ASSOCIATIONS AMONG CHILDREN’S NEGATIVE EMOTIONALITY, EXECUTIVE FUNCTIONS AND PERFORMANCE ON A COGNITIVE TASK, AND PARENTING AMONG KOREAN PRESCHOOLERS

A DISSERTATION
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Abstract

A body of studies has demonstrated that cognitive self-regulation skills or executive functions (EF) during early childhood are a strong predictor for later academic success and social competence. Mother-child relationships, the most intense and enduring relationships of early childhood, presumably affect children’s cognitive development including cognitive self-regulation. Although a greater attention has been paid to the mothers’ contrition to children’s development, a substantial body of literature suggests that difficult child temperament elicits negative parenting behaviors, which in turn increase children’s difficult temperament or negative emotionality over time. However, little is known about ways in which different temperamental traits interact with each other affecting parenting behaviors. Also, according to the differential susceptibility hypothesis, children’s difficult temperament, as a phenotypic marker of underlying neurobiological processes, interacts with an environment (e.g., parenting), generating variations in children’s developmental outcomes. However, only few studies have tested the moderating role of temperament in the associations between parenting and children’s cognitive development with most studies focusing on socio-emotional development. Also, even though maternal characteristics, such as educational attainment, are likely to affect maternal responses to children’s difficult temperament, there have been only few studies examining this issue. Therefore, the current study shed light on these under-researched issues among parenting (parenting styles and interactional behaviors), children’s temperament and cognitive outcomes (cognitive self-regulation (EF) and performance on a spatial cognitive task), and mothers’ characteristic (educational
attainment). Specifically, the present study addressed the following research questions:

1) Does parenting predict children's EF and performance on a spatial cognitive task?
2) Do children’s difficult temperamental characteristics predict parenting style?
3) Do difficult temperamental traits (negative emotionality traits) interactively predict authoritarian parenting style?
4) Does children’s negative emotionality moderate the associations between parenting style and children’s cognitive development (EF and performance on a spatial cognitive task)?
5) Do associations between children’s negative emotionality and parenting style vary as a function of maternal educational attainment? Most of the prior studies addressing these issues have been conducted in Western countries, and thus, little is known about the degree to which the findings are culture-specific. Thus, in this study these questions were addressed with a non-Western sample, Korean mothers and children.

Eighty mother-child dyads were recruited from 10 preschools in Seoul, Korea. Children’s mean age was about 59 months (45 – 66 months). Mothers assessed children’s temperamental proneness to anger (anger proneness) and difficultness to soothe (unsoothability) as traits of negative emotionality through parent questionnaire. They also answered items regarding their own parenting style (authoritative and authoritarian dimensions). Their interactional behaviors during a mother-child joint puzzle task were videotaped (about 10 minutes) and analyzed: the frequency of different types of maternal behaviors (i.e., cognitive and emotional supportive and controlling (directive) behaviors) and the ratings of overall maternal sensitivity and autonomy support during the puzzle activity were coded as a proxy of their usual interactional behaviors. Children’s performance during the puzzle activity was rated
based on a five point scale with a higher score meaning a better performance, and six tasks, measuring children’s inhibitory control, working memory, attention shifting, and delay of gratification, were administered to assess their cognitive self-regulation skills (EF). Two EF composites, memory/attention control and behavioral inhibition, deriving from principal component analysis of the five measures (except “day/night” task that measures inhibitory control) were included in the analyses. To address the research questions, multiple regression analyses were conducted.

The main findings are as follows. First, maternal autonomy-supportive behaviors (a composite of maternal sensitivity and autonomy support (rating-based) and directive and controlling behavior (frequency-based)) did not predict children’s performances on EF composites. Also, when children possessed two negative emotionality traits at the same time, that is, when they were prone to anger and simultaneously difficult to soothe, mothers were inclined to show more authoritarian parenting (relative to authoritative parenting) than when children were only difficult to soothe but not prone to anger. Next, depending on the degrees of children’s negative emotionality (a composite of anger proneness and unsoothability), associations between children’s performance on a spatial cognitive task (reflecting children’s cognitive abilities) and parenting varied. Among children with higher levels of negative emotionality (above the sample mean), a relatively greater amount of warm and democratic parenting (authoritative) was associated with lower performances on a spatial cognitive task and a greater degree of structure and control in parenting (authoritarian) with higher performances on the task, while the opposite pattern was observed among better-regulated children with low negative emotionality (below the
mean). Finally, mother’s educational attainment was found to moderate the associations between negative emotionality and parenting style. Specifically, compared to two-year college graduates, mothers with 4-year-college or graduate degrees tended to show more authoritative parenting when their children’s negative emotionality was higher than the sample mean. More-educated mothers’ parenting style tended to be associated with children’s negative emotionality to a lesser degree.

These findings suggest that mother-child relationships are associated with interplay among many factors, such as children’s (e.g., combinations of temperamental traits) and mothers’ characteristics (e.g., educational attainment). With cautions in mind regarding the correlational findings based on cross-sectional data, the study findings suggest that children possessing two negative temperamental characteristics at the same time who are also raised by low-educated mothers (again, probably educational attainment as an indicator of maternal personality or other traits) may be those most in need of more attention and support. More studies to address these issues with culturally, ethnically, and socio-economically diverse populations would better inform the complex interplay among parenting, child outcomes, parents’ and children’s characteristics, and cultural context. Given that the current sample consisted of well-educated middle to upper-middle class mothers and harsh authoritarian parenting behaviors were rare among them and that educational attainment was the only characteristics examined as maternal characteristic, further research with samples and information of more diverse socio-economic backgrounds in other cultural context with longitudinal or intervention designs is necessary to confirm the generalizability of the current study findings.
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Chapter 1: Introduction

In the United States, school readiness in early childhood has drawn increased attention from educators and parents as accountability in school systems has become a central issue. Along with this trend, a body of studies has demonstrated that self-regulation skills involved in controlling one’s cognition, emotion, and behaviors are important for a child to succeed in school academically and socially (Cooper & Farran, 1988; Ladd, Birch, & Buhs, 1999; McClelland, Morrison, & Holmes, 2000).

Although the development of self-regulation in young children is presumed to be the product of interactions between genetic and environmental factors, most of the research in the area has focused on associations between neurological structure and development in the prefrontal cortex and self-regulation skills. Much less attention has been paid to the manner in which daily interactions with parents and teachers, as key socio-cultural players, affect children’s self-regulation development, making differences in the neurological structure. Mother-child relationships typically constitute the most intense and enduring relationships of early childhood, representing the core of most young children’s social environment. Thus, there is value in examining what aspects of and in what ways mother-child interactions are associated with self-regulation and cognitive development.

According to a transactional model of development, the effect of parents on children needs to be considered in the context of a reciprocal relationship (Sameroff, 1993). Just as parent behavior affects children’s development, children’s behavior affect parents’ behavior. Children’s temperamental characteristics may be particularly important. A substantial body of literature suggests that difficult child temperament
predicts an increase over time in negative parenting behaviors (e.g., Bridgett et al., 2009; Lipscomb et al., 2011). Evidence also suggests a reciprocal relationship between children’s difficult temperament and disruptions in parenting behaviors (e.g., inconsistent discipline, rejection, etc.) over time (e.g., Lengua, 2006; Lengua & Kovacs, 2005). Many studies have investigated concurrent or longitudinal associations between temperament and parenting. Few studies, however, have examined ways in which different temperamental traits might interact in their effects on parenting behaviors. It is possible that some negative temperamental characteristics affect parenting behaviors negatively only if they are in combination with other difficult temperamental traits. The current study examines interactions of two difficult temperamental traits (i.e. anger proneness & unsoothability) on authoritarian parenting.

One reason for examining children’s difficult temperament comes from the differential susceptibility (Belsky, 1997, 2005; Belsky & Pluess, 2009) or the biological-sensitivity-to-context (Ellis, Essex, & Boyce, 2005; Ellis, Jackons, & Boyce, 2006) frameworks. According to these two frameworks, children’s difficult temperament, as a phenotypic marker of underlying neurobiological processes, interacts with a stressful or supportive environment, thereby generating variations in developmental outcomes (for a review: Belsky & Pluess, 2009, Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2007; van IJzendoorn & Bakermans-Kranenburg, 2012). Thus, for example, a stressful environment would be expected to affect development differently for children who have a negative temperamental characteristic than for children who do not have that characteristic. Although there have been a
growing number of studies supporting the moderating role of children’s negative emotionality in the associations between environment and development, there have been gaps in the literature. First, the majority of the relevant studies have focused on social-emotional development (e.g., externalizing or internalizing behaviors), not cognitive development. Also, many studies have not included positive dimensions of parenting, instead paying exclusive attention to negative parenting (as detrimental environment) in relation to developmental dysfunctions and difficult temperament (Belsky & Pluess, 2009). To address these gaps, this study included ordinary parenting (authoritative and authoritarian parenting) and children’s EF and cognitive ability as outcomes.

Mother-child relationship is bidirectional and maternal characteristics, such as personality (Prinzie, Stams, DeKović, Reijntjes, & Belsky, 2009) and educational attainment (Carr & Pike, 2012; Neitzel & Stright, 2004), are known to contribute to the relationship. Particularly, maternal educational attainment has been found to predict parenting quality (Carr & Pike, 2012; Hart & Risley, 1995) and to moderate associations between children’s difficult temperament and parenting behaviors (Neitzel & Stright, 2004). In the study conducted by Neitzel and Stright (2004), mothers’ responses to children’s difficult temperament varied as a function of their educational levels; more educated mothers encouraged their children’s active role and autonomy more when they perceived their children as difficult than when they perceived their children as easy. These findings suggest a need to examine the role of maternal education as a moderator in relations between children’s negative emotionality and parenting. However, compared to a large amount of research
showing associations between maternal education and parenting quality, only few studies have paid attention to its moderating effects. Thus, this study also addressed this gap in the literature.

The present study also extends research on parent-child interactions to a non-Western culture. Most studies pertaining to the impact of parent-child interactions or parenting on children’s cognitive self-regulation development have been conducted in Western countries, such as Canada, England, United States (Landry, Miller-Loncar, Smith, and Swank, 2002; Bibok, Carpendale, & Müller, 2009; Bernier, Carlson, and Whipple, 2010; Bernier, Carlson, Deschênes, & Matte- Gagné, 2012; Hughes & Ensor, 2009). Likewise, studies examining the moderating role of children’s temperamental characteristics or maternal characteristics in associations between parenting behaviors and children’s developmental outcomes mostly come from Western samples. As a consequence, little is known about the degree to which the findings are culture-specific. Extending research to a non-Western culture provides an opportunity to assess the generalizability of previous findings.

In summary, to reduce significant gaps in the literature, the present study addressed the following research questions: 1) Are parenting styles and interactional parenting behaviors associated with children's self-regulation and cognitive development?; 2) Do children’s difficult temperamental characteristics predict parenting behaviors?; 3) Do difficult temperamental traits interactively predict negative parenting?; 4) Does children’s negative emotionality moderate the associations between parenting and children’s self-regulation and cognitive development?; and 5) Do associations between children’s negative emotionality and
parenting style vary as a function of maternal educational attainment? These issues were concurrently examined among 4- and 5-year-old Korean children and their mothers.

In the next chapter I describe fundamental constructs and summarize relevant research in two parts: Part 1 concerns how parenting behaviors are associated with children’s self-regulation and cognitive development and Part 2 concerns how children’s temperament, parenting, and developmental outcomes are associated.
Chapter 2: Literature Review

Part 1: Executive Functions, Cognitive Development, and Parenting

Self-regulation

Self-regulation is an umbrella construct consisting of cognitive, emotional, and behavioral regulatory skills, such as controlling attention, modulating emotions, and planning and organizing. Self-regulation studies have focused on various aspects of self-regulation, such as temperamental reactivity and approach and attention control (Blair & Razza, 2007; Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008), delay of gratification (Mischel, Shoda, & Rodriguez, 1989), attention shifting, working memory, and inhibitory control (Blair & Razza, 2007; McClelland et al., 2007), or some indirect indicators such as social-emotional well-being (e.g., internalizing and externalizing behaviors) and positive social relationship with teachers and peers (Denham, 2006; Mashburn & Pianta, 2006). Despite many confounding terms and constructs in the literature, studies of self-regulation among young children in general have come from two separate (but somewhat overlapping) lines of research: executive function (EF) studies that focus on cognitive regulation, and effortful control (EC) studies that focus more on emotional regulation.

