inhibition for children with low effortful control. The simple slopes analysis showed that both of these slopes were significantly different from zero ($t(35) = 2.64$, $p = .012$; $t(35) = 2.25$, $p = .031$).

Finally, children's effortful control moderated the effects of Reasoning on children's delay of gratification skills ($b = -2.46$, $p = .020$) (See Table 5.30 and Figure 5.6). For children with higher effortful control, Reasoning is negatively related to delay of gratification. For children with lower effortful control, Reasoning is positively related to

delay of gratification skills. Neither of these slopes were found to be significantly different from zero, but the slope for children with low effortful control was marginally significant ($t(35) = 1.76$, $p = .088$.

Negative affectivity. There were no significant interactions between children's negative affectivity and any types of management language. According to these analyses, there is no evidence that negative affect moderates the effects of management language on any of the three EF outcomes measured in this study.

Surgency/extraversion. Children's surgency/extraversion was found to moderate the effects of management language on both inhibition and working memory skills.

Starting with children's inhibition outcomes, there was a significant interaction between Suggestion and surgency/extraversion ($b = 1.83$, $p = .007$; See Table 5.31). As illustrated in Figure 5.7, the relation between Suggestion and children's inhibition skills was positive for children with high surgency/extraversion, and this slope was significantly different from zero ($t(35) = 2.95$, $p = .006$). The relation for children with low surgency/extraversion was not significantly different from zero ($t(35) = -0.41$, *ns*).

Surgency/extraversion also moderated the effects of Bargaining on children's inhibition skills ($b = 6.46$, $p = .038$; see Figure 5.8 and Table 5.32). For children with low surgency/extraversion, the relation between Bargaining and Inhibition was negative. For children high in this temperament dimension, the relation between Bargaining and inhibition was positive. However, neither slope was significantly different from zero ($t(35) = 1.22$, *ns*; $t(35) = -0.68$, *ns*, respectively).

When examining working memory outcomes, there was a significant interaction between Direction language and surgency/extraversion ($b = .37$, $p = .012$, See Table

5.33). As illustrated in Figure 5.9, Direction is negatively associated with working memory in children who have low surgency/extraversion. Indeed, the slope was significantly different from zero for children with low surgency/extraversion ($t(35) = -3.33$, $p = .002$) but not children high in this temperament dimension ($t(35) = 0.57$, *ns*).

There was also a significant interaction between Total Management Language and surgency/extraversion for children's working memory skills ($b = .213$, $p = .011$, See Figure 5.10 and Table 5.34). The findings show that as with Direction, the relation between Total Management Language and working memory is negative, and significantly different from zero for children with low surgency/extraversion ($t(35) = -3.71$, $p = .001$). The slope for children with high surgency/extraversion was not significantly different from zero ($t(35) = 0.17$, *ns*).

Summary

The current chapter describes the first known effort to connect mothers' management practices in the home with children's concurrent EF skills. Contrary to our hypotheses, none of the average amounts of management language were significantly related to children's inhibition and delay of gratification skills. However, there were significant, negative associations between Suggestion and Bargaining management language and children's working memory skills.

The analysis of variability in management language across the four coded segments yielded two significant findings. First, there was a significant interaction between Variability in Suggestion and maternal education demonstrating that Variability in Suggestion was positively associated with inhibition in low-SES children but not associated with inhibition in high-SES children. Second, an interaction between

Reasoning and maternal education showed that Variability in Reasoning was negatively related to inhibition for high-SES children, but positively related for low-SES children.

Finally, the effortful control and surgency/extraversion dimensions of temperament moderated the relations between several types of management language and children's EF outcomes. The results show that the effects of Direction, Bargaining, and Total Management all depend on children's levels of effortful control. The overall pattern shows that each of these types of management language were beneficial to inhibition for children who had high effortful control, but detrimental to inhibition for children with low effortful control.

The role of Reasoning in terms of children's delay of gratification skills was reversed. Children with low effortful control seemed to benefit from Reasoning, but children with high effortful control did not.

Surgency/extraversion was also a significant moderator of management language effects on inhibition and working memory. There was a significant interaction between Suggestion and surgency/extraversion showing that increases in Suggestion were beneficial to children's inhibition only if they were high in surgency/extraversion. Likewise, Bargaining was only beneficial to children's inhibition if they were high in surgency/extraversion. Finally, the effects of Direction and Total Management Language on children's working memory both depended on children's surgency/extraversion. Both of these types of management language were found to be detrimental to children's working memory skills if children were rated as having low levels of surgency/extraversion.

Table 5.1.

Descriptive statistics for child age, maternal education, and household income.

		M(SD)	Min.	Max.
Child Age (months)	40	53.75(5.47)	46	69
Maternal Education	40	15.53(2.15)	12	18
Household Income	33	72,348(43,451)	10,000	200,000

Note. The median household income was $76,000.

Table 5.2. Direction as a Predictor of Children's Inhibition Skills.

	Estimate	SE	β	*t*	sig.
Intercept	-2.53	6.78		-0.37	
Child age	0.28	0.12	0.34	2.27	*
Direction	-0.22	0.11	-0.29	-1.94	+

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.3. Suggestion as a Predictor of Children's Inhibition Skills.

	Estimate	SE	β	t	sig.
Intercept	-0.84	6.87		-0.12	
Child Age	0.24	0.12	0.28	1.89	+
Suggestion	-0.37	0.18	-0.31	-2.06	*

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.4. Reprimand as a Predictor of Children's Inhibition Skills.

	Estimate	SE	β	t	sig.
Intercept	-2.67	7.25		-0.37	
Child age	0.24	0.13	0.29	1.83	+
Reprimand	-0.54	0.68	-0.12	-0.79	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.5. Praise as a Predictor of Children's Inhibition Skills.

	Estimate	SE	β	t	sig.
Intercept	-3.65	7.29		-0.50	
Child age	0.26	0.13	0.31	1.95	+
Praise	-0.15	0.56	-0.04	-0.27	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.6. Reasoning as a Predictor of Children's Inhibition Skills.

	Estimate	SE	β	t	sig.
Intercept	-2.19	6.90		-0.32	
Child age	0.26	0.13	0.31	2.04	*
Reasoning	-0.68	0.40	-0.25	-1.69	+

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.7. Bargaining as a Predictor of Children's Inhibition Skills.

	Estimate	SE	β	t	sig.
Intercept	-2.67	6.15		-0.43	
Child age	0.28	0.11	0.34	2.47	*
Bargaining	-2.44	0.70	-0.47	-3.47	**

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.8. Total Management Language as a Predictor of Children's Inhibition Skills.

	Estimate	SE	β	t	sig.
Intercept	0.30	6.75		0.04	
Child age	0.25	0.12	0.30	2.07	*
Total Mgmt	-0.16	0.06	-0.37	-2.54	*

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.9. Direction as a Predictor of Children's Working Memory Skills.
`

	Estimate	SE	β	t	sig
Intercept	-34.19	21.10		-1.62	
Child age	0.95	0.39	0.37	2.44	*
Direction	-0.14	0.35	-0.06	-0.40	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.10. Suggestion as a Predictor of Children's Working Memory Skills.

	Estimate	SE	β	t	sig
Intercept	-41.26	21.16		-1.95	+
Child age	0.98	0.38	0.39	2.57	*
Suggestion	0.67	0.55	0.18	1.21	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.11. Reprimand as a Predictor of Children's Working Memory Skills.

	Estimate	SE	β	t	sig.
Intercept	-34.13	21.72		-1.57	
Child age	0.92	0.40	0.36	2.32	*
Reprimand	-0.40	2.04	-0.03	-0.20	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.12. Praise as a Predictor of Children's Working Memory Skills.

	Estimate	SE	β	t	sig.
Intercept	-39.96	21.48		-1.86	+
Child age	0.98	0.39	0.39	2.53	*
Praise	1.42	1.65	0.13	0.86	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.13. Reasoning as a Predictor of Children's Working Memory Skills.

	Estimate	SE	β	t	sig
Intercept	-35.93	21.28		-1.69	
Child age	0.94	0.39	0.37	2.41	*
Reasoning	0.24	1.24	0.03	0.19	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.14. Bargaining as a Predictor of Children's Working Memory Skills.

	Estimate	SE	β	t	sig.
Intercept	-35.91	20.97		-1.71	+
Child age	0.93	0.39	0.36	2.39	*
Bargaining	1.09	2.40	0.07	0.45	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.15. Total Management Language as a Predictor of Children's Working Memory Skills.

	Estimate	SE	β	*t*	sig.
(Constant)	-36.99	21.70		-1.70	+
Ageatevaluation	0.94	0.39	0.37	2.42	*
Total Mgmt	0.06	0.21	0.05	0.31	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.16. Direction as a Predictor of Children's Delay of Gratification Skills.

	Estimate	SE	β	*t*	sig.
Intercept	-38.44	26.20		-1.47	
Child age	1.55	0.48	0.48	3.22	**
Direction	-0.03	0.43	-0.01	-0.06	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.17. Suggestion as a Predictor of Children's Delay of Gratification Skills.

	Estimate	SE	β	*t*	sig.
Intercept	-41.10	26.17		-1.57	
Child age	1.56	0.48	0.48	3.26	**
Suggestion	0.44	0.76	0.09	0.58	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.18. Reprimand as a Predictor of Children's Delay of Gratification Skills.

	Estimate	SE	β	*t*	sig.
Intercept	-39.70	26.88		-1.48	
Child age	1.56	0.49	0.48	3.19	**
Reprimand	0.36	2.48	0.02	0.15	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.19. Praise as a Predictor of Children's Delay of Gratification Skills.

	Estimate	SE	β	*t*	sig.
Intercept	-37.26	26.56		-1.40	
Child age	1.54	0.48	0.48	3.19	**
Praise	-0.50	2.04	-0.04	-0.25	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.20. Reasoning as a Predictor of Children's Delay of Gratification Skills.

	Estimate	SE	β	*t*	sig.
Intercept	-38.98	26.35		-1.48	
Child age	1.55	0.48	0.48	3.23	**
Reasoning	0.10	1.55	0.01	0.07	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.21. Bargaining as a Predictor of Children's Delay of Gratification Skills.

	Estimate	SE	β	*t*	sig.
Intercept	-37.94	25.48		-1.49	
Child age	1.60	0.47	0.49	3.38	**
Bargaining	-3.35	2.90	-0.17	-1.15	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.22. Total Management Language as a Predictor of Children's Delay of Gratification Skills.

	Estimate	SE	β	*t*	sig.
Intercept	-38.99	26.66		-1.46	
Child age	1.55	0.48	0.48	3.23	**
Total Mgmt	0.01	0.25	0.01	0.05	

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.23. Descriptive Statistics for the Variability in Management Language Predictors.

	N	Min.	Max.	Mean	SD
Direction SD	38	0.00	22.34	7.09	5.63
Suggestion SD	38	0.58	13.00	4.31	3.53
Reprimand SD	33	0.00	6.11	0.73	1.19
Praise SD	38	0.00	4.95	1.54	1.25
Reasoning SD	38	0.50	5.07	1.97	1.23
Bargaining SD	38	0.00	2.99	1.02	0.80
Total Management SD	38	0.71	37.99	12.41	8.31

Table 5.24. Inhibition performance predicted by Suggestion Variability and the interaction between Suggestion variability and maternal education.

	Estimate	SE	β	*t*	sig.
(Constant)	16.24	1.72		9.42	***
Maternal Ed.	1.55	0.81	0.24	1.91	
Child Age	1.07	0.33	0.42	3.26	**
Suggestion SD	1.18	0.50	0.30	2.38	*
Suggestion SD * Maternal Ed.	-0.63	0.23	-0.35	-2.69	*

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.25. Inhibition performance predicted by Reasoning Variability and the interaction between Reasoning Variability and maternal education.

	Estimate	SE	β	*t*	sig.
(Constant)	16.98	1.93		8.80	***
Maternal Ed.	1.55	0.91	0.24	1.70	+
Child Age	1.09	0.36	0.43	3.06	**
Reasoning SD	0.66	1.61	0.06	0.41	
Reasoning SD * Maternal Ed.	-1.76	0.80	-0.31	-2.19	*

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.26. Correlations between Children's Executive Function Scores and Temperament Ratings on Three Dimensions of Temperament.

	1	2	3	4	5	6
1. Effortful Control	1					
2. Surgency/Extraversion	.137	1				
3. Negative Affect	.020	-.317*	1			
4. Inhibition	-.082	-.239	.064	1		
5. Working Memory	-.080	-.139	.072	.360*	1	
6. Delay of Gratification	.300^{+}	-.136	-.049	.108	.237	1

Note. + $p < .10$, * $p < .05$

Table 5.27. Regression Analysis Predicting Inhibition with Direction and Effortful Control.

	Estimate	SE	β	*t*	sig.
(constant)	14.66	1.96	0.72	7.49	***
Direction	-0.11	0.33	-0.03	-0.33	
Effortful Control	-2.34	1.62	-0.14	-1.44	
Direction*Effortful Control	1.43	0.57	0.25	2.53	*
Child Age	1.03	0.37	0.27	2.78	**

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.28. Regression Analysis Predicting Inhibition with Bargaining and Effortful Control.

	Estimate	SE	β	*t*	sig.
(constant)	13.89	1.98	0.68	7.01	***
Bargaining	2.50	2.29	0.11	1.09	
Effortful Control	-6.38	2.37	-0.39	-2.70	*
Bargaining*Effortful Control	6.09	2.35	0.37	2.60	*
Child Age	0.94	0.37	0.25	2.58	*

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.29. Regression Analysis Predicting Inhibition with Total Management Language and Effortful Control.

	Estimate	SE	β	*t*	sig.
(constant)	14.46	1.93	0.71	7.49	***
Total Management	0.10	0.19	0.05	0.53	
Effortful Control	-2.08	1.58	-0.13	-1.32	
Total Management * Effortful Control	0.78	0.28	0.27	2.79	**
Child Age	1.00	0.36	0.26	2.75	**

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.30. Regression Analysis Predicting Delay of Gratification with Reasoning and Effortful Control.

	Estimate	SE	β	*t*	sig.
(constant)	46.31	2.57	0.97	18.01	***
Reasoning	0.67	1.57	0.02	0.43	
Effortful Control	5.03	3.24	0.13	1.55	
Reasoning*Effortful Control	-2.46	1.05	-0.20	-2.35	*
Child Age	1.44	0.46	0.16	3.10	**

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.31. Regression Analysis Predicting Inhibition with Suggestion and Surgency/Extraversion.

	Estimate	SE	β	*t*	sig.
(constant)	16.68	1.98		8.42	***
Suggestion	1.30	0.60	0.35	2.16	*
Surgency/Extraversion	-0.38	2.52	-0.02	-0.15	
Suggestion*Surgency/Extraversion	1.83	0.63	0.44	2.88	**
Child Age	1.01	0.37	0.40	2.74	*

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.32. Regression Analysis Predicting Inhibition with Bargaining and Surgency/Extraversion.

	Estimate	SE	β	*t*	sig.
(constant)	15.03	1.99		7.54	***
Bargaining	1.65	2.30	0.11	0.72	
Surgency/Extraversion	-3.09	2.46	-0.19	-1.26	
Bargaining*Surgency/Extraversion	6.46	2.99	0.33	2.16	*
Child Age	1.07	0.40	0.42	2.71	*

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.33. Regression Analysis Predicting Working Memory with Direction and Surgency/Extraversion.

	Estimate	SE	β	*t*	sig.
(constant)	9.88	0.63		15.67	***
Direction	-0.21	0.11	-0.27	-1.94	+
Surgency/Extraversion	-0.07	0.78	-0.01	-0.09	
Direction*Surgency/Extraversion	0.37	0.14	0.38	2.64	*
Child Age	0.37	0.13	0.44	2.91	**

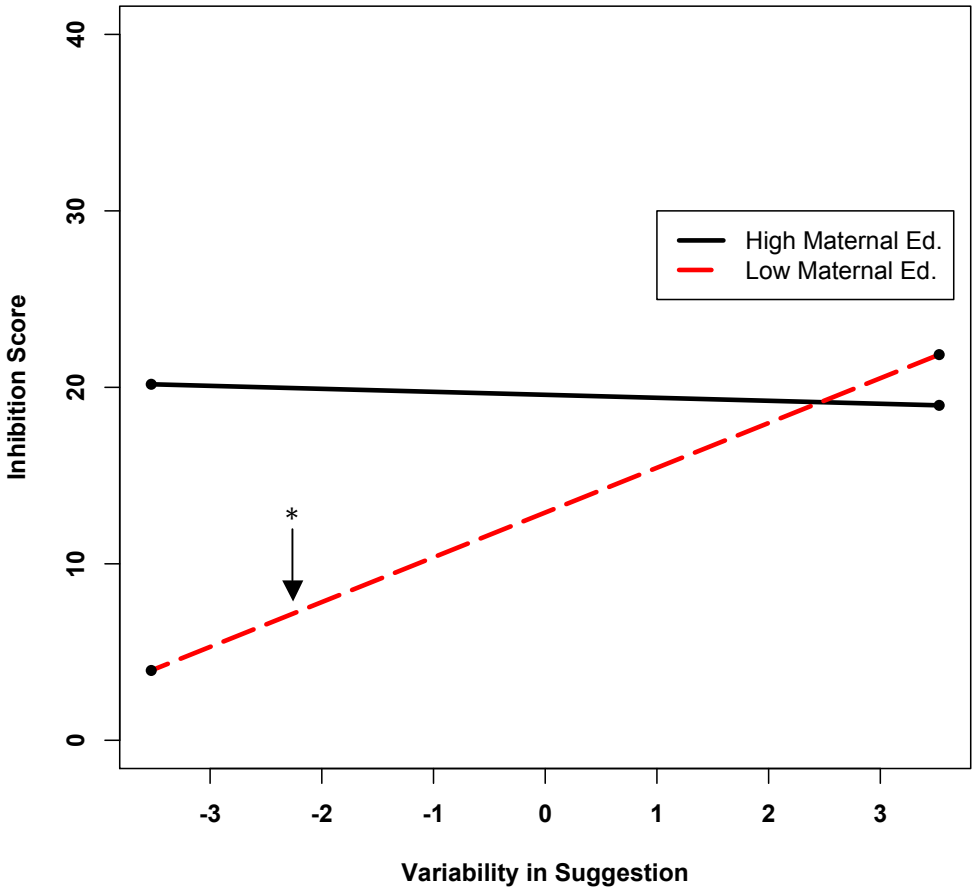
Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 5.34. Regression Analysis Predicting Working Memory with Total Management Language and Surgency/Extraversion.

	Estimate	SE	β	*t*	sig.
(constant)	9.94	0.61		16.36	***
Total Management	-0.15	0.06	-0.35	-2.57	*
Surgency/Extraversion	-0.37	0.75	-0.07	-0.49	
Total Management* Surgency/Extraversion	0.21	0.08	0.38	2.70	*
Child Age	0.32	0.12	0.38	2.66	*

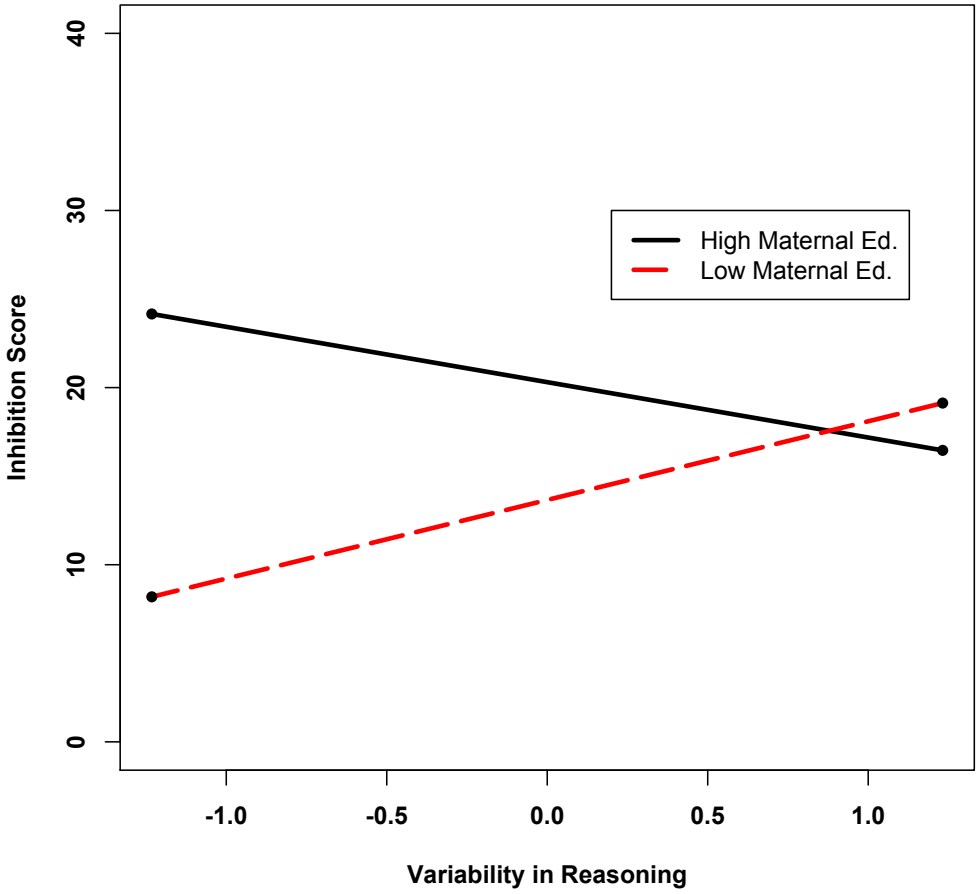
Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 5.1. Interaction plot for the Effects of Variability in Suggestion and Maternal Education on Children's Inhibition Performance.