Executive functions are defined as “a group of skills that helps us to focus on multiple streams of information at the same time, monitor errors, make decisions in light of available information, revise plans as necessary, and resist the urge to let frustration lead to hasty actions” (Center on the Developing Child at Harvard University, 2011, p.1). In other words, EFs refer to skills involved in volitional control...
of thinking in goal-directed activities. EFs are assumed to consist of three primary components: a) working memory (i.e., the ability to hold and manipulate information for a short period of time), b) attention shifting or cognitive flexibility (i.e. the ability to shift the focus of attention or responses between competing rules according to situational demand), and c) inhibitory control (i.e., the ability to suppress impulsive or dominant responses and resist interference and distraction) (Miyake, Friedman, Emerson, Witzki, & Howarter, 2000; for a review, see Obradović, Portilla, & Boyce, 2012).

Although EFs concern mostly cognitive aspects of self-regulation, some researchers differentiate between emotional aspects of executive function that involve regulating affect and motivation, and the more cognitive aspects of executive function, such as skills involved in problem solving (e.g., Kerr & Zelazo, 2004; Zelazo & Müller, 2002). Effortful control, which is the term widely used in emotional self-regulation studies, refers to “a major temperamental control system that regulates children's genetically predisposed variability in emotional, behavioral, and attentional reactivity” (Obradović et al., 2012, p.327). Since temperament-based studies define temperament as emotional reactivity and the regulation of this reactivity (e.g., Posner & Rothbart, 2000; Rothbart & Ahadi, 1994), a temperament-based line of self-regulation research, along with studies of adaptive functioning, have used the term effortful control (Eisenberg et al., 1997; Eisenberg et al., 2004; Raver, 2004; Rothbart & Ahadi, 1994; Valiente et al., 2003) despite considerable overlap with executive functions. Blair and Razza (2007) claim that the two constructs are similar in that both include inhibitory control (the ability to inhibit a prepotent or dominant response in
favor of a less salient response) as a primary construct. However, they differ in that effortful control includes aspects of automatic or non-conscious emotional reactivity and regulation as well, while executive functions concern processes required for only the “conscious” control of thought and action (Blair & Razza, 2007).

Concerning the connections between cognitive and emotional self-regulation overall, Blair and colleagues (Blair & Dennis, 2010; Blair & Ursache, 2011) have proposed a bidirectional model that conceptualizes the relations between executive function (cognitive self-regulation) and effortful control (emotional self-regulation) as reciprocal. In the model, EF is thought of as the top-down or volitional component of self-regulation responsible for the effortful processing of information in a complex learning task while being influenced by the bottom-up or more automatic regulation of responses to the environment through attention, emotion, and stress response systems (Blair, 2002; Blair & Dennis, 2010).

Since the present study is mainly designed to examine associations among children’s ability to volitionally control their cognition, parenting, and children’s temperament, the term executive function was used instead of effortful control. Information on children’s temperament regarding their negative responses to emotional arousal was collected through a parent questionnaire via items regarding how readily children exhibit anger (anger-proneness) and how difficult to soothe them (unsoothability) when they are emotionally aroused by stressful external stimulations.

**Importance of Self-regulation Skills & Performance Differences Among Cultural Groups**
Research has shown that self-regulatory skills are crucial for early school success. There are studies that have shown that cognitive self-regulatory skills, EF, predict children’s concurrent and subsequent math and literacy ability in preschool and kindergarten even when controlling for general intelligence or prior achievement (Blair & Razza, 2007; McClelland et al., 2007; Welsh, Nix, Blair, Bierman, & Nelson, 2010). The contribution of self-regulation to academic achievement is also found in studies on emotional regulation (Raver, 2002; Raver, Garner, & Smith-Donald, 2007), controlling for IQ (Graziano, Reavis, Keane, & Calkins, 2007). Also, children entering formal schooling without adequate self-regulatory skills have been found to be at significantly greater risk for difficulties, including low levels of academic achievement and peer rejection (Cooper & Farran, 1988; Ladd, Birch, & Buhs, 1999; McClelland et al., 2000). Furthermore, EF in childhood was found to predict physical health, substance dependence, socioeconomic status, and the likelihood of a criminal conviction at the age of 32 years, controlling for the current social class and IQ (Moffit et al., 2011).

Despite the importance of EF, one study found that a substantial number (17%) of U.S. kindergarteners were lacking necessary self-regulation skills, unable to sit still, follow directions, or work independently without becoming distracted (McClelland, Morrison, & Holmes, 2000). In another study (Rimm-Kaufman, Pianta, & Cox, 2000), 46% of U.S. teachers reported that more than half of children entering kindergarten classes did not possess basic regulatory competencies needed to do well in school.
EF difficulties may be more common in Western than in Asian cultures. A few studies that have compared EF between Western children and East Asian counterparts (China and Korea) have shown that the latter outperformed the former (U.S. and British children) in some dimensions of EF (China: Lan et al., 2011; Sabbagh, Xu, Carlson, Moses, & Lee, 2006; Korea: Carlson & Choi, 2008; Oh & Lewis, 2008). For example, in a study by Oh and Lewis (2008), 3- & 4-year-old Korean preschoolers consistently outperformed British counterparts in tasks measuring inhibitory control (e.g., the Day/Night task) and attention shifting (e.g., the Dimensional Change Card Sort task): Korean preschoolers displayed ceiling performance on these tasks while British preschoolers did not. Similarly, Chinese preschoolers showed higher performance on inhibitory control and attention control tasks than U.S. counterparts (3- to 4-year olds in Sabbagh et al., 2006 & 4- to 5-year olds in Lan et al., 2011). Asian children’s better performance, however, appeared only on tasks measuring inhibitory control and attention shifting; no difference was found between the two groups in working memory tasks (Carlson & Choi, 2008; Lan et al., 2011; Oh & Lewis, 2008; Sabbagh et al., 2006). Regarding delay of gratification measures that assess emotional EFs, findings are mixed. Asian children showed performance similar to Western counterparts in one study (Oh & Lewis, 2008) while outperforming Western children in another study (Zelazo & Qu, 2005).

Taken altogether, these findings suggest that an understanding of how socio-cultural factors and processes contribute to the development of self-regulation skills could guide the development of strategies to promote self-regulation skills. Cross-cultural differences in children’s EF could be explained by differences in cultural
values and practices underpinning the development of self-regulation, or genetic factors. Indeed, a particular gene linked with ADHD, which is associated with inhibitory control problems (Barkley, 1997), was found to be present in up to 40% of children from the Americas while in only 1.7% of children in East Asian countries (cited from Chang, Kidd, Livak, Pakastis, & Kidd, 1996). However, the genetic links with developmental disorders are controversial (Buitelaar, 2005; Hutchison, Stallings, McGeary, & Bryan, 2004). We do not know why and how these observed cross-cultural differences in EF develop. To understand these differences we need to understand how genetic and proximal and distal environmental factors affect EF development altogether. As a very small step in this context, the present study examined associations among parenting, children’s temperamental characteristics, children's EF and intelligence, and mothers’ educational attainment with a non-Western sample of mother-child dyads from South Korea.

**Social Origins of Cognition and Self-regulation: Focusing on Parenting**

Vygotsky (1978) originally emphasized the social processes in the development of cognition and cognitive self-regulation. According to Vygotsky (1978), as language, which was only for communicative purposes during the initial years of life, becomes gradually internalized by young children, thinking becomes verbal and allows children to consciously control their minds through *inner speech*. That is, along with speech development, initial practical intelligence – evinced by use of tools— becomes gradually intertwined with use of signs and symbols (e.g., language), which allows children to acquire higher-order cognitive functions. Specifically, he claims that in a goal-pursuing situation word-object associations
enable children to consider a greater number of options in their mind, including those that are not immediate, visual, and concrete, and they help them to plan future actions. In the process, children use egocentric speech (or private speech) to divide the required series of actions into consecutive stages and control their own actions along the way. Thus, children’s direct operations on objects for problem-solving are gradually replaced by psychological processes, and their behaviors become less impulsive and spontaneous. In the end, when language is completely internalized and children consciously control their minds through inner speech, egocentric speech disappears (Vygotsky, 1978). In sum, Vygotsky regarded children’s egocentric speech as evidence of language’s role of cognitive regulation. Given that language is formed according to societal conventions and externally imposed upon young children and that children’s thinking develops through verbal communications with advanced learners, the development of cognition and self-regulation is constructed through social interactions in Vygotsky’s theoretical framework.

Empirical evidence suggesting the impact of social contexts on EF development exists in intervention studies revealing that EF components are malleable to environmental influences such as preschool curriculum (e.g., Diamond, Barnett, Thomas, & Munro, 2007; Raver et al., 2011; Riggs, Greenberg, Kusche, & Pentz, 2006). Also, a considerable body of research has demonstrated associations between cognitively stimulating environments and young children’s cognitive growth (e.g., Bradley & Corwyn, 2002; Hart & Risley, 1995; Sarsour et al., 2011). In this section, I review research on how social interactions with a primary caregiver (mother) in the
home (e.g. parenting styles and interactional behaviors such as scaffolding) are related to the development of EF and intelligence.

**Authoritative & Authoritarian Parenting and EF & Cognitive Development**

Baumrind (1971)’s typology of parenting style has been one of the most extensively investigated parenting theories. Baumrind categorized parenting style into three types: authoritative, authoritarian, and permissive. Building on these classifications, Maccoby and Martin (1983) added one more category, *neglectful/disengaged* parenting, by classifying the four parenting styles as the configurations of high or low levels in affection (responsiveness) and demandingness (structure or control) respectively: authoritative (high in both dimensions), authoritarian (high in demandingness-low in affection), permissive (low in demandingness-high in affection), and neglectful/disengaged (low in both dimensions). *Demandingness* refers to the extent to which parents show control, demands, and supervision in their parenting, while *affection* refers to the extent to which parents show affective warmth, acceptance, responsiveness, and involvement. Among the four types of parenting, *authoritative parenting* has been defined to be characterized by warmth and responsiveness, respect for the child’s viewpoint and independence, clear limits for their child’s behaviors along with provision of reasoning for those limits. *Authoritarian parenting* is defined by controlling and demanding and affectively cold attitudes, high expectation for the child’s obedience to the rules they set, and adoption of harsh and punitive discipline for disobedience (Robinson, Mandleco, Olsen, & Hart, 1995). *Permissive parenting* is warm and responsive but low in parental control to the extent that parents tend to allow whatever
their child wants to do, while disengaged parenting is neither demanding and controlling nor warm and responsive. Since permissive and disengaged parenting styles are not likely to be found among Korean parents whose parenting is characterized by high control over children’s behaviors (Park & Kim, 2006), prior research regarding only authoritative and authoritarian parenting styles and children’s cognitive/academic or self-regulation development is reviewed.

Prior studies have shown that dimensions related to authoritative parenting, such as parental warmth and democratic control, are positively correlated with children’s school performance, whereas harsh parenting is associated with negative academic outcomes among school-aged children (e.g., Chen, Liu, & Li, 2000; Ginsburg & Bronstein, 1993; Shumow, Vandell, & Posner, 1998). However, when it comes to executive functions, little is known about the associations between parenting styles and children’s growth in cognitive control. There have been a few studies that examined how authoritative and authoritarian parenting styles are related to children’s emotional or temperament-based self-regulation skills, that is, effortful control (e.g., Cheah, Leung, Tahseen, & Schultz, 2009; Lee et al., 2012; Zhou, Eisenberg, Wang, & Reiser, 2004). These studies were conducted with Chinese children who share cultural backgrounds with Korean children to a greater extent than children in North America. Overall, authoritarian parenting characterized by high hostility (averaged across verbal hostility, corporal punishment, and non-reasoning/punitive strategies) was found to be associated with lower levels of inhibitory control or attention control concurrently (Zhou et al., 2004) and longitudinally (Lee et al., 2012). Findings regarding authoritative parenting style were mixed. While authoritative parenting style (averaged
across warmth/acceptance, reasoning and induction, and democratic participation) was not significantly associated with growth in inhibitory or attentional control in Lee et al. (2012), it was positively associated with children’s attentional and behavioral self-regulation in Cheah et al. (2009). The child outcomes that were assessed in these studies, however, were parent-reported temperament-based regulation (effortful control). No study was found that assessed associations between parenting styles (authoritative and authoritarian parenting) and directly-measured EF. However, positive associations have been reported between individuals’ effortful control and executive functions (Bridgett et al., 2013; Simonds, Kieras, Rueda, & Rothbart, 2007). There is another reason to expect significant associations between parenting styles and children’s EF. Some previous studies have reported significant associations between parenting styles and more fine-grained interactional behaviors (Carr & Pike, 2012; Mulvaney, McCartney, Bub, & Marshall, 2006), which have in turn been found to positively predict children’s EF development. Thus, this study examined associations between parenting styles and children’s EF, along with associations between maternal interactional behaviors and children’s EF, which are discussed in the next section.

Recently, a growing body of studies focusing on microcosmic mother-child interactions during observed activities have shown associations between parenting behaviors and children’s EF and cognitive development (Landry, Miller-Loncar, Smith, & Swank, 2002; Bibok, Carpendale, & Müller, 2009; Bernier, Carlson, and Whipple, 2010; Bernier, Carlson, Deschênes, & Matte- Gagné, 2012; Hughes & Ensor, 2009). These studies, reviewed next, have often paid attention to parental autonomy-supportive or scaffolding behaviors vs. hostile or disciplinary behaviors.
during the activities (See Fay-Stammbach, Hawes, & Meredith, 2014 for a brief review of relevant studies).

**Parental Scaffolding vs. Controlling Behaviors**

Scaffolding is a metaphor for graduated assistance to a novice (Wood, Bruner, & Ross, 1976), similar to carpenters’ scaffolds, which in education has been used to mean strategic support that more advanced learners (e.g., teachers, parents, advanced peers) provide for less advanced learners (typically, children) to get to the next stage or level (Raymond, 2000). Children receiving scaffolding are expected to not only master the task moving to the next level but also ultimately internalize the way in which the instructor structures and approaches the task (executive planning). In this respect, scaffolding is likely to affect children’s EF development. Accordingly, most of the studies that examined both parenting and child EF have paid great attention to parental scaffolding (Bibok et al., 2009).

The studies that investigated parental scaffolding have focused on parental utterances, such as the richness in parental verbal guidance (the average frequency of maternal scaffolding: Landry et al., 2002) or the types of utterances parents used in the observed interactions with their children (directive vs. elaborative; Bibok et al., 2009). For example, in a study by Landry et al. (2002), mother-child interactions during daily activity (60 minutes) and toy play (10 minutes) at home were observed at the child’s age of 3 and 4 years respectively. Children’s EF was measured at 6 years of age. The proportion of maternal scaffolding was calculated based on the proportion of scaffolding in the total verbal stimulation. Landry et al. (2002) found that 3-year maternal scaffolding had a significant indirect effect on 6-year EF through its direct
effect on children’s earlier language skills, controlling for family SES. On the other hand, Bibok et al. (2009) focused on the types of maternal utterances. They administered EF tasks to 2 year-old children and videotaped their interactions with mothers (36 Canadian mother-child dyads, children’s mean age=24.97 months (SD: 2.65)). Then, they coded parental utterances into directive and elaborative utterances. *Directive utterances* refer to parental utterances “that command, direct, or state the future course of action that the child should take next,” while *elaborative utterances* refer to parental utterances “that either elaborate on or evaluate the child’s presently occurring course of action” (Bibok et al., 2009, p. 26-27). The authors found that only parental *elaborative* utterances that were contingent on children’s performance (success or failure) were significant, over and above other covariates included in the regression model (e.g., maternal education, child age & gender, child’s verbal ability).

Some studies have focused on broader aspects of mother-child interactions by including measures of maternal emotional support as well (Bernier, Carlson, &Whipple, 2010; Bernier, Carlson, Deschênes, & Matte- Gagné, 2012; Hughes and Ensor, 2009). For example, Bernier, Carlson, and Whipple (2010) measured the quality of parenting in three dimensions (i.e., *maternal sensitivity* (at 12 months), *mind-mindedness* (12 months), and *autonomy support* (at 15 months)) (N=80 dyads) and infants’ EF at 18 and 26 months. Autonomy support was assessed based on the extent to which maternal behaviors supported children’s goals and choices verbally and/or non-verbally; the construct of autonomy support in Bernier et al.’s work (2010; 2011) included not only strategic cognitive support (*scaffolding* according to Bibok et al. (2009)’s definition) but also emotional support in a challenging joint puzzle task.
The measure of maternal sensitivity was based on the degree to which mothers showed appropriate and consistent responses to infants’ signals (using the MBQS; Pederson & Moran, 1995); mind-mindedness reflected mother’s tendency to use mental terms when talking to infants mentioning their needs or emotional state (the total number of appropriate comments). The authors found that while all three dimensions were related to children’s EF, parental autonomy-support was the strongest concurrent predictor of EF at both 18 and 26 months, independent of the children’s general cognitive ability and maternal education. However, maternal mind-mindedness was the only significant predictor of change in EF between 18 and 26 months. Note that mind-mindedness was assessed by the frequency of maternal words that asked about or evaluated children’s emotional state and intention. Perhaps mothers’ overall warmth and sensitivity to children’s behaviors and needs in daily activities affected children’s emotional self-regulation by easing emotional reactivity.

Another line of work suggesting the impact of parental warmth comes from a study that shows links between attachment security and children’s EF (Bernier et al., 2012). Since warm and responsive parenting is essential in the formation of secure attachment between a parent and a child (Rispoli et al., 2013; Roisman & Fraley, 2008; Spieker, Nelson, & Condon, 2011; van den Boon, 1994), parental warmth might affect the attachment security between a mother and a child, which in turn affects children’s self-regulation development. For example, Bernier et al. (2012) assessed interaction between mother- and father-child dyads and attachment security for children between 1 and 2 years of age and children’s EF at 2 and 3 years. Children’s attachment security was found to be a significant predictor of children’s performance
on attention-shifting and working memory measures, controlling for children’s verbal ability, family SES, and parenting behaviors (the composite of sensitivity, mind-mindedness, and autonomy-support). In sum, these attachment security studies, along with research having shown the direct prospective link between maternal mind-mindedness and child EF performance, suggest that parental warm and responsive behaviors contribute to children’s EF growth.

In contrast to rather consistent positive associations between children’s EF and mothers’ cognitively and emotionally supportive behaviors during joint activities, relatively fewer number of studies have examined how maternal hostile and disciplinary behaviors during interaction are related to children’s EF. The existing studies reveal negative associations between negative parental behavior and children’s EF (Blair et al., 2011, Bindman, Hindman, Bowles, & Morrison, 2013; Holochwost, 2013). For example, using Structural Equation Modeling (SEM), Blair et al. (2011) tested a comprehensive model including components of maternal positive (warm and sensitive) and negative (intrusive and hostile) interactional behaviors during the structured play and children’s cortisol level, EF, and IQ, as well as ethnicity (African-America vs. White), poverty (income to needs ratio), and maternal education. Blair et al. found that earlier maternal negative behaviors (a composite of measures from 7, 15, & 24 months) during the structured play (behaviors that are intrusive, detached, and characterized by expressions of negative emotions towards children) were associated with children’s lower levels of EF at age three, while maternal warm and sensitive behaviors were positively associated with children’s subsequent EF at age three.

Likewise, Bindman et al. (2013) found that three-year-old preschool children’s EF was
negatively associated with maternal directive language (commands) during a joint play at home concurrently.

Literature concerning self-determination theory also suggests significant links between parental interactional behaviors and children’s behavioral/emotional self-regulation and cognitive development (Grolnick, 2009; Grolnick & Ryan, 1989; Hess, Holloway, Dickson, & Price, 1984). For example, Grolnick and Ryan (1989) examined the link between three aspects of parenting (autonomy-support, provision of structure, and involvement), measured through parent interview, and children’s self-regulation (self-reported) and behavioral adjustment in school (teacher-reported) among elementary school children (grades 3-6). In this study, parental autonomy support was defined as the degree to which parents value and use techniques that encourage independent problem-solving, choice, and participation in decision-making versus externally dictating outcomes and motivating by employing punitive disciplinary techniques, pressure, or controlling rewards. Structure was defined as the extent to which parents provide clear and consistent guidelines, expectations, and rules for child behaviors; and involvement was defined as parents’ dedication and positive attention to child-rearing process (parental knowledge about children’s psychological well-being and behaviors, the amount of time spent together, and levels of enjoyment parents feel from the joint activity with children). Grolnick and Ryan (1989) found that parental autonomy support was positively related to children’s self-reports of autonomous self-regulation, teacher-rated competence and adjustment, as well as school grades and achievement. Maternal involvement was related to teacher-rated competence and academic achievement. Provision of structure was positively related
to children’s awareness of control, that is, lower levels of self-reports of unknown sources of control. With regard to cognitive outcomes, Hess et al. (1984) found that mothers’ more affective and autonomy-supportive interactional behaviors when their children were 5 and 6 years predicted concurrent higher school readiness and subsequent academic outcomes (math and vocabulary) at grade 6, while directive and harsh parental behaviors negatively predicted the outcomes. Taken together, these findings indirectly suggest that parental behaviors related to authoritative parenting, such as provision of autonomy support, guidelines, and affection, are associated with higher levels of self-regulation and cognitive development.

In sum, the findings of the reviewed studies altogether suggest that both microcosmic (e.g., cognitive and emotional support or directive or hostile behaviors during an activity) and macrocosmic (e.g., general warm or harsh parenting styles) aspects of parenting can affect children’s EF and cognitive development. All studies reviewed through this point pertain to how parenting behaviors might affect children’s executive functions and cognitive development. However, there is also evidence that children influence parents’ behaviors. The next section summarizes relevant research, focusing on the role of children’s temperament.

Part 2: Temperament, Parenting, & Development

Temperament and Parenting: Reciprocity in Mother-Child Relationship

Temperament refers to individual differences in reactivity (i.e., responsiveness to change in the environment) and self-regulation (i.e., processes to modulate
reactivity such as effortful control) that are biologically based and influenced by heredity, maturation, and experiences (Rothbart & Bates, 2006; Sanson et al., 2004). In the New York Longitudinal Study (NYLS), the first large-scale study of temperament, Thomas, Chess, Birch, Hertzig, and Korn (1963) constructed a profile of a “difficult temperament” which included the following cluster of components: negative mood, withdrawal, low adaptability, high intensity, and low rhythmicity amongst the above identified nine dimensions. Despite an ongoing controversy on temperamental dimensions and qualities characterizing difficultness (Putnam et al., 2002; Rothbart & Bates, 2006), negative emotionality has remained the essential, overarching dimension of the difficult temperament encompassing key difficult temperamental traits (Rothbart & Bates, 2006). Negative emotionality is defined as a child’s tendency to react to stressors with high degrees of negative affect, characterized by negative mood (e.g., sadness, fear, discomfort), and (un)soothability, and highly intense negative reactions (e.g., frustration/anger, irritability; Rothbart & Bates, 2006). Because parenting a child who has a negative emotional temperament is likely to be demanding and exhausting, many of the studies investigating links between temperament and parenting have focused on qualities related to negative emotionality (e.g., Belsky, Fish, & Isabella, 1991; Field, 1994; Kochanska & Aksan, 2004; Putnam et al., 2002; Sanson et al., 2004; Rispoli et al., 2013).