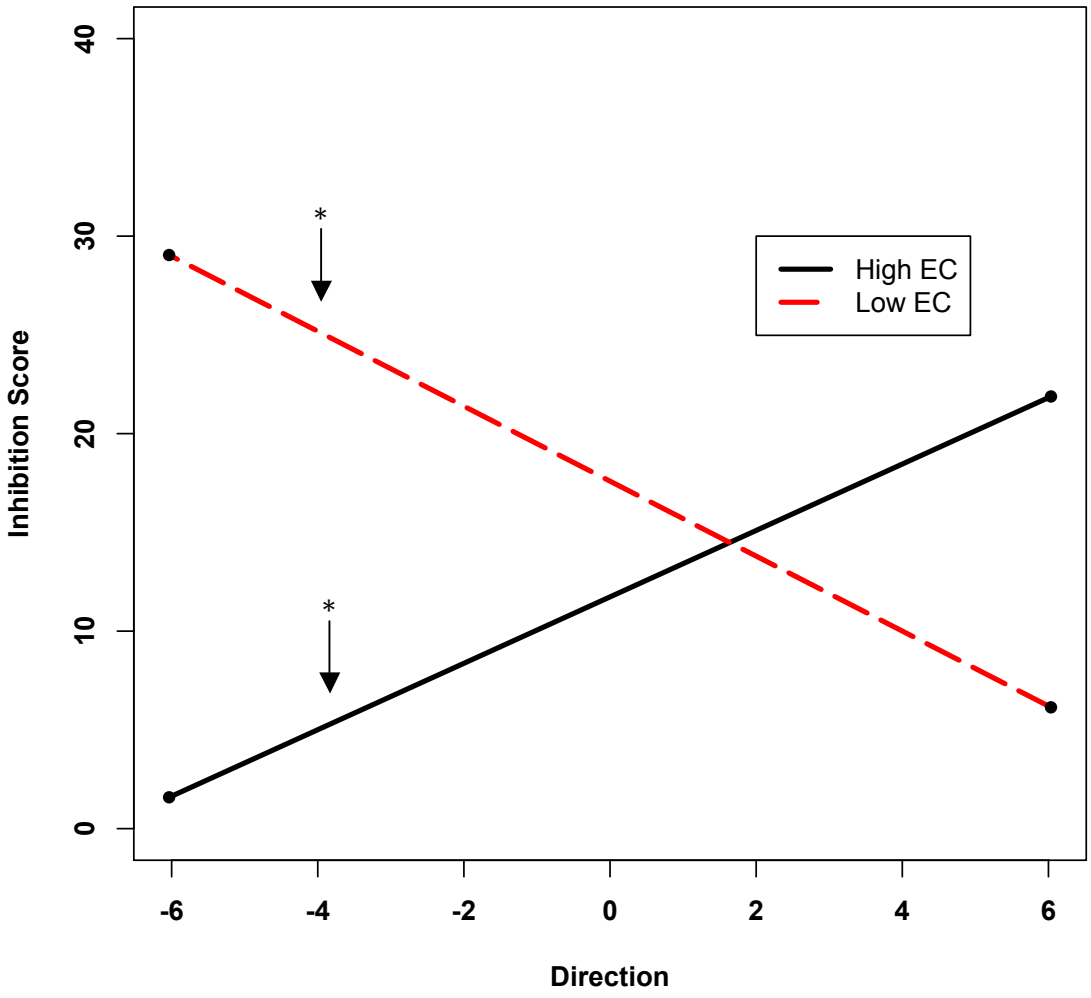
Note. Plotted points represent 1 standard deviation above and below the mean for Variability in Suggestion and Maternal Education. * Simple slope is significantly different from zero ($p < .05$).

Figure 5.2. Interaction plot for the Effects of Variability in Reasoning and Maternal Education on Children's Inhibition Performance.



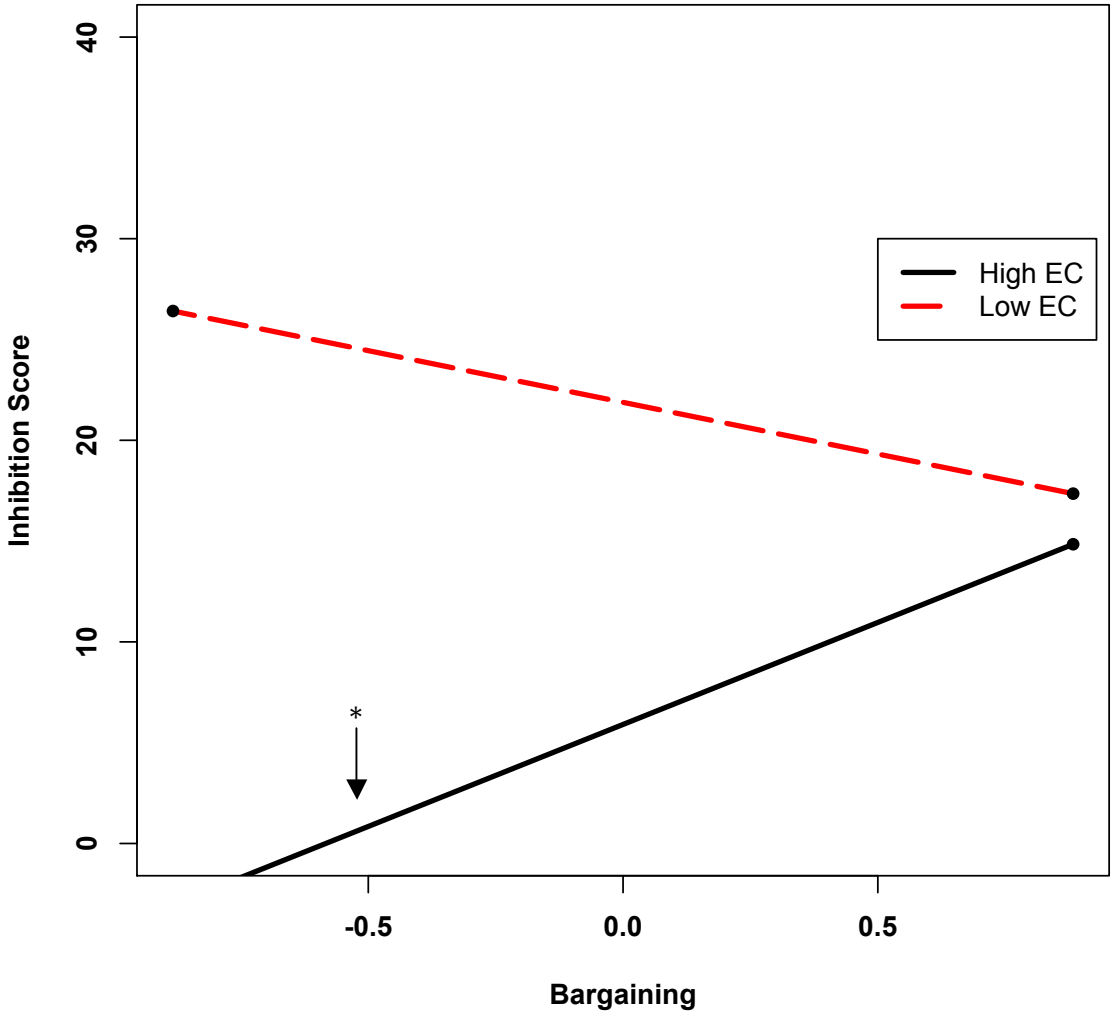
Note. Plotted points represent 1 standard deviation above and below the mean for Variability in Reasoning and Maternal Education. * Simple slope is significantly different from zero ($p < .05$).

Figure 5.3. Interaction plot for the Effects of Direction and Effortful Control on Children's Inhibition Performance.



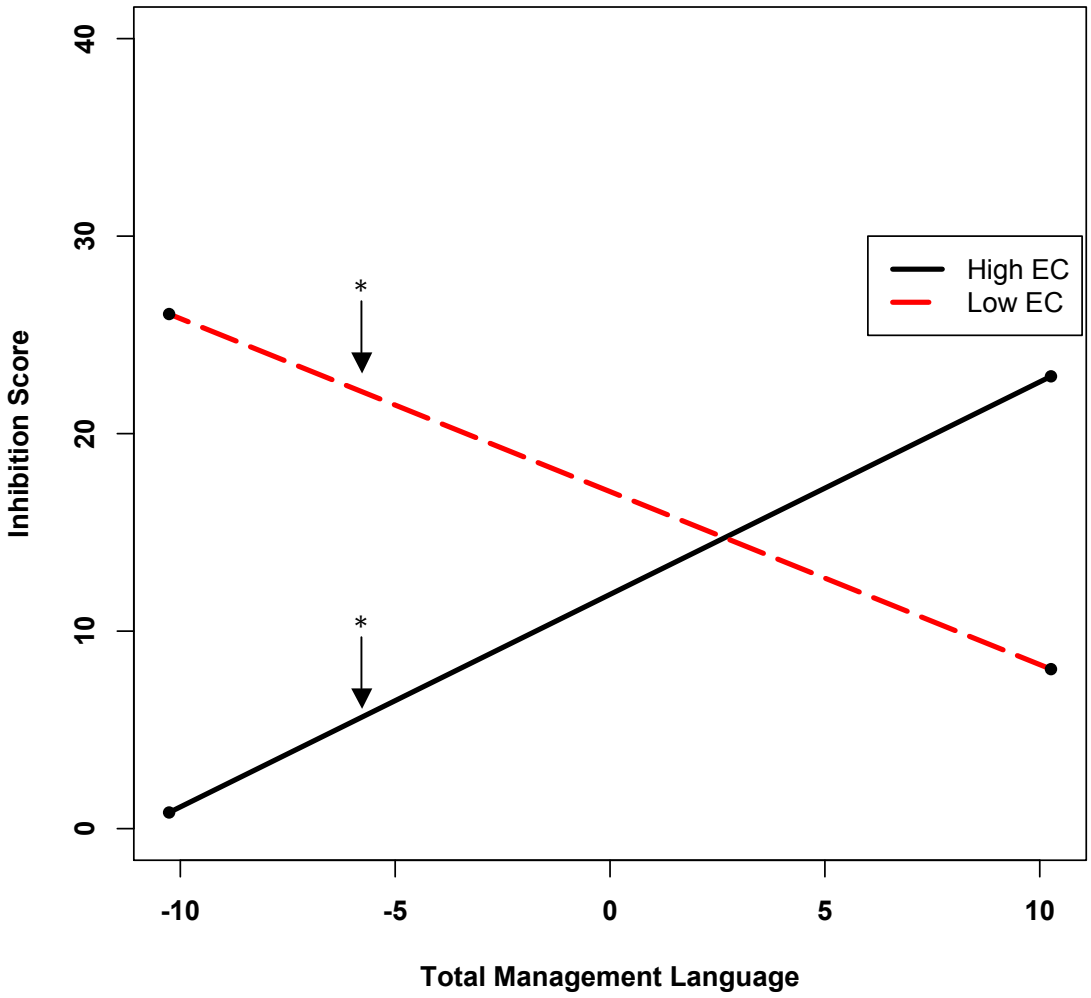
Note. Plotted points represent 1 standard deviation above and below the mean for Direction and effortful control. * Simple slope is significantly different from zero ($p <$ .05).