Negative Emotionality & Parenting

Although a few studies have reported positive associations between negative emotionality and responsive parenting (Owens, Shaw, & Vondara, 1998; Washington, Minde, & Goldberg, 1986), most studies have shown negative associations (Belsky et
al., 1991; Bridgett et al., 2009; Field, 1994; Mertesacker, Bade, Haerkock, & Pauli-Pott, 2004; Rispoli et al., 2013; see Paulussen-Hoogeboom et al., 2007 for a review). Most of the prior research involves simple concurrent associations (Paulussen-Hoogeboom et al., 2007), but a few studies have reported longitudinal associations between negative emotionality attributes and parenting behaviors during the early years of life (Bridgett et al., 2009; Katainen et al., 1997; Lerner & Galambos, 1985; Lipscomb et al., 2011). Among studies revealing the impact of parenting on children’s subsequent temperament, Katainen et al. (1997) found that disciplinary style of parenting for girls at age 3 years predicted higher levels of negative emotionality at age 6. Similarly, in a study by Lerner and Galambos (1985), maternal rejection at age 3 years was significantly associated with higher child difficultness at age 4, while child difficultness at age 2 did not predict higher maternal rejection at age 3. Conversely, some studies have revealed the impact of child negative emotionality on parenting behaviors (Bridgett et al., 2009; Lipscomb et al., 2011). Using a Latent Growth Modeling (LGM), Lipscomb et al. (2011) found that parents with children showing greater increases in negative emotionality over time reported greater decreases in parenting efficacy and greater increases in over-reactive parenting. Findings revealing transactional relations between child negative emotionality and disruption in positive parenting come from studies with elementary school-age children (e.g., Lengua, 2006; Lengua & Kovacs, 2005). For example, Lengua (2006) found that higher child irritability was associated with increasingly negative parenting trajectories among 8 to 12 year-old children. At the same time, higher initial levels of
parental rejection were associated with increases in child fear and irritability over time.

In sum, a substantial body of research suggests that child negative emotionality is negatively associated with responsive parenting and positively associated with negative or harsh parenting. Building on these observed associations, it is very likely that individual negative temperamental traits also interact with each other in predicting negative parenting behaviors. Parents may, for example, be able to maintain positive interactions with a child who displays one difficult temperamental quality, such as unsoothability, but adding another, such as anger proneness, could put them over the edge. Little attention has been paid to such potential interactive contributions of negative emotionality traits to parenting behaviors. Only a couple of studies, however, have paid attention to how negative temperamental characteristics interact with each other in predicting peer relations (Eisenberg, Fabes, Bernzweig, Karbon, Poulin, & Hanish, 1993; Pérez-Edgar et al., 2011). For example, Pérez-Edgar et al. (2011) found that toddlers who were behaviorally inhibited displayed social withdrawal (characterized by temperamental shyness and unfocused behavior, negative affect, and low activity level during a play session with an unfamiliar peer) at the age of five years only when they had a strong attention bias towards threat as well, that is, paying attention to a threatening stimulus among many other objects (e.g., angry face) – instead of avoiding it or showing no bias at all. In other words, children’s attention bias moderated the relations between early behavioral inhibition and later social withdrawal.
To my knowledge, no study has examined interactions between two temperamental characteristics in predicting parenting behaviors. The current study examines the interactive contributions of two negative emotionality traits (anger/frustration & unsoothability) to authoritarian parenting.

Parents’ responses to children’s negative temperamental characteristics may be influenced by their cultural ideologies of desirable parenting and human development. The next section reviews research on how associations between temperament and parenting differ by cultural contexts, focusing on a comparison between independent vs. interdependent societies.

**Culture, Temperament, & Parenting**

Studies of collectivistic or interdependent cultures (mostly Chinese samples) reveal both differences and similarities to Western cultures. For example, there is some evidence that parents in individualistic Western and collectivist Asian cultures respond differently to children’s inhibition. Chen et al. (1998) found that while Canadian children’s inhibition was positively associated with mothers’ negative attitudes towards the child, Chinese children’s inhibition was associated with positive maternal behaviors—less maternal rejection and greater maternal warmth and acceptance. There have, however, been counter-examples showing cross-cultural similarities. Belsky, Rha, and Park (2000) found the common tendency in both Korean (interdependent) and U.S. (independent) parents that overall those having more inhibited children are more reactive to their inhibited behaviors (e.g., encouraging approach, encouraging withdrawal, & discouraging withdrawal).
Unlike inhibition or shyness, relational patterns between parenting behaviors and children’s emotional self-regulation (effortful control) seem similar across cultures. For example, Lee, Zhou, Eisenberg, and Wang (2012) found negative longitudinal associations between children’s effortful control and authoritarian parenting. Children’s lower levels of effortful control predicted higher levels of authoritarian parenting over time, while higher levels of authoritarian parenting predicted lower levels of subsequent effortful control over time in Chinese children (6-9 years), which is consistent with the findings from Western samples as discussed above. This similarity might reflect the universal emphasis of self-regulation across cultures but for different reasons – for group harmony and interpersonal relationships in interdependent/collectivistic culture and for independence and autonomy in independent/individualistic culture (Trommsdorff, 2012). Thus, children’s behavioral expressions of anger or irritability, which are related to lower effortful control (Zhou, Lengua, & Wang, 2009), are likely to have negative associations with supportive parenting in collectivistic/interdependent culture because they can negatively impact interpersonal relationships and group harmony. In the same vein, it can be presumed that children who are relatively more difficult to soothe and simultaneously more anger-prone are more likely to receive restrictive or negative parenting behaviors than those who are either less irritable or less anger-prone among a Korean sample having collectivistic background.

In addition to affecting parents’ behaviors, negative emotionality may also moderate the effect of parent’s behavior on children’s development. There is evidence, based on the differential susceptibility thesis, in which children’s temperamental
characteristics interact with the environment, thereby resulting in different developmental outcomes (Belsky, 2005; Belsky & Pluess, 2009; Ellis et al., 2011; Hertzman & Boyce, 2010). In the next section, extant findings suggesting that parenting practices can have differential impact on children’s developmental outcomes, depending on their negative emotionality are reviewed.

**Child Temperament as a Moderator**

Temperamental and emotional characteristics of young children, especially negative emotionality, have been pointed out as a phenotypic marker of children’s differential susceptibility to environmental impact (Belsky, 2005; Belsky & Pluess, 2009). If temperament indeed moderates the association between environment and children’s developmental outcomes, it may do so in various ways. Temperament, in particular, negative emotionality may cause (a) relatively worse child outcomes under negative environmental circumstances but better outcomes under positive environmental circumstances (Model a in Figure 1, referred to as the *differential susceptibility* model); (b) both high and low negative emotionality groups are susceptible to environmental influences but in opposite directions (Model c in Figure 1, referred to as *contrastive effects*); (c) negative emotionality may result in worse outcomes only under negative environment with no disadvantage under positive environment (Model d in Figure 1, referred to as the *diathesis-stress/dual-risk model*); or (d) negative emotionality may function only as a positive susceptibility factor generating better outcomes only (Model e in Figure 1, the *dual gain* model) (Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2007; van IJzendoorn & Bakermans-Kranenburg, 2012).
Among these hypothesized interactions, contrastive effects refer to cases in which children with higher negative emotionality demonstrate worse outcomes under favorable environment while children with lower negative emotionality evince better developmental outcomes and vice versa in adverse environment, and thus two groups show contrastive regression slopes (Belsky et al., 2007). Recently, a few studies have reported contrastive effects of negative emotionality and environment on developmental outcomes (e.g., Dilworth-Bart, Miller, & Hane, 2012; Morgan, Shaw, & Olbino, 2012; Poehlmann et al., 2011). For example, Morgan et al. (2012) found the contrastive effect of negative emotionality on the associations between destructive sibling relationships and internalizing problems. Destructive conflict with siblings exerted negative impact on children’s internalizing behaviors among boys having higher negative emotionality (above the mean), increasing internalizing problems under more destructive sibling relationships. Ironically, boys having lower negative emotionality (below the mean) manifested the fewer number of internalizing problems under more destructive sibling relationships.

Next, the diathesis-stress/dual-risk hypothesis has often been contrasted with the differential susceptibility hypothesis. The former is based on the premise that detrimental effects of adverse environment are observed only among children having high negative emotionality because negative emotionality is a vulnerability factor with no developmental benefits even under favorable and supportive environments. In contrast, the latter presumes that “vulnerable” individuals who are most adversely affected by negative environmental factors may reap the most benefits under enriched environmental support or the absence of adversity (Bakermans-Kranenburg, & van
IJzendoorn, 2007; Belsky, 1997, 2005; Belsky et al., 2007; Belsky & Pluess, 2009; Ellis, Essex, & Boyce, 2005; Ellis, Jacksons, & Boyce, 2006; Ellis et al., 2011; Hertzman & Boyce, 2010; van IJzendoorn & Bakermans-Kranenburg, 2012). Thus, in the framework of the differential susceptibility hypothesis (or the biological-sensitivity-to-context thesis), temperamental negative emotionality is regarded as a phenotypic marker of higher plasticity or susceptibility to both positive and negative environment for better and for worse outcomes. The more susceptible children to environmental impact – postulated to reflect their higher neurobiological or physiological reactivity to environmental influences in the biological sensitivity hypothesis—are often referred to as orchid children, in contrast to dandelion children, who are low in reactivity to environmental influences manifesting only minimal differences in developmental outcomes across a variety of circumstances (Boyce & Ellis, 2005).

To empirically test whether temperament’s moderation effects exist and if they do, which of the above models is supported, ideally the full range of environment—from negative to positive—needs to be considered in the model (Belsky & Pluess, 2009). There are a few more conditions to verify whether observed interactions between temperamental characteristics and the environment correspond to the differential susceptibility thesis and not the dual gain or dual risk models (Belsky & Pluess, 2009; Belsky et al., 2007; van IJzendoorn & Bakermans-Kranenburg, 2012). First, the plotted lines for children having varying degrees of negative emotionality should cross over within the full range of the environment. Additionally, the observed interactions are considered to support the differential susceptibility hypothesis only
when there are no zero-order associations between the susceptibility factor (e.g., temperamental characteristic) and the environment (e.g., parenting) and between the susceptibility factor and the outcomes. If there is an association, for example, between child negative emotionality (a susceptibility factor) and parenting behaviors (the environment) in predicting externalizing behaviors (the outcome), the evidence would not support the prediction that parenting affects externalizing behaviors more strongly for children high in negative emotionality. Rather, such a finding would indicate that high emotional negativity in children elicited negative parenting or negative parenting fostered emotional negativity in children. Likewise, if negative emotionality and outcome are significantly correlated, the evidence would support only a dual risk or dual gain model—depending on the direction of the association.

Due to these rather stringent conditions in conjunction with preexisting preponderance of research focusing on relations between the adverse environment and developmental dysfunctions, there are relatively few studies that provide sufficient evidence for the differential susceptibility hypothesis. Many prior studies have revealed that young children high on negative emotionality are at greater risk of having poorer developmental outcomes under poor-quality child rearing than children low on negative emotionality, supporting the diathesis-stress/dual risk model (Model d in Figure 1). Most of the extant research focused on social development, such as externalizing or internalizing problems or social competences (Belsky, Hsieh, & Crnic, 1998; Morrell & Murray, 2003; Smeekens, Riksen-Walraven, & van Bakel, 2007). For instance, Belsky et al. (1998) found that negative parenting characterized by intrusion, negative affect, and detachment during the second and third years of life
was associated with higher levels of externalizing problems at age 3 years in infants high in negative emotionality compared to those low. Similarly, a parent-child interaction lacking effective limit setting, high quality instruction, and supportive presence in toddlerhood predicted externalizing behavior at 5 years only among children highly anger-prone in toddlerhood but not among less anger-prone children (Smeekens et al., 2007). The vulnerable effects of negative emotionality were also observed among Turkish immigrant families in the Netherlands (Yaman, Mesman, van IJzendoorn, & Bakermans-Kranenburg, 2010); associations between lack of positive parenting at 2 years and aggression at 3 years were stronger among children reported to have difficult temperament at 2 years.