Figure 5.4. Interaction plot for the Effects of Bargaining and Effortful Control on Children's Inhibition Performance.



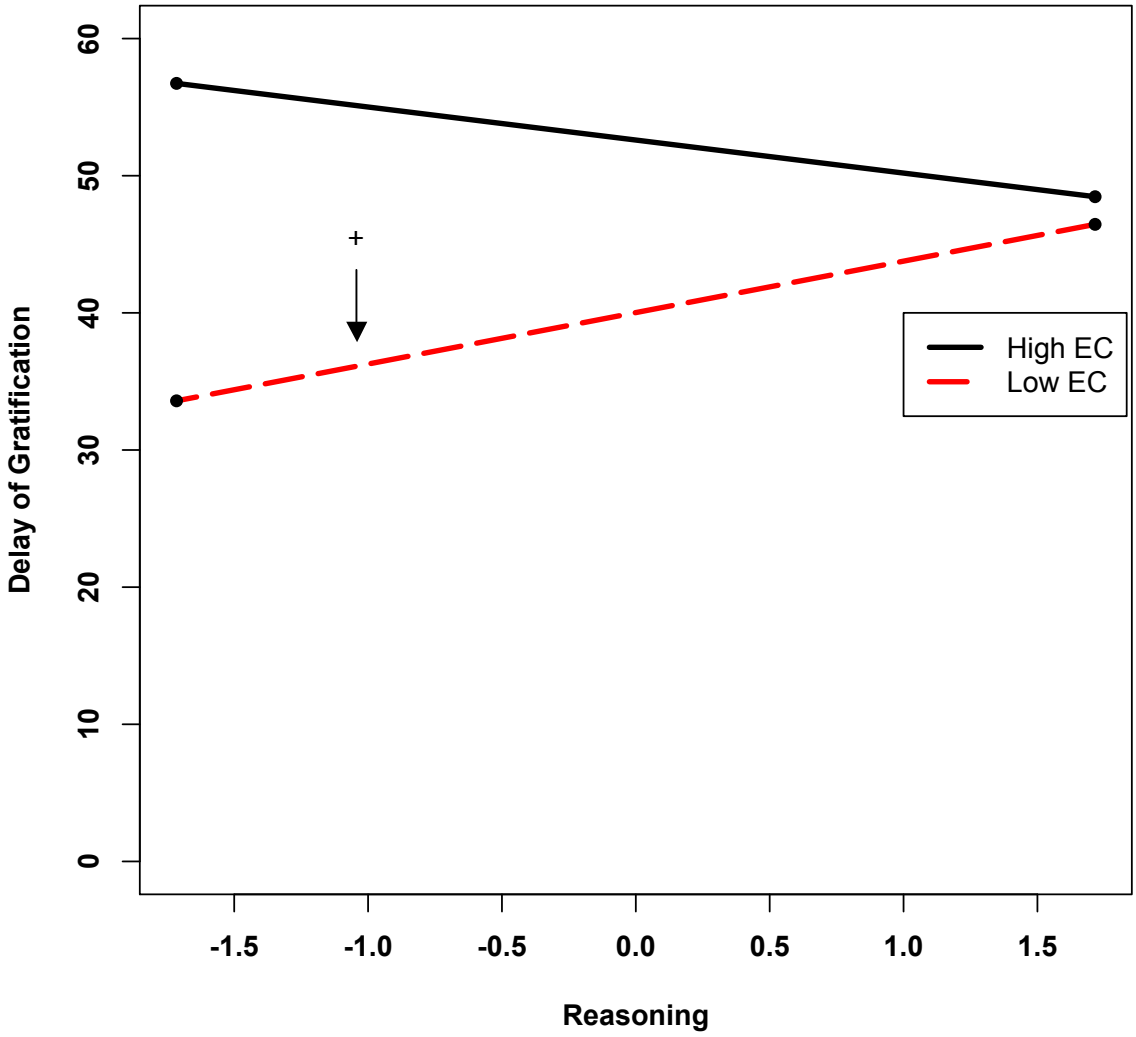
Note. Plotted points represent 1 standard deviation above and below the mean for Bargaining and effortful control. Because the model predicted negative inhibition scores for children with high effortful control, the y-axis was trimmed to represent only feasible values of inhibition scores. * Simple slope is significantly different from zero ($p < .05$).

Figure 5.5. Interaction plot for the Effects of Total Management Language and Effortful Control on Children's Inhibition Performance.



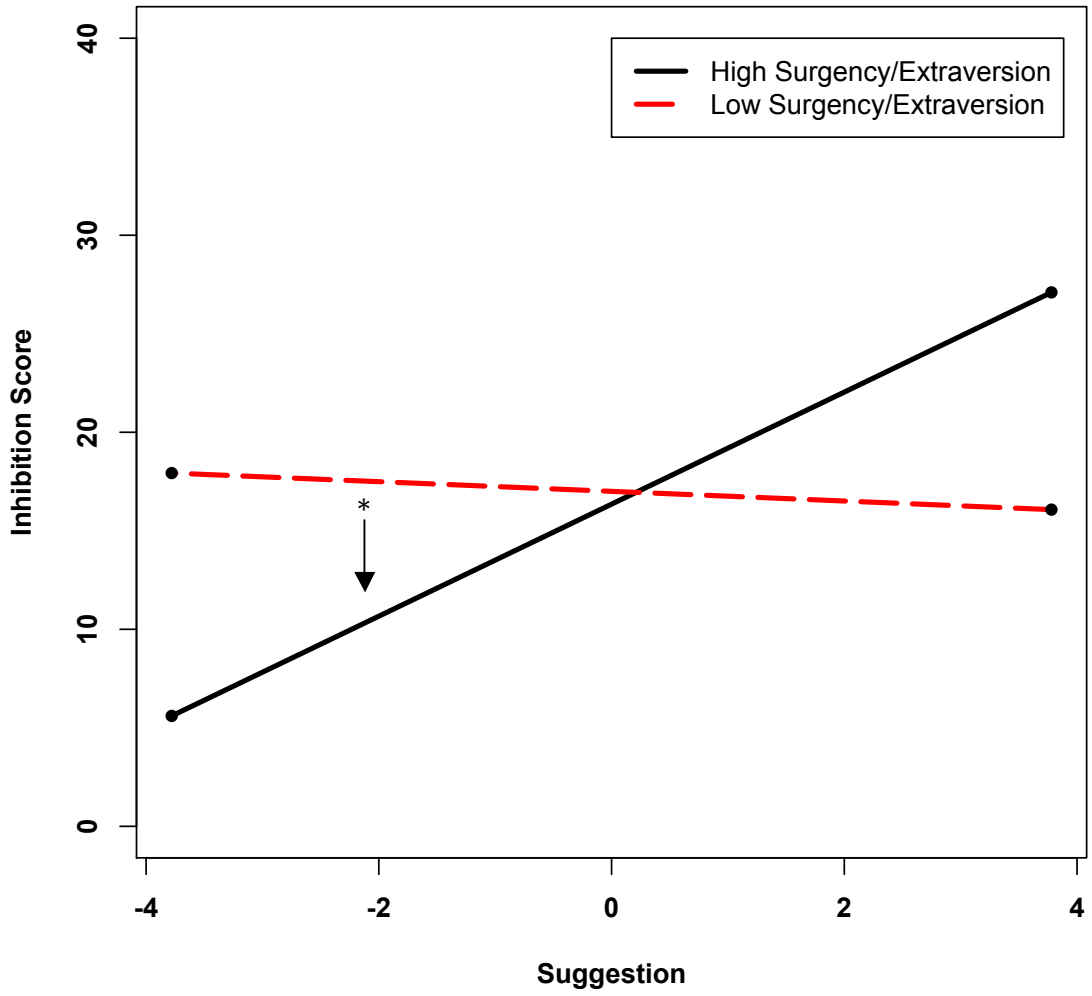
Note. Plotted points represent 1 standard deviation above and below the mean for Total Management Language and effortful control. * Simple slope is significantly different from zero ($p < .05$).

Figure 5.6. Interaction plot for the Effects of Reasoning and Effortful Control on Children's Delay of Gratification Performance.



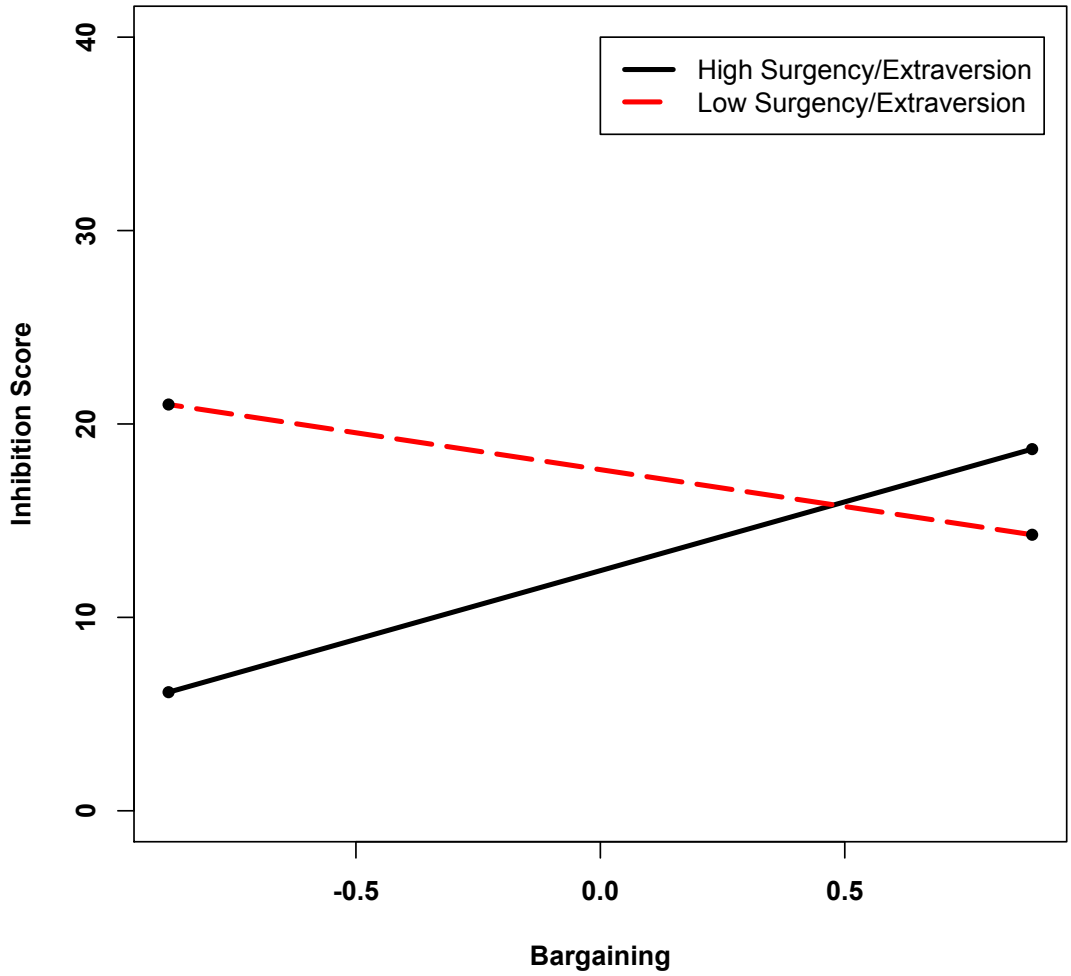
Note. Plotted points represent 1 standard deviation above and below the mean for Reasoning and effortful control. + Simple slope is marginally different from zero ($p <$ .10).