Although there are relatively fewer studies that have shown evidence supporting the differential susceptibility hypothesis (Model a in Figure 1) or focused on the supportive parenting environment, the number has been growing (e.g., Van Aken, Junger, Verhoeven, van Aken, and Dekovic, 2007; Kochanska, Aksan, and Joy, 2007). For example, Kochanska, Aksan, and Joy (2007), children’s fearfulness, maternal assertive and forceful control, and mother–child positive relationships (a composite of maternal responsiveness and shared emotional positivity during observed naturalistic daily interactions) were assessed when children were 22 and 33 months old. Children’s moral self (e.g., whether children keep rules when their mothers are not present) was measured at 56 months using a puppet interview. Children’s moral sense is an early indicator of conscience (Kochanska, 2002), which is an important component of self-regulation. Although no parenting effects were found for children low in fear, those temperamentally high in fear evinced a greater moral sense if their
mothers depended little on assertive control to regulate their behavior but a limited moral sense if their mothers relied heavily on assertive/forceful control. Some experimental studies have shown that children high on negative emotionality are indeed orchid children under positive environment (Blair, 2002; Cassidy, Woodhouse, Sherman, Stupica, & Lejuez, 2011). Blair (2002) conducted a comprehensive intervention study that provided educational stimulation and quality care to children, along with comprehensive health, life skills, parenting, and social service information to their families. He found that treatment infants who were high on emotional negativity exhibited substantially lower levels of externalizing problems and higher levels of cognitive functioning at 3 years of age than control infants who were similarly high on negative emotionality (orchid under less favorable environment), while no such treatment effect was detected among other infants low on negative emotionality (dandelion under favorable environment). Cassidy et al. (2011) also found that only temperamentally irritable infants profited from a home visit intervention aimed at enhancing attachment security.

There are also a few studies that revealed differential susceptibility effects on children’s cognitive/academic outcomes (e.g., Stright, Gallagher, & Kelley, 2008; Pluess & Belsky, 2010). For example, using the National Institute of Child Health and Human Development Study of Early Child Care, Stright, Gallagher, and Kelley (2008) found that associations between parenting quality (emotional and autonomy support) during infancy and early childhood and academic outcomes as well as social skills in the first grade were stronger for children who were reported to be high in difficult temperament than those who were reported to be low. Pluess and Belsky (2010)
examined interactions between temperament and *quality of childcare* during early childhood using the same NICHD data set with a longer period of follow-up till 11 years. They found the same trend; associations between environmental impact (both parenting quality and childcare quality) and child outcomes (cognitive-academic achievement and social adjustment) were stronger for children who manifested more difficult temperament as infants than those who did not. Furthermore, when the authors residualized the effects of parenting quality to take into account the associations between the predictor (parenting) and the moderator (temperament) in a subsequent analysis, the previously detected interactions still remained significant (Pluess & Belsky, 2010).

The findings of these studies raise the question of what causes differential susceptibility among people. Why are some people more negatively affected by adverse environments but more positively affected by enriched environments? What underlies these interactions between temperamental negativity and environment in predicting different outcomes? These questions have been addressed in studies on endophenotypic and genetic markers of higher malleability to environmental impact (see Belsky & Pluess, 2009; Obradović & Boyce, 2012 for a review). The biological-sensitivity-to-context proposition focuses on endophenotypic systems and characteristics that intervene in physiological reactivity to stressful surroundings, such as *autonomous nervous system* (e.g., reactivity of skin conductance level, blood pressure, or vagal tone (respiratory sinus arrhythmia (RSA)) under a stressful situation) and *neuroendocrine system* (e.g., salivary cortisol level controlled by the hypothalamus-pituitary-adrenal axis (HPAA)). Studies in this literature have shown
that children displaying higher reactivity in autonomous nervous or neuroendocrine systems under stressful situations manifest better outcomes in favorable environments (e.g., fewer externalizing and internalizing problems, respiratory illnesses, etc.).

Turning to genetic markers of differential susceptibility, there have been studies providing evidence of a few genes that create differential plasticity to environmental influence, such as MAOA, 5-HTTLPR, HTR2A, DRD4 (D4), and DRD2 (D2). These genes were found to encode functions of or the receptors of the neurotransmitters (e.g., serotonin & dopamine) that engage in emotion and mood regulation, attentional and motivational mechanisms, and stress responses, and thus engender differential outcomes depending on the positivity of the surroundings. The studies focusing on the interactions between genes and environment have found that carriers of at least one of these genes display better outcomes under favorable environment (e.g., sensitive parenting) while worse outcomes (e.g., ADHD, depressive symptoms, substance use, etc.) under negative environment (e.g., maltreatment in childhood) (see Belsky & Pluess, 2009 for a review).

In summary, prior studies have shown that children’s negative emotionality moderates associations between parenting and children’s social and cognitive outcomes. However, further efforts are needed to identify the underlying mechanism of the moderation effects and to substantiate which model regarding the interactions between temperament and environment is supported under what circumstances or for what populations. Evidence from most past studies is also limited because they focused exclusively on adversity and developmental dysfunctions. The current study is designed to examine whether children’s negative emotionality interacts with ordinary
parenting practices in the prediction of children’s developmental outcomes.

Specifically I examined whether children’s negative emotionality (a composite of anger proneness and unsoothability) moderated associations between parenting style (a composite of authoritarian and authoritative parenting) and children’s EFs and performance on a spatial cognitive task. This investigation contributes further to the existing literature by addressing relatively under-researched aspect of cognitive outcomes in a non-Western sample.

**Maternal Education as Moderator**

If children’s characteristics, such as negative emotionality, influence the mother-child relationship, mothers’ characteristics, such as personality (Prinzie et al., 2009) and educational attainment (Carr & Pike, 2012; Neitzel & Stright, 2004), are also likely to contribute to the relationship. In particular, maternal educational attainment has been found to predict more sensitive and less harsh parenting, and higher frequencies of engagement in discussion and contingent scaffolding (Carr & Pike, 2012; Hart & Risley, 1995; Hoff, 2003). In addition, maternal educational attainment has been found to moderate associations between children’s difficult temperament and parenting behaviors (Neitzel & Stright, 2004). In Neitzel and Stright (2004), mother-child interactions were observed in joint problem-solving tasks during a home visit. Mothers’ cognitive, emotional, and autonomy support were coded as they provided assistance. The authors found that more educated mothers regulated task difficulty, encouraged their children’s efforts, and encouraged their children’s active role more when they perceived their children as difficult than when they perceived their children as easy. These findings suggest a need to examine the moderating role of
maternal education in the associations between children’s negative emotionality and maternal parenting.

Summary

Taken together, the reviewed studies suggest that mother-child relationship is shaped in a reciprocal manner and needs to be examined within a cultural context. Specifically, children’s difficult temperament (or negative emotionality) has been found to elicit negative parenting behaviors in both independent/individualistic Western and interdependent/collectivistic non-Western samples, but little is known about the interaction effects of individual temperamental characteristics on parent behaviors. The evidence also suggests that maternal educational attainment can play a moderating role in the association between child temperament and parent behaviors. Prior research has shown that more educated mothers are inclined to exhibit a greater number of autonomy-supportive behaviors when perceiving children higher on negative emotionality than lower on negative emotionality. The reviewed studies also suggest that parenting behaviors influence children’s cognitive and self-regulation development, although the effects of parenting on children’s developmental outcomes may differ as a function of children’s temperament. The current study is to further understand the complex interplay among child temperament, parent behaviors, and children’s developmental outcomes.

Research Questions and Hypotheses
The main purposes of this study are to examine: a) whether parenting is associated with children’s executive functions and performance on a spatial cognitive task; b) whether children’s temperamental characteristics independently or interactively are associated with parenting behaviors; c) whether associations between parenting and children’s EF and performance on a spatial cognitive task vary as a function of children’s temperamental negative emotionality; and d) whether relations between parenting and children’s negative emotionality vary as a function of maternal educational attainment. Specifically, I address the following research questions (see Figure 2 for a conceptual map):

RQ1. Does parenting predict children’s EF and performance on a spatial cognitive task?
   RQ1.1. Do authoritative and authoritarian parenting styles predict children’s EF and performance on a spatial cognitive task?
   RQ1.2. Do maternal interactional behaviors (i.e., scaffolding and controlling behaviors, and overall sensitivity and autonomy support) during the puzzle activity predict children’s EF and performance on a spatial cognitive task?

Reviewed studies showed that cognitively stimulating and emotionally supportive parenting dimensions that are related to authoritative parenting (e.g., warm and responsive, and autonomy-supportive parenting) were generally associated with higher levels of children’s self-regulation and cognitive outcomes. Thus, in this study, I expected authoritative parenting and autonomy-supportive interactional behaviors to be positively associated with children’s EF and performance on a spatial cognitive task and authoritarian parenting and controlling behaviors to be negatively associated with children’s performance.
RQ2. Do children’s temperamental characteristics (i.e. anger proneness & unsoothability) independently predict authoritarian parenting, controlling for authoritative parenting?

Considering that a large body of research supports that children’s negative emotionality traits tend to be associated with negative parenting behaviors across cultures, I expected children’s temperamental proneness for anger and unsoothability to be positively associated with authoritarian parenting, holding constant authoritative parenting.

RQ3. Do temperamental anger proneness and unsoothability interact in predicting authoritarian parenting, when controlling for authoritative parenting?

Raising children who are prone to anger and simultaneously difficult to soothe would be more demanding and exhausting than taking care of children who are high in only one of those traits or low in both. Thus, I expected children’s temperamental unsoothability to predict authoritarian parenting more strongly for children with relatively high levels of anger proneness, compared to children with relatively low levels of anger proneness.

RQ4. Does children’s negative emotionality moderate the associations between parenting style (a composite of authoritative and authoritarian parenting) and children’s EF and performance on a spatial cognitive task?

Based on prior studies supporting the differential susceptibility hypothesis with cognitive/academic or self-regulation-related outcomes, I hypothesized that associations between parenting style and children’s EF and performance on a spatial cognitive task would differ as a function of children’s negative emotionality. Specifically, I predicted that under a relatively greater authoritative parenting relative
authoritarian parenting, children with relatively high negative emotionality (as an indicator of higher plasticity to environmental influence) would show higher levels of EF and performance on a spatial cognitive task than those with relatively low levels of negative emotionality. In contrast, I expected that under a greater proportion of authoritarian parenting relative to authoritative parenting, children with relatively low levels of negative emotionality to outperform those with relatively high levels of negative emotionality.

RQ5. Does maternal educational level moderate the associations between children’s negative emotionality and parenting behaviors?

Based on the prior study finding that more educated mothers tended to display higher frequency of positive parenting behaviors (e.g., encouraging and respecting children’s autonomy) when they perceived their children to be relatively high on negative emotionality, I expected children’s negative emotionality to be positively associated with more authoritative parenting (relative authoritarian parenting) among more educated mothers and to be negatively associated with authoritative parenting among less educated mothers.

In the following chapter, I describe sample, measures, and analysis plans.
Chapter 3: Methods

Sample

Eighty mother-child dyads were recruited from 10 preschools located in various districts in Seoul, Korea. The number of dyads from each preschool varied from 6 to 12. The mean age of the sample children was 59 months (range: 45 to 66 months); 43% of the sample was girls (Table 1).

The sample consisted of largely highly-educated parents from middle- or upper-middle classes: 70% of the mothers and 80% of the fathers had 4-year college or graduate degrees, and approximately 67% of the families had a monthly income corresponding to or greater than the Korean threshold for middle class ($5,000 per month). The relatively high education and income of the parents was the result of logistical limitations; preschools in low-income communities did not have an extra room to administer EF tasks and video-record mother-child interactions during the daytime.

Procedures

Preschool directors were first contacted through phone calls or emails. The purpose of the study was explained and specific details of recruitment conditions and logistics were provided. They were asked to identify four children (ideally, two boys and two girls) who are relatively high or relatively low in self-regulation skills respectively (e.g., concentrating on activities, listening attentively and sitting still in group activities, following classroom rules well, etc. vs. showing impulsive and hyperactive behaviors, acting out, etc.) and to recruit their mothers as well.
Recruitment was carried out by preschool directors or teachers because I could not obtain mothers’ contact information until after they were informed of the study. Each preschool was given $50 as a thank you gift.

When each mother visited the preschool on a scheduled date and time, I explained to the mother in a separate room—while her child was not present yet—the purpose of the study and the activity she and her child were going to engage in using a standardized protocol (Appendix 1).

After the mother was informed of the study, I introduced the puzzle, consisting of 25 wooden cubes (2×2×2 inches) having various geometric shapes in two colors (e.g., half circle, triangle, etc.) on each of the six dimensions (Figure 3). When assembled as a big square (5 by 5), the cubes as a whole can construct numerous images (e.g., dog’s face, flower, palace, etc.). This puzzle was selected to be challenging for 4 to 5 year olds in order to observe how mothers intervene in the task and deal with children’s frustration. After the 10-minute puzzle activity was over, mothers filled out a questionnaire (see Appendix 2) about family socio-demographics (e.g., family income, parent education, etc.), children’s temperamental characteristic (anger/frustration & unsoothability), and their own parenting practices. The questionnaire was completed after the observation was over so that maternal behaviors during the puzzle activity were not influenced by the content of the questionnaire. Mothers were given $30 as a thank you gift for their participation.

Interactions of 80 mother-child dyads were videotaped using a digital camera, and later the footages were coded using a real-time video-coding device (Lily 1.2.0) on a computer. Coding protocols for mothers’ and children’s behaviors (Tables 2 & 4)
were put into the device in advance so that buttons for the coding categories were
generated on screen for occasions when the actual coding happened. Every incident
that corresponded to the coding categories was instantly clicked. Two video footages
were excluded from the analysis because for one of the dyads, the child unexpectedly
moved his seat turning back to the camera so that interactions between the mother and
the child were not visible and for the other dyad because the sounds of interaction
were not recorded due to an unexpected technical problem with the camera.

To measure inter-coder agreement, a graduate student in Korea, who was
doing a masters degree in psychology, was hired to code 20% of the recorded video
footages (16 footages) independently. Before carrying out independent coding of the
16 footages, she was trained on the coding protocols (Tables 2-5) and the video-
coding device for about 1.5 hours. During the training, the coder and I independently
coded three video-footages of mother-child interactions and rated child’s puzzle
performance. Cohen’s Kappa (for mother-child interactions) and the proportion of
ratings that were within one point (for the puzzle performance; Paro, Pianta, &
Stulman, 2004) during the training were calculated to assess reliability. Cohen’s
Kappa was computed based on the proportion of agreement in the codes from two
coders that appeared within the window of 5 seconds considering latency of coding for
the same behavior. Since the preliminary inter-coder reliability during the training was
.78 (Kappa) for mother-child interactions and 100% for ratings of puzzle performance,
the coder proceeded to independently code 16 footages randomly selected out of 75.
The three footages used in the training were excluded in the random selection (78-
3=75). The coder remained unaware of the purpose of the study throughout the
training and coding processes. The inter-coder reliability for the selected 16 footages is presented in Table 6; descriptions of the coding protocols are presented below under observation-based measures.

Children’s EFs were directly assessed by administering EF tasks in a separate room in a fixed order (as presented in Appendix 3) during the same week that children were observed with their mothers while engaging in a puzzle activity.

**Measures**

**Parent-report measures**

*Authoritative vs. Authoritarian parenting.* Items to measure authoritative and authoritarian parenting were from the subscales of the Parenting Styles and Dimensions questionnaire (PSD; Robinson, Mandleco, Olsen, & Hart, 1995). The authoritative parenting subscale consists of four dimensions, each containing 4 to 11 items: 1) warmth/acceptance (e.g., “I express affection by hugging, kissing, etc.”); (2) reasoning/induction (e.g., “I give child reasons why rules should be obeyed”); (3) democratic participation (e.g., “I take into account child’s preferences in making plans for the family’’); and (4) easygoing/good-nurtured (e.g., “I am easygoing and relaxed with my child”). The *authoritarian parenting subscale* consists of the four dimensions, also each consisting of four to six items: a) non-reasoning/punitive strategies (e.g., “I punish by taking privileges away from child with little if any explanation”); (b) corporal punishment (e.g., “I use physical punishment as a way of disciplining our child”); (c) directiveness (e.g., “I demand that my child does/do things”); and (d) verbal hostility (e.g., “I yell or shout when my child misbehaves”).
The response alternatives for each item ranged from 1 (never) to 5 (always). The PSD has been used in numerous previous studies as has been found to predict non-Western, specifically, Chinese children’s effortful control (Zhou et al., 2004 & Lee et al., 2012) and internalizing problems (Eisenberg, Chang, Ma & Huang, 2009; Muhtadie, Zhou, Eisenberg, & Wang, 2013), and also Korean pre-primary children’s internalizing and externalizing behaviors (Kim & Kim, 2011). To reduce the total number of items in the questionnaire, only the items showing relatively high (from and above 0.5) loadings on each subscale in Robinson et al. (1995) were included in the parent questionnaires. The averages of the respective four sub-dimensions in the authoritative and authoritarian parenting subscales were used in analyses. Alphas of the authoritative and authoritarian parenting were 0.78 and 0.81 respectively (Table 7).

**Children’s temperamental characteristics.** Items measuring children’s negative temperamental characteristics were from the subscales of the standard form of the Child Behavior Questionnaire (CBQ, Rothbart, Ahadi, Hershey, & Fisher, 2001). The CBQ consists of three temperamental super-dimensions: Negative Affectivity, Surgency/Extraversion, and Effortful Control. Each of these three primary super-constructs is composed of a few sub-dimensions. The construct of interest in this study, Negative Affectivity, includes sadness, discomfort, fear, anger/frustration, and soothability/falling reactivity (negative loading) (Rothbart, Ahadi, Hershey, & Fisher, 2001). Among the sub-dimensions, the anger/frustration and the soothability/falling reactivity were selected for this study because the anger/frustration and irritability dimensions are the most examined traits in negative emotionality research (see Paulussen-Hoogeboom et al., 2007 for a list of relevant studies). Also, prior studies
have shown that children’s fearfulness (related to inhibited responses in social context; Rubin, Hastings, Stewart, et al., 1998) is not associated with negative responses among parents in interdependent culture (Eisenberg et al., 2001) while anger/frustration and irritability have been shown to be significantly associated with authoritarian parenting (Lee et al., 2012). Although less is known about parents’ responses towards children’s other negative emotion such as sadness in interdependent cultures, it has been argued that negative emotions that do not threaten in-group cohesion, that is, powerless negative emotions (e.g., shame, sadness) that are related to giving up or retreating from individual goals, elicit emotional support from others in interdependent culture (Fisher, Manstead, & Rodriguez Mosquera, 1999; Friedlmeier, Corapci, & Cole, 2011). In short, for these reasons, I focused on the two sub-dimensions of anger/frustration and unsoothability (reversed soothability/falling reactivity) in this study. The anger/frustration (13 items) and the falling reactivity/soothability subscales (13 items) were included in the parent questionnaire and rated on 7-point scale, with 1 (extremely untrue) to 7 (extremely true) as the response options. The anger/frustration subscale assesses the amount of negative affect associated with interruption of ongoing tasks or goal blocking, while the falling reactivity/soothability subscale assesses the rate of recovery from peak distress, excitement, or general arousal. The falling reactivity/soothability was reverse-coded in the current study, referred to as unsoothability henceforth, so that higher scores in the subscale mean greater difficulty in recovering from distress and arousal. Alpha of each subscale was 0.82 and 0.72 respectively (Table 7). In previous research the CBQ has significantly predicted children’s social competence (Spinrad, Eisenberg, Cumberland
et al., 2006), effortful control (Lee et al., 2012; Zhou et al., 2004), and internalizing and externalizing problems (Leve, Kim, & Pears, 2005).

**Child Assessment Measures**

**Children’s executive functions.** Six EF tasks were administered. The selection criteria of EF tasks were: 1) age-sensitive tasks having various degrees of difficulty (Carlson, 2005; Oh & Lewis, 2008); 2) inclusion of all three EF sub-components; and 3) inclusion of tasks that tap different aspects of EF (e.g., verbal vs. visual). Based on these criteria, the following EF tasks were selected: 1) Day/Night (inhibitory control); 2) Luria’s Hand Game (inhibitory control); 3) Backward Word Span (working memory); 4) Corsi block tapping (working memory); 5) Dimensional Change Card Sorting (DCCS, cognitive flexibility); 6) Thank you gift (delay of gratification). (See the Appendix 3 for the detailed description of each of these measures and how the final scores were calculated). To increase the reliability of these measures as an index of children’s EF, two factor composites were generated through principal component analysis (described in more detail below in the section on composite measures).

**Children’s Verbal ability.** Children’s verbal ability was measured with the vocabulary subscale of the Korean–Wechsler Preschool and Primary Scale of Intelligence (K–WPPSI; Park, Kwak, & Park, 1995). For the first three questions, children were shown the pictures of a cat, a tree, and a key and asked to label them. They gained 1 point for each question they answered correctly. For the remaining 22 questions, children were asked to define the words presented by the experimenter. For each question, they were scored according to the following scoring system: 2 points for full understanding (including key words for the definition), 1 point for partial understanding (missing a
couple of key words for the definition or using the given word to define itself but including some key words), and 0 point for no understanding (explicitly saying “do not know” what it means or giving completely wrong definition). The perfect score is 47.

**Observation-based Measures**

The videotaped mother-child interactions were coded for the first 610 seconds (10 minutes and 10 seconds). The actual data coding was done based on Level 2 categories (see the below Tables 2 & 4), but later the level 2 categories were combined into Level 1 categories for data analysis. The hostility category was dropped from the analyses since hostile behaviors were not observed at all among 85% of the participant mothers (66 out of 78). Another trained coder independently conducted data coding for 20% of the sample (16 mother-child dyads). All of the following observation-based measures showed excellent to reasonably high inter-coder reliability, with Kappas ranging from .92 to .97 for frequency-based measures and intra-class correlations of 0.74 & 0.85 for rating-based measures (maternal sensitivity and autonomy support respectively) (Table 6).

**Frequency of maternal cognitive scaffolding (level 1).** Mothers’ elaborative utterances (utterances that either elaborate on or evaluate the child’s presently occurring course of action, Bibok et al., 2009) and indirect support, such as giving the child a hint of the location of a right piece, were coded as cognitive scaffolding (Table 2).

**Frequency of maternal emotional scaffolding (level 1).** Maternal responses of complimenting, encouraging, acknowledging the child’s emotional state or intention
(mind-mindedness, Bernier et al. 2010), asking the child’s opinion, and showing warm gestures were coded as emotional scaffolding (Table 2).

**Frequency of maternal controlling behaviors (level 1).** Maternal behaviors that restrict children’s autonomy, such as directive and intrusive comments and actions, were coded as controlling behaviors (Table 2).

**Maternal sensitivity.** Maternal overall sensitivity during the interaction was rated based on 10 items (e.g., “Monitors the child’s actions during the interaction”; “Responds to the child’s signals”, Table 3) selected among 25 items of the mini-MBQS (Moran, 2009), the short version of the Maternal Behavior Q-Sort (MBQS; Pederson & Moran, 1995). As the MBQS is originally based on home-visit observation, 15 items that are irrelevant for the observation in the preschool setting were dropped. Unlike the original mini-MBQS rated either 0 or 1 depending on the presence of each of the listed behaviors, the maternal sensitivity items in the current study were rated on a 5-point scale (1: very untrue to 5: very true). The original MBQS has been validated as a reliable measure to assess maternal sensitivity in numerous studies, for example predicting mother-child attachment security (Pederson, Gleason, Moran, & Bento, 1998) and predicting children’s EF (Bernier et al., 2010, 2012). Also, the MBQS has been found to be significantly correlated with other assessments of maternal behavior, such as the Home Observation for Measurement of the Environment Inventory and the Ainsworth scales (Pederson & Moran, 1995).