Figure 5.7. Interaction plot for the Effects of Suggestion and Surgency/Extraversion on Children's Inhibition Performance.



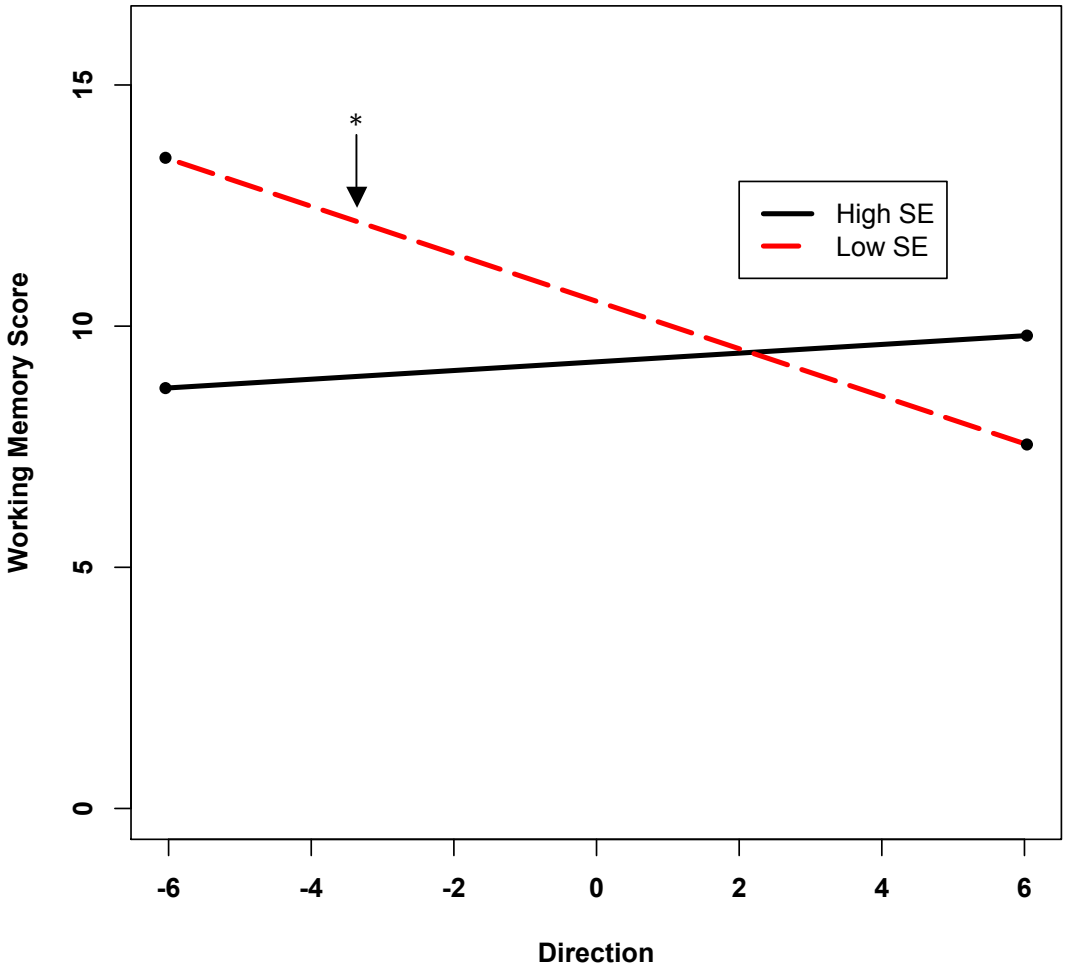
Note. Plotted points represent 1 standard deviation above and below the mean for Suggestion and surgency/extraversion. * Simple slope is significantly different from zero ($p < .05$).

Figure 5.8. Interaction plot for the Effects of Bargaining and Surgency/Extraversion on Children's Inhibition Performance.



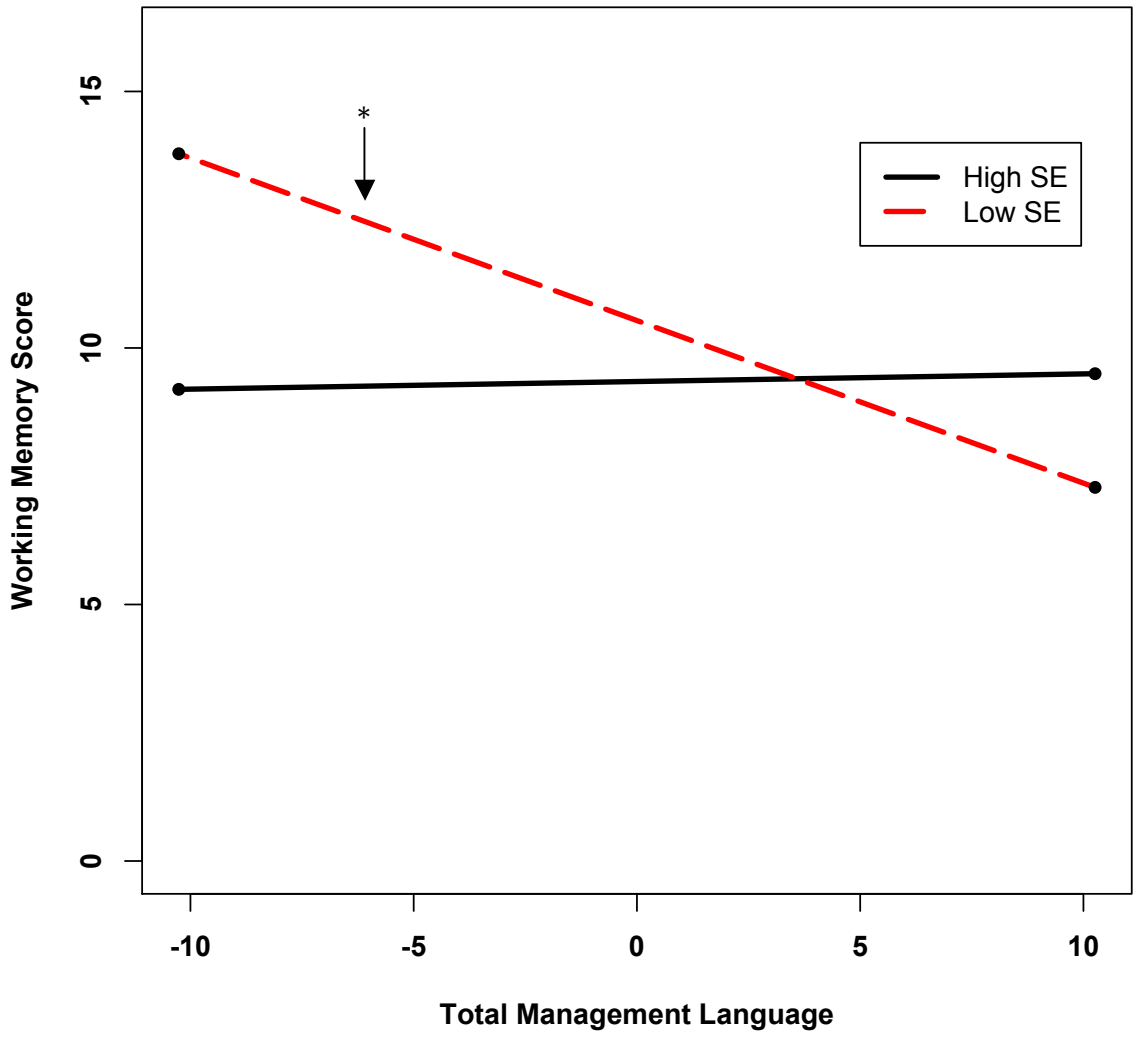
Note. Plotted points represent 1 standard deviation above and below the mean for Bargaining and surgency/extraversion. * Simple slope is significantly different from zero ($p < .05$).

Figure 5.9. Interaction plot for the Effects of Direction and Surgency/Extraversion on Children's Working Memory Performance.



Note. Plotted points represent 1 standard deviation above and below the mean for Direction and surgency/extraversion. * Simple slope is significantly different from zero ($p < .05$).

Figure 5.10. Interaction plot for the Effects of Total Management Language and Surgency/Extraversion on Children's Working Memory Performance.



Note. Plotted points represent 1 standard deviation above and below the mean for Total Management Language and surgency/extraversion. * Simple slope is significantly different from zero ($p < .05$).

Chapter VI.

Discussion

The current study addressed several research questions regarding variability in language and parenting across different situations as well as the relations between mothers' use of management language and children's EF outcomes. In this final chapter, the findings from each of the research questions are discussed in depth with respect to past work. Advantages and limitations of the study design, the voice recording methodology, and the management language coding system are also discussed. Finally, the implications of the current work are outlined along with several directions for future research.

Aim 1: Variability in Parent-Child Conversation in the Home

The first aim sought to investigate how the home language environment of a preschooler varies depending on the time of the day (i.e., morning or bedtime) and the day of the week (i.e., weekday or weekend day). Three indicators from the LENA software were used: Adult Word Count, the number of words spoken by adults in the child's vicinity; Child Vocalization Count, the number of words spoken or attempted by the target child; and Conversational Turns, the number of times that an adult spoke and the child answered, or vice versa.

The findings revealed striking differences in the amount of language used by parents and children during different daily routines. There were significant increases in the Adult Word Count during weekday bedtime routines when compared to weekday mornings. Conversely, the Child Vocalization Count and number of Conversational Turns was significantly reduced at both weekday and weekend bedtime when compared to weekday morning.

These findings are in line with past work showing that the peak times for adult language input occur in the evening (Gilkerson & Richards, 2009). However, instead of being a time of increased parent-child conversation, bedtime seemed to be a time when parents were talking and children were listening rather than participating in conversation. This finding can be attributed to storybook reading. Because we captured the last 15 minutes before children went to sleep, many recordings included parents reading storybooks to their children. The findings suggest that parents and children do not engage in a lot of conversation during shared book reading; instead children seem to be primarily listening.