**Maternal autonomy support.** Maternal overall level of autonomy support consisted of four items (e.g., “Intervenes according to the child’s needs and adapts the task to create an optimal challenge”, “Takes the child’s perspective and demonstrates...
flexibility in her attempts to keep the child on task”, Table 3) from Bernier and her colleagues’ studies (Bernier et al, 2010, p. 330; Bernier et al. 2011, p.15). The items were rated on 5-point scale with 1 (very untrue) to 5 (very true) as anchors.

Children’s performance on a spatial cognitive task. Children’s overall performance during the given puzzle task was rated on a 5-point scale based on the protocol presented in Table 5. Since mothers were allowed to intervene in the activity directly (e.g., directly placing a right piece or directly pointing out a right piece) or indirectly (e.g., giving a hint), the protocol for the ratings was created focusing on children’s independent performance as much as possible. Inter-rater agreement was reasonably high: the proportion of ratings on the puzzle performance that were identical was 68.8% (11 out 16) and that within one point difference was 87.5% (14 out of 16).

Composite measures

To reduce the number of variables, a few composite measures were created. As for composites based on factor analysis (i.e., a composite of interactional behaviors & composites of children’s EF), the summary of the reduced component variables and their loadings on the composite factors are presented in Table 8.

A composite of parenting style. To generate a variable to display how authoritative mothers are relative authoritarian in parenting, authoritative and authoritarian parenting behaviors were combined by subtracting the mean of authoritarian parenting from the mean of authoritative parenting. Thus, greater positive values on the composite indicated more authoritative parenting relative to authoritarian parenting while negative values on the composite more authoritarian parenting relative to authoritative parenting.
**A composite of interactional behaviors.** To create a composite of interactional behaviors, maternal cognitive and emotional scaffolding behaviors (frequency) and controlling behaviors (frequency), and the overall ratings of maternal sensitivity and autonomy support during the observed puzzle activity were entered into a principal component factor analysis. The factor analysis resulted in only one factor with an eigenvalue over 1.0. Because the loadings on this factor for cognitive and emotional scaffolding were low (0.37 & 0.28 respectively), those two variables were dropped and the factor analysis was rerun with the remaining three variables (Table 8). Since controlling behaviors loaded on the factor negatively, while sensitivity and autonomy support loaded positively, higher values on the factor composite indicated higher levels of autonomy support and sensitivity and lower levels of controlling behaviors (Table 8). This composite (factor score), referred to as the composite of interactional behavior henceforth, was used in the analyses.

**A composite of negative emotionality.** A composite of negative emotionality was created by averaging children’s anger proneness and unsoothability scores, despite a rather weak correlation between them ($r = .29$) for the following reasons. First, previous research has combined scores of temperamental subscales to measure negative emotionality (Dougherty, Klein, Durbin, Hayden, & Olino, 2010; Pauli-Pott, Mertesacker, Bade, Bauer, & Beckmann, 2000; Slatcher & Trentacosta, 2012), which is the construct of interest in my study. Also, another widely-used questionnaire to assess children’s negative emotionality, the Emotionality section of the Emotionality, Activity, Sociability, and Impulsivity (EASI) Temperamental Survey for Children (Buss & Plomin, 1984) is composed of five items mostly concerning children’s anger.
expression and irritability (e.g., my child cries easily; tends to be somewhat emotional; often fusses and cries; gets upset easily; and reacts intensely when upset), the average of the items are used in the analysis revealing valid predictability of outcomes of interest (Dich, Doan, & Evans, 2014; Lengua, Sandler, West, Wolchik, & Curran, 1999; Paschal, Gonzalez, Mortensen, Barnett, & Mastergeorge, 2015). Furthermore, the nature of the negative emotions (unsoothability or anger proneness) was not theoretically relevant. Finally, using them separately would double the total number of statistical results, which makes already complex finding even more complex.

**Composites of children’s EF.** Principal component analysis (PCA) of the six EF measures revealed two meaningful factors: since the loadings of day/night on both factors were very low (0.13 & 0.23), the day/night measure was dropped and the factor analysis was rerun with the remaining five EF measures to create the factor composites. As seen in Table 8, factor 1 was labeled as a “memory/attention” factor because measures assessing children’s working memory (backward word span & Corsi block tapping) and attention shifting (DCCS) were heavily loaded on it. Factor 2 was labeled as a “behavioral inhibition” factor since the measures assessing children’s ability to inhibit dominant or impulsive behaviors (inhibitory control and delay of gratification; i.e., Luria’s Hand game & gift task) heavily loaded on the factor. These two EF composites (factor scores) were used in the analyses.

**Analysis**

Because vocabulary and family SES were not significantly associated with parenting style, dimensions of interactional behaviors, children’s EF, performance on
a spatial cognitive task, and negative emotionality traits (Table 9), they were not included as covariates in regression analyses.1 Also, preliminary analysis showed that there were no significant preschool-level differences in children’s EF and performance on a spatial cognitive task. Thus, multiple regression analyses, instead of Hierarchical Linear Modeling (HLM), were conducted to address each research question. Predictor and outcome variables for each question are presented below.

RQ1. Do parenting predict children’s EF and performance on a spatial cognitive task?

RQ1.1. Do authoritative and authoritarian parenting styles predict children’s EF and performance on a spatial cognitive task?

A composite of parenting style (“authoritative parenting” minus “authoritarian parenting”) was used as an IV in the regression predicting children’s EF composites (factor scores) and performance on a cognitive task.

RQ1.2. Do maternal interactional behaviors (i.e., the composite of interactional behaviors) during the puzzle activity predict children’s EF and performance on the spatial cognitive task?

A factor composite of maternal interactional behaviors (factor score) was used as an IV in the regression designed to predict children’s outcomes.

1 The absence of significant correlations between vocabulary and EFs differs from previous studies in which language skill was associated with both parental scaffolding and EF (Bibok, Carpendae, & Müller, 2009; Landry et al., 2002) and family SES was significantly associated with parenting and children’s cognitive and socio-emotional development (Bradley & Corwyn, 2002; Sarsour et al., 2011). The lack of significant associations among family SES, parenting behaviors, and children’s EF and puzzle performance in the current study is most likely the result of the narrow range of family SES.
RQ2. Do children’s temperamental characteristics (i.e. anger proneness & unsoothability) independently predict authoritarian parenting, controlling for authoritative parenting?

To examine whether children’s temperamental anger proneness predicted authoritarian parenting when controlling for authoritative parenting, regression analysis was conducted with anger proneness as an independent variable (IV), authoritarian parenting as a dependent variable (DV), and authoritative parenting as a covariate. Since the correlation between unsoothability and authoritarian parenting was not significant (Table 9), an analysis with temperamental unsoothability as the IV was not carried out.

RQ3. Does temperamental anger proneness moderate the association between unsoothability and authoritarian parenting, when controlling for authoritative parenting?

To examine whether anger proneness moderated the association between unsoothability and authoritarian parenting, an interaction term between unsoothability and anger proneness was added into the multiple regression models predicting authoritarian parenting.

RQ4. Does children’s negative emotionality moderate the associations between parenting style (a composite of authoritative and authoritarian parenting) and children’s EF and performance on a spatial cognitive task?

To create a variable of parenting behaviors that can reveal how mothers are authoritative relative authoritarian, a composite of parenting style (“authoritative” minus “authoritarian” parenting) was generated as described in the analysis section. Next, an interaction term between the parenting style composite and the negative
emotionality composite (average of anger proneness and unsoothability) was added to respective regression models predicting EF & performance on a spatial cognitive task.

**RQ5. Does maternal educational level moderate the associations between children’s negative emotionality and parenting style?**

To examine whether mothers’ education levels moderated the associations between negative emotionality and parenting styles, an interaction term between maternal education and negative emotionality (a composite) was added to the multiple regression models predicting parenting styles (a composite of authoritative and authoritarian parenting).

The results are presented in the next chapter.
Chapter 4: Results

Descriptive Statistics

Descriptive statistics of authoritative and authoritarian parenting, and children’s temperamental characteristics and cognitive measures are presented in Table 7. There are two noteworthy points before proceeding to correlational findings.

First, most of the respondent mothers considered their parenting more authoritative (i.e., being warm to the child, allowing the child’s democratic participation in family affairs, and adopting reasoning in parenting) than authoritarian (i.e., making hostile comments, employing corporal punishment, and being directive). The overall distributions of authoritative parenting dimensions (rated on a 5-point scale) ranged from 2.9 to 4.7 with the means close to 4 (mostly true). In contrast, authoritarian parenting dimensions ranged from 1.4 to 3.1 with means close to 2 (rarely true). A similar trend was also found in observed interactional behaviors: the average overall ratings of maternal sensitivity and autonomy support during the puzzle activity were 4.56 and 3.92 (out of 5) respectively (Table 7).

Second, in accord with prior studies displaying ceiling performances of Chinese and Korean children in EF measures (e.g., inhibitory control, attention shifting and delay of gratification; Lan et al., 2011; Oh & Lewis, 2008), the majority of the children in the present study acquired almost perfect scores in inhibitory control and delay of gratification. For example, 53.75% of the sample children scored 14 points or above (max: 16) in the daynight task while 67.25% scored 12 points or above (max: 15) in Luria’s hand game. In the gift task measuring delay of gratification,
66.23% of the children (51 out of 80) successfully waited, not peeking at the gift for the whole given time (180 seconds).

**Correlations Among All Study Variables**

Tables 9 report correlations among children’s temperamental characteristics, authoritative and authoritarian parenting, maternal behaviors during the observed mother-child interactions, and children’s EF and performance on a spatial cognitive task, and Table 10 report correlations among various composites of EF, negative emotionality, parenting style and interactional behaviors and children’s other outcomes and socio-demographic variables. There are several associations to be noted before specifically addressing the research questions.

Child temperamental anger proneness and unsoothability were positively correlated with each other to moderate degrees ($r = .285, p < .01$; Table 9) and anger proneness was negatively associated with authoritative parenting and positively associated with authoritarian parenting. Authoritative and authoritarian parenting was negatively correlated with each other ($r = -.574, p < .001$; Table 9).

Turning to the observed maternal behaviors during the puzzle task, the overall rating of maternal autonomy support was significantly associated with the frequencies of cognitive and emotional scaffolding behaviors (Table 9). In contrast, the frequency of maternal controlling behaviors was negatively correlated with all the other observed measures, except emotional scaffolding. Overall sensitivity and autonomy support were strongly correlated ($r = .776, p < .001$). The observed maternal behaviors were not significantly correlated with the self-reported authoritative and authoritarian parenting scales.
Significant correlations were found among the children’s performances on the EF and puzzle tasks (Table 9). Specifically, backward word span and performance on a spatial cognitive task were significantly associated with many of the other measures: 1) Backward word span was correlated with Corsi block tapping \( (r = .329, p < .01) \), DCCS \( (r = .410, p < .001) \), and puzzle performance \( (r = .385, p < .001) \); 2) puzzle performance was significantly correlated with Corsi block tapping \( (r = .252, p < .05) \), DCCS \( (r = .286, p < .05) \), and day/night \( (r = .294, p < .01) \), along with backward word span \( (r = .385, p < .001) \). Older children acquired higher scores on some of the measured outcomes (Table 10). Girls tended to be regarded by their mothers as more difficult to soothe when disturbed by negative external stimuli \( (r = .227, p < .05) \).