Our findings also show that, contrary to expectations, the quantity of parent language, child language, and conversational turns in the home does not differ between weekends and weekdays. It was expected that on the weekends, families would have more time for conversation, but it seems that the sheer quantity of conversation is similar regardless of whether it is a weekday or a weekend day.

Finally, there were few relations between the three language indicators and the demographic factors tested (i.e., maternal education, child gender, and the number of siblings in the home). It was surprising that mothers' education levels did not relate to

any of the language counts, particularly the number of adult words that occurred in the home. It is well documented that mothers with more education tend to talk more to their children than mothers with less education (Hart & Risley, 1995; Hoff, 2003). The lack of significant relations between maternal education and the three language variables in question may be due to the somewhat constrained variability in maternal education in this sample of mothers. Although mothers' education ranged from 10 years (about a 10th grade education) to 18 years (an advanced graduate degree), most mothers reported having at least some college experience. There may not have been enough variability in maternal education to reveal significant differences in conversation in the home.

In terms of child gender, no significant differences in any of the language variables were present. This lack of differences runs contrary to a meta-analysis showing that on average mothers provide approximately 10% more linguistic input to girls than boys (Leaper et al., 1998). However, it should be noted that the findings from the meta-analysis were much more prominent for mothers than fathers. Fathers did not use different amounts of language when talking to girls and boys. It is possible that because the Adult Word Count comprises language from mothers and fathers (and any other adult in the home), differences in the amount of language that mothers provided to girls and boys were obscured. An alternative explanation is that the studies included in the Leaper meta-analysis were published between 1969 and 1993, and mothers' ideas about gender roles and the transmission of these roles to children have changed over time.

Finally, there was a marginally significant, negative relation between the number of siblings in the home and the Adult Word Count. Although conventional significance was not reached, this finding was in the predicted direction and supports the theory that

parents with more children in the home are able to provide fewer resources, in this case less language stimulation, for each child (Downey, 2001). The finding may not have reached significance because the total number of siblings ranged only from zero (i.e., the target child was an only child) to three (i.e., a total of four children in the household). The effect of siblings in the home may also vary depending on whether the siblings are older or younger than the target child. Because of the small sample size in this study, it was not possible to examine differences between children with different combinations of older and younger siblings.

These findings replicate previous work showing variability in the home language environment across different times and extend past work in a number of important ways. The finding that the evening times examined contained the most language input from adults in the home replicate findings from the LENA Natural Language Study. However, the Natural Language Study was limited: it only included children ages 0-48 months, it examined average language use across different hours of the day rather than during specific routines, and it did not provide results for the children's participation in conversations in the home (Child Vocalization Count and Conversational Turns). The current study thus provides much new information about the quantity of language that 4- and 5-year-olds are exposed to in the home, and how much they participate in conversation during specific routines.

An unexpected difference between the current work and past research is the lack of differences in daily conversation according to mothers' education levels. This lack of significant findings should be interpreted with caution, as the current sample did not permit a thorough examination of this question. Overall, the first aim provides a firm

foundation of evidence that parent-child interactions vary across situations. This is one of only two known studies to demonstrate such differences in conversation in the home.

Aim 2: Management Language Use in the Home

Using a revised management language coding system with additional codes for capturing mothers' reasoning, negotiation, and feedback about children's behavior, the second aim sought to investigate variability in management language use across daily routines and days of the week. This is the first study to directly examine how mothers' management strategies, an indicator of autonomy support and control, differ depending on the activity and the day of the week.

Several findings were revealed with regards to the use of each management language type, and total management language, during different routines on weekdays and weekend days. Overall, mothers used less management language on weekend days than weekdays. This trend included significantly less Direction, Suggestion, and Bargaining on weekends, demonstrating that mothers managed children less on weekends regardless of the autonomy supportive or controlling nature of their strategies.

With the exception of the findings for Bargaining, these patterns also held true when examining management language as a proportion of mothers' total language. Mothers did not simply talk less to their children on weekends; managing children's behavior made up a smaller part of conversations on the weekend than on weekdays. This is the first known study to reveal that mothers manage their children's behavior less on weekends, suggesting that family routines may be more relaxed or even truncated over the weekend as compared to weekdays.

This is also the first study to demonstrate that mothers change their management strategies between morning and bedtime routines. During both weekday and weekend bedtime, mothers used less Suggestion and more Reprimands when compared with weekday morning. It seemed that mothers were less willing to offer children Suggestions (i.e., choices and invitations for the child to provide input into the flow of the activity) at bedtime than in the morning. Mothers were also more likely to give children negative feedback about their behavior during bedtime routines. It should be noted that the majority of children in the study did not leave the home for preschool early in the morning, which likely lessened the stress associated with morning routines. Anecdotal evidence also suggests that children in the study were more reluctant to participate in bedtime routines than morning tasks.

The same trends were present when examining management language as a proportion of mothers' total language. Suggestion formed a smaller proportion of mothers' total language during weekday bedtime than weekday morning, and Reprimand formed a larger proportion of total language during weekday bedtime than weekend morning. Differences in the use of Suggestions and Reprimands were not simply due to differences in the amount that mothers talked to their children. Taken together, the findings suggest that bedtime routines were more stressful or more time-limited than mornings. Mothers were more autonomy supportive during morning routines than they were at bedtime, when they seemed less likely to invite the child to make choices and more likely to scold the child.

The absence of significant relations between maternal education and management language use was surprising. Although efforts were made to include families with a wide

range of socioeconomic backgrounds, few mothers who had a high school degree or less volunteered for the study. As noted above, the fact that mothers on the low end of the spectrum of education were not well represented in the sample may account for the absence of findings. When considering management as a proportion of total language, it was found that mothers with more education used less Direction than did mothers with less education. This finding shows that when differences in the total amount of language mothers produced are taken into account, it is the case that in line with our hypotheses, low-SES mothers use more Direction than high-SES mothers. This finding also corroborates research showing that low-SES mothers are more likely to use controlling management strategies and that commands make up a greater share of their conversations with children than middle- or high-SES mothers (Hart & Risley, 1995; Hoff et al., 2002).

There were few associations between child gender and the management language counts and proportions. Boys were found to receive significantly more Reprimands than girls. This finding could be related to the fact that boys' self-regulatory skills mature slightly later than girls' (Matthews et al., 2009); mothers may have used more Reprimands with boys because boys were perceived to behave inappropriately more often than girls. However, it remains unclear why mothers were more likely to scold boys than girls. A number of factors including mothers' perceptions of gender differences in children likely play a role in differences between how mothers talk to girls and boys (Leaper et al., 1998).

There were no associations between the raw management language counts and the number of siblings in the home. The findings suggest that the sheer quantity of management language that mothers use is not related to the number of siblings in the

home. However, the proportions of Bargaining and Reasoning out of total language were both negatively associated with the number of siblings in the home. It seems that in homes with more siblings, Bargaining and Reasoning both make up a smaller portion of mothers' total talk than in homes with fewer siblings. Mothers with more children seem less willing to negotiate and justify their requests than mothers with fewer children. Both Bargaining (i.e., negotiation) and Reasoning are arguably autonomy supportive in that they involve children in decision-making processes, and it seems that mothers with more children in the home use these forms of management less frequently than mothers with fewer children. Again, these findings complement the analyses of the raw management counts by showing that differences in management language are revealed only when differences in the total amount of talk are taken into account.

Overall, by permitting an examination of parenting across different daily routines, the LENA recording method revealed that there are meaningful differences in mothers' management practices, and thus their use of autonomy support vs. control, across different times of the day and week. These results suggest that variability in parenting across everyday routines is a rich area for future study. The implications of these findings for the study of parenting and relations between parenting and children's EF skills are wide-ranging, suggesting that observations of parenting drawn from one particular situation (e.g., a joint puzzle task in the lab) do not represent parents' behavior in all interactions with the child. It is also very important to note that the few demographic differences that did emerge were only detectable when mothers' total language production was taken into account.

Aim 3: Examining Links Between Management Language and Children's Executive Function

The final aim of this study was to examine several research questions about the relations between mothers' management language and children's concurrent EF skills. Three separate sets of analyses examined the predictive value of 1) the raw management counts, 2) variability in each type of management language as indexed by the standard deviation of the counts across the four segments coded, and 3) interactions between management language and child temperament.

Direct Links between Management Counts and Proportions and Children's Executive Functions

There was only one pattern of significant findings when examining the predictive value of the raw management counts for children's EF outcomes. The average amounts of Suggestion, Bargaining, and Total Management Language were all negatively related to children's working memory skills. One plausible explanation for this pattern is that, in line with transactional theory, mothers responded to children with poorer skills for holding information in mind by providing more management and reminders. Evidence from work on children's autobiographical memory suggests that there are bidirectional effects of mothers' talk during children's recall of past events, with children's memory skills predicting mothers' use of elaborative statements and vice versa over the late preschool years (e.g., Reese, Haden, & Fivush, 1993). Together, the evidence suggests that the concurrent relations between management language and children's working memory found in the current study may be due to mothers' responding to children's unique skill levels. However, a longitudinal follow-up would be needed to test for

bidirectional relations between management language and children's working memory over time.

An alternative explanation is that excessive management language actually has a negative impact on children's working-memory skills. Controlling language that discounts the child's contributions and point of view has been found to associate negatively with children's memory skills in studies of autobiographical memory (e.g., Larkina & Bauer, 2010), so it is reasonable to expect that an excess of commands and requests could hinder children's working memory skills. However, the types of management language driving the negative associations between management and children's working memory (i.e., Suggestion and Bargaining) are autonomy supportive in nature. For this reason it does not seem likely that increases in management language led to poor working-memory skills.

The current findings differ substantially from prior work on management language. The previous study of management language during a pretend birthday party found that Direction was negatively associated, and Suggestion was positively associated, with children's concurrent inhibition skills (Worzalla et al., 2012). This divergence was not present in the current study: both Suggestion and Direction were negatively associated with children's working memory (though the relation for Direction was only marginally significant). The conflicting findings of the two studies may be due to a number of factors. First, the prior study examined management language as it relates to EF skills in 3-year-olds, whereas the current work focused on 4- and 5-year-olds. There is evidence that the effects of management language on children's EF outcomes differ by child age: Direction (commands) seems to benefit 2-year-olds, but not older preschoolers (Landry et

al., 2002). A second factor may be the stark differences in the tasks used to assess management in the two studies. In the birthday party task, mothers seemed to rely on Direction or Suggestion depending on the child's level of EF skills: children with stronger skills were given more Suggestions, or opportunities to make choices and contribute to the flow of the activity. However, in the everyday contexts assessed in the current work, mothers used a wider variety of management types, and seemed to adjust their strategies depending on the situation. These important differences in the ages and situations studied likely account for the differences between the findings of the current work and the preceding study.

Variability in Management Language Across Situations as a Predictor of Child Executive Functions

Variability in management language was only a significant predictor of children's EF skills in a couple of cases but findings suggest that changes in management language across situations, rather than stability, may be beneficial for low-SES children (as indexed by maternal education). Variability in Suggestion language was positively related to children's inhibition skills, but only for children from low-SES backgrounds. Variability in Suggestion did not relate to inhibition for children in middle-SES families. The findings for Reasoning were similar. The significant interaction between Variability in Reasoning and Maternal Education showed that children from low-SES backgrounds benefitted from more Variability in Reasoning in terms of their inhibition skills. For children from middle-SES backgrounds, Variability in Reasoning did not seem to relate to inhibition skills. These two findings may indicate that low-SES mothers help their children to develop inhibition skills by adjusting the amount of Suggestion and

Reasoning (both of which are considered to be autonomy supportive in nature) they provide in different situations. In a broader sense, these findings indicate that variability in management language may be an important predictor of children's EF skills, particularly for children from low-SES backgrounds.

The Moderating Role of Child Temperament

Effortful control. The effortful control dimension of temperament was a significant moderator of the effects of Direction, Bargaining, and Total Management Language on children's inhibition skills. Each of these predictors was positively associated with children's inhibition skills for children who were rated by their mothers as having high effortful control. For children rated as having low effortful control, these three types of management language had negative relations with inhibition. In terms of autonomy support (vs. control), these findings seem to indicate that controlling language (i.e., commands) hinders inhibition performance in children who are predisposed to have lower levels of these skills. However, the findings are inconsistent in this manner; Bargaining can be considered autonomy supportive in that it acknowledges the child's wishes, but in this case it did not seem to help children with low temperamental inhibition.

There was one additional significant finding for the moderating role of effortful control, which showed that children with low effortful control seemed to benefit from increases in Reasoning in terms of their delay of gratification skills. Children with high effortful control showed no relations between Reasoning and delay of gratification. Reasoning with children to justify the need for them to comply with parental requests and

social norms seemed to help children who were low in temperamental inhibition to learn to delay gratification.

An important caveat to the findings regarding the moderating role of effortful control is that mothers' ratings of this aspect of temperament may not be equivalent to direct assessments of effortful control skills. It is helpful to consider the items that are used to index this aspect of temperament on the Children's Behavior Questionnaire (Putnam & Rothbart, 2006) used in this study. First, it should be noted that parent ratings of children's effortful control do not correspond precisely with direct assessments. In the seminal effortful control study by Kochanska and colleagues, mothers' ratings on the Children's Behavior Questionnaire were found to correlate significantly with children's performance on a battery of effortful control tasks ($r(104) = .45$, $p = .001$) (Kochanska et al., 2000). Likewise, in the current study, the relation between mothers' ratings of effortful control and children's delay of gratification was modest and marginally significant ($r(38) = .300$, $p = .068$). Thus, there is a correspondence between the two sources of data, but the shared variance is only about 20% or less.

Moreover, the conceptual match between the items on the Questionnaire and typical effortful control tasks is tenuous. Effortful control tasks require children to suppress a dominant response in favor of a non-dominant response (Rothbart & Bates, 2006). However, sample items from the Questionnaire ask parents to rate how much the child enjoys hearing songs and nursery rhymes and whether the child is able to focus on one task for long periods of time. With the possible exception of those items referring to sustained attention on a given task, there are not any items that directly address the child's ability to suppress a dominant response. For these reasons, mothers' ratings of

children's effortful control should not be interpreted on the same way as direct assessments of the child's effortful control skills but rather as the mother's estimate of the child's proclivities with regards to maintaining his or her attention on a given task, detecting changes in the environment, following instructions, and planning. In light of this information about the parent ratings of children's effortful control, the moderation findings described above seem to indicate that children who have strong capacities in these areas are better able to benefit from management language than children who do not.

Negative affectivity. Negative affectivity did not moderate any of the relations between management language and child EF outcomes. Contrary to the findings of past work on negative emotionality and difficult temperament, there was no evidence that this aspect of children's temperament moderated the effects of parenting on any of the three EF outcomes measured in this study. One reason for this discrepancy may be that in past work, negative affectivity was assessed in infancy as opposed to the preschool years. There is now evidence to show that negative affectivity is not stable through infancy and early childhood (Bridgett et al., 2009). Thus, children who show high amounts of negative emotion in infancy may not possess these qualities during preschool. For this and other reasons, it is not clear that negative emotion functions in the same way as a risk factor when assessed in infancy and the preschool years. A second possible reason for the discrepancy between the current and past findings is that past work focused on how children with different levels of negative affect react to sensitive parenting. Our study focused on management language, which may not interact with child temperament in the same way as sensitive parenting.

Surgency/extraversion. Finally, there were several significant findings for the moderating role of surgency/extraversion. With regards to children's inhibition outcomes, the effects of both Suggestion and Bargaining depended on children's surgency/extraversion. Children who were rated as being high on this temperament dimension seemed to benefit from Suggestion and Bargaining whereas children with low surgency/extraversion actually seemed to be harmed by it. Secondly, the relations between both Direction and Total Management language and children's working memory skills were both moderated by children's surgency/extraversion. Children with low surgency/extraversion showed negative relations between Direction and their working memory skills. Children with high surgency/extraversion showed no relations between the two. The results for total management language paralleled the findings for Direction and were likely driven by the Direction counts.

In each of the above cases, the moderation results seem to suggest that children who are high in surgency/extraversion (i.e., those who are impulsive, outgoing, and likely to experience high intensity pleasure) seem to benefit from Suggestions and Bargaining. These types of management language, which are both autonomy supportive, may help mitigate some of their impulsivity or perhaps satisfy their proclivity for social interaction to help them learn to exert their inhibition skills. These same children also seem to benefit from Direction and Total Management with respect to their working memory skills. Unlike their counterparts who are low on surgency/extraversion, these children seem to be able to benefit from mothers' commands and overall management.

Summary of Links Between Management Language and Child Executive Functions

To summarize, the voice recording method revealed many links between mothers' use of management language in the home and children's EF. There were few direct relations between the different types of management language and children's EF skills. The prevailing trend showed that children with poor working memory skills received significantly more management utterances than children with stronger working memory skills.

This study is the first to examine variability in mothers' management strategies as a predictor of children's EF skills. It seemed that variation in both Suggestion and Reasoning was important for children growing up in low-SES households.

The most important lesson to draw from the current findings is that the relations between mothers' management practices and children's EF skills are highly dependent on children's temperament. Overall, children who were rated as being high in effortful control and surgency/extraversion seemed able to benefit from increased management language, regardless of whether it was autonomy supportive in nature. For these children, several types of management language were positively associated with EF skills.

The idea that parenting interacts with children's temperament to affect child outcomes has robust support in the extant literature, but past studies have examined this question in a somewhat narrow manner. Past work has examined self-regulation and several other outcomes in children who are at risk for poor outcomes because they have either difficult temperament in infancy or genotypes associated with poor emotional and behavioral adjustment. Children at risk due to these factors have been found to be disproportionately vulnerable to the adverse effects of insensitive parenting and insecure mother-child attachment (e.g., Kochanska, Kim, Barry, & Philibert, 2011; Kochanska et

al., 2009). Some research also suggests that children at risk actually stand to benefit more from sensitive parenting than other children (Pluess & Belsky, 2010).

The current work continues this line of research in a new direction by examining the moderating role of additional major dimensions of temperament, namely effortful control, negative affectivity, and surgency/extraversion, in early childhood. The findings did not align with past findings of enhanced vulnerability in children at risk for poor outcomes. Instead, they suggest that children high in certain temperament dimensions (i.e., effortful control and surgency/extraversion) were able to profit from mothers' management practices whereas children low in these characteristics did not. Children low in these characteristic seemed to be negatively affected by increases in management language, whether it was Direction, Suggestion, Bargaining, or Total Management. Contrary to the prediction that autonomy supportive management (e.g., Suggestion) would be more beneficial to child EF than controlling management (e.g., Direction), it seems that children who are either low in temperamental inhibition or extraversion are put at risk for poor EF outcomes when mothers' use too much management language.

In addition to evidence that the effects of parenting are moderated by child temperament and genes, there is evidence that mothers adjust their parenting based on child characteristics including genes, temperament and also children's skill levels. Past research has found that measures of children's attention skills at 54 months and 6 years predicted mothers' sensitive parenting at ages 6 and 8 years, respectively (Belsky et al., 2007). Likewise, infants who showed increasing problems with self-regulation from 4 to 12 months were more likely to experience negative parenting at 18 months (Bridgett et al., 2009).

This evidence suggests that the findings in our study may also have been due to bidirectional effects of children's effortful control on mothers' management language. Mothers may be tempted to over-manage children who they perceived to struggle to maintain their attentional focus and form plans (i.e., those rated as having low effortful control on the temperament questionnaire), which seems to have a detrimental effect in terms of those children's inhibition skills. In terms of surgency/extraversion, mothers may also have provided more management for children they perceived as being shy or slow to approach new situations, which also seems to have been detrimental for those children in terms of their inhibition and working-memory skills. Such transactional processes provide additional explanations for our findings, but it is important to note that only a longitudinal study could begin to tease out these effects.

When examined in light of transactional theory and research, the lack of significant findings for negative affectivity is surprising. There is ample evidence to suggest that children's negative affectivity is associated with increases in insensitive parenting. For example, Calkins (2002) found that high amounts of negative emotion (operationalized as frustration, distress, aggression, and defiance) on the part of the child predict more negative parenting during the toddler years. There are several possible reasons why our findings did not match past research in this way. First, a recent meta-analysis reveals that effect sizes for relations between child negative emotionality and negative parenting are generally small ($r \leq .10$)(Paulussen-Hoogeboom, Stams, Hermanns, & Peetsma, 2007). We may not have had enough power to detect them in this sample. The meta-analysis also found that several child and family characteristics moderated such relations with stronger associations occurring in low-SES families, of which we had few in our study.

Finally, it is important to note that our measure of parenting, management language, is not directly related to insensitive parenting. It is possible that mothers do not adjust their management language to children's negative affectivity. Further research is needed to ascertain the meaning of this null finding.

Overall, it seems that high amounts of management are not advisable for children who are low in effortful control and surgency/extraversion. It is also eminently clear that children's temperament must be taken into account when examining the relations between everyday management practices and children's EF development.

Limitations

Several important limitations of the study sample and design should be acknowledged. Because of the intensive nature of the data collection method, the sample size was necessarily small. Moreover, difficulties with recruitment resulted in a final sample that was smaller than planned. The small sample size put the current study at a disadvantage for answering questions about differences in parent-child interactions according to demographic characteristics. As noted above, a sample with more stark variability in SES would be useful for exploring group differences in the amount of language provided by mothers with different levels of education. Another sample characteristic that could be improved in future work is the balance of girls and boys. For unknown reasons, approximately twice as many mothers of boys than girls volunteered for the current study. Two girls were also dropped from the current analyses because they produced very little recorded data. A larger sample of girls would be more appropriate for examining relations between child gender and conversation in the home. Finally, the predictive value of the number of siblings in the home could be more accurately assessed

using a sample that included families with a more even distribution of different numbers of children.

A second major concern is the concurrent nature of the study design. Because child skills were assessed within the same week that the recordings of mother-child interactions were collected, there is no way to draw causal conclusions about the relations between mothers' management language and children's EF skills. Any apparent effects of parenting on child outcomes may have actually been the result of mothers reacting to the child's temperament and current skill level. A follow-up assessment of children's EF skills approximately one year after the first wave of data collection is currently in progress and will offer a means of examining how parenting is related to growth in children's EFs over time.

A third major concern is that the current study used mother-report questionnaires to assess children's temperament. As noted above, the temperament measures in the current work should be interpreted as mothers' perceptions rather than unbiased ratings of children's effortful control and surgency/extraversion. Further, there is reason to question the construct validity of the effortful control index from the Children's Behavior Questionnaire, which further complicates the conceptual issues regarding the similarities between EF and effortful control. If time constraints had not been present, direct observations of children's temperament would have been more appropriate for answering questions about how child temperament moderates the relations between parenting and child EF outcomes.

Advantages and Disadvantages of the Voice Recording Methodology

The voice recording method, and the LENA system in particular, had several important advantages for the study of parent-child interactions in the home. First and foremost, the interactions captured using voice recorders were more naturalistic than those captured through lab tasks and in-home videotaping. Although children and parents in particular were likely aware of the voice recorders for at least portions of the study days, the necessity of completing morning and bedtime routines seemed to override parents' desire to act in socially desirable ways during the recordings. Anecdotally, it seemed that when situations were stressful, particularly before bedtime, mothers used any management language they thought would keep children on track with their routines. Further, with the exception of Reprimands, the management language of interest in the current study was not particularly value-laden. For these reasons, the voice recording system proved very useful for capturing a naturalistic view of mothers' management practices.

The only caveat is that mothers seemed to be affected by the social desirability bias in terms of their use of physical punishment and punitive control strategies like yelling as these forms of discipline occurred very infrequently. Although these aspects of discipline were not of interest in the current study, it should be noted that mothers likely used them less often than they would have had they not been under observation. It does not seem that the voice recording technique used in this study would be useful for collecting information about discipline practices like corporal and verbal punishment.

In terms of the content provided by the recordings, a second challenge was finding daily interactions that are common across families and standard enough for examining between-family variability. The current study focused on morning and bedtime routines

largely because they were the most likely to be present for all families. This focus on routines with a concrete goal (e.g., getting the child to sleep) was a limitation for the current work. Dinnertime would be another useful time to study family interactions, but we found it difficult to study for two reasons. First, it was very difficult to identify the beginning and end of the dinnertime period. Some families all sat together at a dinner table and some did not. Sometimes the transition between dinnertime and other activities was very smooth and hard to delineate. Second, during any family activity, including dinnertime in most cases, it was very difficult to determine to which child the mother was speaking at any given moment. These challenges are present when examining any daily activity using the voice recording methodology and they make it especially difficult to study activities with less structure such as play or free time.

A major disadvantage of using voice recorders in the home was that parents were reluctant to volunteer for the study. Recruiting families was difficult and the success rate was less than 5% when accounting for the total number of informational packets that were distributed through the preschools. There are likely two major reasons for this low rate of consent. First, for privacy reasons, families may not have been comfortable having their daily interactions recorded and analyzed. Efforts were made to explain that parents were not going to be judged based on their parenting behaviors, but there are many other reasons why parents might not be comfortable being recorded. The second reason that parents may have been unwilling to consent for the study is the perceived amount of time and effort that the study required. Providing mothers with detailed estimates of the time commitment required for the study may have ameliorated this concern to some extent. In reality, apart from the two home visits, which required about 2 hours total and were

scheduled at the families' convenience, putting on and taking off the recorders required very little time. Nonetheless, mothers were likely daunted by the request for three days of recordings.

For these reasons, the voice recording method seems like it would be more useful for collecting a smaller amount of data from each family. We decided to collect three days of recording in part because we hoped that mothers and children would become less aware of the recorder over time. However, the number of days recorded did not seem to affect mothers' susceptibility to the social desirability bias, at least with regards to management language use. Any researcher hoping to capture aspects of everyday parent-child conversation that are not highly value-laden would probably only need to record interactions for one day.

The LENA System. A major advantage of the LENA recording system in particular is that it is very safe and convenient for work with children. The design of the Digital Language Processor is sturdy and none of the recorders were damaged in the course of the study. Although mothers often seemed to have trouble getting their children to put the recorder on in the morning, many children were also interested in the recorder because it resembles a video game or computer. The specially designed t-shirts provide a convenient way for children to wear the recorders. It should be noted that children in our study strongly preferred t-shirts and polo shirts in gendered colors and patterns to the plain, gender-neutral t-shirts provided by the LENA foundation. For the few children who found the recorder to be intrusive, a smaller or lighter (yet still child-safe) DLP would probably be useful.

A second advantage of the LENA system is that it offers an expedient account of language exposure and conversation in the home through three language counts: Adult Word Count, Child Vocalization Count, and Conversational Turns. Although the primary focus of the current study was not the amount of conversation in the home, these language counts proved useful as an initial demonstration of variability in parent-child interactions at different times of the day and week. The language counts would be useful for addressing a variety of research questions including additional comparisons of times of the day and week as well as links between conversation and child development.

The LENA system also has a few limitations that reduce its usefulness for developmental research. First, the study of the content of in-home conversations would be enhanced immensely if the accompanying software had transcription capabilities. At this point in time, transcription technology is not advanced enough to capture multiple speakers, including children, but automatic transcription of everyday conversations should be a major goal for the future. A second major improvement would be to enhance the LENA software's handling of language coming from the television. Currently the software seems to count adult language coming from the television in an inconsistent manner. This will continue to be a confounding factor for researchers hoping to use the LENA language counts in the their research.

Management Language as an Indicator of Autonomy Support and Control

When compared with the first study of management language, which used videotapes of a play task in the home, the results of the current study seem very promising. The voice recording method captured much more variability in mothers' use of praise, reprimands, reasoning, and negotiation during everyday interactions with their

children. The findings from the prior study were not replicated; instead, mothers seemed to use more management language with children who had low working memory skills. This pattern of effects suggests that mothers simply use more reminders and guidance when working with children who have relatively weak skills for holding information in mind while problem solving. It seems that during the birthday party, mothers tended to use two main types of language: Direction and Suggestion. During everyday interactions, mothers used a wider range of types of management language.

Management language itself is an imperfect indicator of autonomy support (versus control). For the purposes of the current study, Direction utterances have been characterized as controlling in nature. However, mothers may use commands in autonomy supportive ways. For example, a mother might direct her child to generate and choose from several possible solutions when faced with a problem such as a disagreement with a sibling. Using Direction in this way would support the child's autonomy and could thus lead to improvements in EF. This important issue may explain why the hypothesized effects of autonomy supportive and controlling language were not supported by our results.

Variability in Parenting Across Situations

However imperfect, coding management language provides a quantitative indicator of parenting that is highly useful for comparing parenting practices across different situations. The current study showed striking differences in the amounts and types of management language that were used during morning and bedtime routines, on weekdays and weekend days. The findings represent only a fraction of the variability that may exist in parenting. Future work should attempt to explore differences in parenting

during additional situations, namely dinnertime and possibly free time as well. The current study suggests that there are stark contrasts in how parents interact with their children during different activities and that these differences may be important for skills like EFs.

As noted in the introduction, this is not the first study to examine mother-child interactions, and mothers' management practices, in everyday contexts. Work by Kochanska and colleagues took place in a lab "apartment" setting with everyday routines and props (Kochanska et al., 1989). Likewise, work by Landry and colleagues (2002) took place in the home during a 60-minute period of everyday routines. In both cases, mothers were allowed to choose which activities to engage in with their children. The issue raised by the current findings is that parenting might vary drastically across everyday interactions, which may suggest that the previous work was biased depending on which situations were observed.

Future Directions

The findings from this study suggest several directions for future research. First, the exploration of differences in parenting across different daily routines is only in its beginning stages and is a prime area for future work. The current study shows that the LENA system would be very useful for building on the extant literature on morning and bedtime routines. Additional situations (e.g., dinnertime) should be examined using the LENA system and the consequences of variability across situations should be explored in depth. In the current study, increased variability was beneficial for children from low-SES backgrounds but did not seem meaningful for those from middle-SES backgrounds. Future work should examine what factors determine how mothers' parenting practices

change from situation to situation, how the structure of daily routines changes as children develop, and how changes in parenting relate to a variety of child outcomes.

Second, the construct of management language should be investigated further. It is clear that additional work is needed to understand the meaning of the different forms of management language for children's EF and other self-regulatory skills. Future work with management language should try to capture additional richness in this aspect of parenting by examining how it is used to either support or discourage the child's independence. Investigating children's responses to different types of management language may also be a fruitful way to understand their potential for fostering children's EF skills during everyday interactions.

The complement to additional investigations of management language will be further studies of relations between autonomy support (vs. control) and child EF. There is much evidence to suggest that autonomy support is beneficial for children's EF development (e.g., Bernier et al., 2010) but little is known about the mechanisms through which this relation arises.

Finally, the current study revealed many intriguing findings in terms of the moderating role of child temperament. It is clear that it will be very important to include child characteristics in future research on parenting and children's EF. Because the relations between management language and child EF varied drastically depending on child temperament, we are unable to offer concrete suggestions in terms of which types of management language are beneficial for children's EF development. However, additional study of children with different temperament profiles will yield results that can be applied and tailored to specific children.

Closing Thoughts

Voice recording methodology provides a strong complement to other methods of collecting data on parent-child interactions. It provides a uniquely naturalistic view of everyday conversations in the home. Voice recording is thus very well suited to studies of conversation that do not require strict control of the conditions under which data are collected. Many applications of this technology to the study of parenting are possible, but it should be acknowledged that this method is best used as a complement to more traditional methods like parent surveys and structured tasks in the lab or home. For example, survey methods would be useful for gaining insight into parents' knowledge of and attitudes towards children's EF development. Likewise, structured tasks would be helpful for studying how parents talk to children about EF during tasks that are designed to place demands on that particular skill set as these types of conversations will not necessarily occur regularly during the course of everyday interactions when studied using naturalistic methods. Voice recordings provide the most naturalistic source of rich data on parenting, but they offer the least control and thus should be incorporated into parenting research programs in conjunction with other types of studies and data collection methods.

The current study makes impressive progress in the quest to understand how everyday parent-child interactions can be harnessed to foster children's EF skills during the preschool years. When combined with conventional data collection techniques, work using voice-recording methods will yield a vital perspective on this issue.

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