Next, regarding parental socio-demographic variables, family income was not significantly correlated with authoritative and authoritarian parenting, most likely because of the narrow range of family incomes. In contrast to previous studies showing positive associations between authoritative parenting and family SES (Pinderhughes et al., 2000), greater levels of maternal education were associated with less reasoning in parenting \( (r = -.226, p < .05) \). In accord with the previous studies, even in this sample with limited variability in maternal education, higher maternal educational attainment was significantly associated with less corporal punishment \( (r = -.304, p < .01) \). Although no significant correlations were found between self-reported parenting behaviors and family income, family income was negatively associated with maternal behaviors during the observed interaction; higher income was significantly associated with less cognitive scaffolding during the puzzle task \( (r = -.335, p < .01) \).
Family income, parental education, and authoritarian and authoritative parenting styles were not significantly correlated with any of children’s EF, puzzle, & vocabulary scores. Although no significant associations were found between self-reported parenting behaviors and those performance scores, a few significant associations appeared between the observed maternal behaviors during the puzzle task and children’s EF. For example, backward word span was negatively correlated with the number of maternal controlling behaviors ($r = -.284, p < .05$), and positively correlated with autonomy support rating ($r = .249, p < .05$) and cognitive scaffolding ($r = .274, p < .05$), while DCCS was associated with the maternal autonomy support rating ($r = .300, p < .01$) and marginally with the maternal sensitivity rating ($r = .208, p = .067$). Taken together, more fine-grained aspects of maternal behaviors—the observed interactions with the child during the puzzle activity—were more likely than parenting styles to be associated with child cognitive outcome. In contrast, self-reported parenting styles were more likely to be associated with children’s temperamental characteristics (such as predispositions for anger and unsoothability), perhaps because the parenting styles capture the long-term nature of the relationship between mothers and children better than behaviors observed in a very specific context.

I turn now to results related to the particular questions that the study was designed to address.

**RQ1.1. Do authoritative and authoritarian parenting styles predict children’s EF and performance on a spatial cognitive task?**
The composite of parenting style did not significantly predict the memory/attention composite and performance on the spatial cognitive task (Models A & C, Table 11), when children’s age was controlled. However, the parenting style composite significantly, negatively predicted children’s behavioral inhibition (Model B, Table 11). Children of mothers who displayed relatively greater authoritative parenting tended to show lower behavioral inhibition, while children of more authoritarian (relative to authoritative) mothers tended to exhibit higher behavioral inhibition.

**RQ1.2. Do maternal interactional behaviors (i.e., a composite of interactional behaviors) predict children’s EF and performance on a spatial cognitive task?**

The composite of maternal interactional behaviors did not significantly predict the memory/attention and behavioral inhibition composites and performance on a spatial cognitive task (Models D -F, Table 11), when children’s age was controlled.

**RQ2. Do children’s temperamental characteristics (i.e. anger proneness & unsoothability) independently predict authoritarian parenting, controlling for authoritative parenting?**

To examine whether children’s temperamental anger proneness predicted authoritarian parenting when controlling for authoritative parenting and unsoothability, multiple regression analyses were conducted (Table 12). Model J (Table 12) was adopted as the final model because temperamental unsoothability did not significantly predict authoritarian parenting and explained only a slight amount of variance independently. When controlling for authoritative parenting, temperamental anger proneness significantly predicted authoritarian parenting ($\beta = .16, p < .01$).
RQ3. Do temperamental anger proneness and unsoothability interact in predicting authoritarian parenting, when controlling for authoritative parenting?

To examine whether anger proneness moderated the association between unsoothability and authoritarian parenting, an interaction term between unsoothability and anger proneness was added in the multiple regression models predicting authoritarian parenting (Table 13). Coefficients of temperamental unsoothability increased when the interaction term was added in the models (Models M & N). The interaction term was significant, even when controlling for authoritative parenting (β = .20, p < .05, Model N, Table 13).

To find where significant interaction effects exist across groups of children having different levels of anger proneness (Pluess & Belsky, 2010; Preacher, Curran, & Bauer, 2006), children were divided into five groups depending on their levels of anger proneness: 2SDs above the mean (n=5), 1SD above the mean (n=18), around the mean (n=30), 1SD below the mean (n=24), and 2SDs below the mean (n=3). Since there were only few children in the 2SDs above and below the mean group respectively (n=5 & n=3), the +2SDs group was combined into the +1SD group and the -2SDs group into the -1SDs group in the analyses. Then, these three groups were dummy-coded and regression analyses including interaction terms between each dummy variable and unsoothability were conducted. The mean group was omitted as a reference group. The follow-up analyses revealed that significant interaction effects existed between below-the-mean group (-1SD & -2SD anger proneness group, lower anger group) and the above-the-mean group (higher anger group): t-values demonstrated that the slopes for interaction effects between the lower anger group and
the higher anger group significantly differed from each other \( t = 5.99, p = .02 \). (See Appendix 4 for separate scatterplots for below-the-mean group and above-the-mean group).

Figure 4 illustrates the final model (N) revealing that the associations between unsoothability and authoritarian parenting differed significantly as a function of anger proneness (i.e., below the mean vs. above the mean groups): authoritative parenting was held constant by entering its sample mean (3.76) into the equation (Model N). Figure 4 shows that among the children having the lower temperamental anger proneness (indicated as \( \text{anger -2SDs or -1SD} \) in the figure), higher levels of unsoothability predicted lower levels of authoritarian parenting, while among children having above-the-average degrees of anger proneness (indicated as \( +1SD \) or \( +2SDs \) respectively), higher levels of unsoothability predict higher levels of authoritarian parenting, when controlling for authoritative parenting.

**RQ4. Does children’s negative emotionality moderate the associations between parenting style (a composite of authoritative and authoritarian parenting) and children’s EF and performance on a spatial cognitive task?**

Multiple regression analyses were conducted separately for the two EF composites and performance on a spatial cognitive task (Table 14). While no interaction effects were found across models predicting children’s EF composites (Models O to T), the composites of parenting style and negative emotionality were found to interact in predicting children’s performance on a spatial cognitive task (Model W). The model W explained about 10% of the variance in children’s performance on the cognitive task.
Again, to examine in what levels of negative emotionality significant interaction effects are detected (Pluess & Belsky, 2010; Preacher, Curran, & Bauer, 2006), children’s negative emotionality were dummy-coded into five groups initially: -2SDs below the mean (n=2), -1SD below the mean (n=18), the mean (n=35), +1SD above the mean (n=18), and +2SD above the mean (n=7). Since there were only two children in -2SDs group, they were combined with the -1SD group and similarly, the +2SDs group were combined with the +1SD group. Follow-up regression analyses included interaction terms between each level of negative emotionality and parenting style. F-test results detected significant differences in the slopes between the higher negative emotionality group (+1SD & +2SDs) and the lower negative emotionality group (-1SD & -2SDs) \( F = 5.61, p < .05 \) (See Appendix 4 for separate scatterplots for higher negative emotionality and lower negative emotionality groups).

Figure 5 visually illustrates the moderating role of negative emotionality in the association between parenting and children’s performance on a spatial cognitive task. Among children having +1SD or +2SDs negative emotionality, greater authoritative, relative to authoritarian, parenting was associated with lower levels of performance on a spatial cognitive task, whereas the inverse association was observed among children having the lower levels of negative emotionality (1SD or 2SDs below the sample mean). These results support the contrastive effects model (Model C in Figure 1): Both slopes are significantly different from zero but in opposite directions with higher negative-emotionality group (+1SD & +2 SDs negative emotionality) manifesting worse outcomes under favorable environment.
RQ5. Does maternal educational level moderate the associations between children’s negative emotionality and parenting behaviors?

Maternal educational attainment was found to interact with children’s negative emotionality in predicting parenting style (a composite of authoritative and authoritarian parenting; Table 15, Model AA). Maternal educational attainment was dummy coded into three groups (2 year college (n=19), 4 year college (n=47), & graduate degrees (n=11)) for a supplementary analysis to find in what levels of maternal education significant interaction effects existed. Interaction terms between each level of maternal educational attainment and parenting style were generated. Before proceeding to conducting regression analyses, including separate interactions terms between each maternal education groups and children’s negative emotionality, a scatterplot of parenting style and negative emotionality for each group of mothers was examined. They revealed that among mothers having a graduate degree, one outlier distorted the result (See Appendix 4). Because there were only 11 observations, the outlier could not be dropped, and thus instead, the four-year-college mothers and graduate degree mothers were combined. The 2-year college mother group was omitted as a reference group. T-test result detected significant moderating effects of maternal education on the associations between children’s negative emotionality and parenting style between 2 years of college and 4-year-college or graduate degree holders ($t = 2.33, p < .05$).

Figure 6 illustrates the differing associations between negative emotionality and parenting behaviors between mothers with 2-year college diploma and those with 4-year-college or graduate degrees. While higher negative emotionality was overall
associated with more authoritarian parenting relative to authoritative parenting in both groups of mothers, slopes were less steep among mothers with 4-year-college or graduate degrees (Figure 6). When children have relatively lower negative emotionality (one and two standard deviations below the mean indicated as 3 and 2.5 respectively), less educated mothers showed greater authoritative parenting relative to authoritarian parenting than more educated mothers. Overall, the observed pattern revealed that children’s negative emotionality was associated with parenting style to a lesser extent among more-educated mothers than among 2-year-college mothers.

These findings are discussed in the next chapter.
Chapter 5: Discussion

The main aim of this study was to examine the interplay among children’s negative emotionality traits, parenting behaviors, children’s EF and performance on a spatial cognitive task, and mothers’ educational attainment by focusing on some essential pieces of the picture among mother-child dyads from a non-Western culture.

In this section I discuss associations found between maternal interactional behaviors and children’s EF and the ways in which children’s anger proneness and unsoothability combined predicted parenting styles. I then discuss the findings pertaining to negative emotionality’s moderation effects in relations between parenting and performance on a spatial cognitive task. Next I discuss a general trend found in the associations among parenting styles, interactional behaviors, and children’s negative emotionality and then move to the findings concerning maternal education’s moderating effects in associations between negative emotionality and parenting and cross-cultural differences in EFs between Korean and Western preschoolers. Finally, I conclude the study by discussing implications of the study findings and limitations.

Maternal Parenting Behaviors and Children’s Executive Functions

Maternal interactional behaviors consisting of maternal sensitive responses, autonomy support, and controlling behaviors during a purposeful activity did not predict Korean children’s executive functions (behavioral inhibition and working memory/attention control) in this study. These results are inconsistent with extant study findings among Western samples showing that fine-grained cognitively or emotionally supportive parenting behaviors during an activity were associated with
children’s subsequent EF outcomes (e.g., Landry et al., 2002; Bibok et al., 2009; Bernier et al., 2010; 2012; Hughes & Ensor, 2009), while children of parents who were more disciplinary or hostile performed relatively poorly on EF tasks (Blair et al., 2011, Bindman et al., 2013; Holochwost, 2013). These discrepancies in findings might have resulted from the fact that children’s EF were assessed only once, thus not capturing children’s EF reliably in this study.

Contrary to the hypothesized associations, greater authoritative parenting was found to predict lower levels of behavioral inhibition (the composite of delay of gratification and inhibitory control) among Korean children, whereas no significant associations were detected between parenting style (authoritative and authoritarian parenting) and a measure of children’s working memory and attention shifting. Considering that there was a rather narrow distribution of authoritarian parenting, with no cases of truly hostile and punitive parenting (i.e., 4 (mostly true) or 5 (always true) on authoritarian parenting items), the higher levels of authoritarian parenting in the present sample likely corresponded to reasonable degrees of parental discipline that foster behavioral self-control in children. This interpretation is supported by a meta-analysis (Karreman et al., 2006), in which parental positive control (e.g., limit-setting, directiveness with low to moderate power assertion, guidance and instructional behavior) was significantly associated with children’s higher compliance. Since authoritarian parenting in the present sample was likely closer to positive control, rather than negative control (e.g., power-assertive control, coercive behavior, over-control, etc.), this explanation is plausibly applicable to the pattern of findings in the present study.
The observed positive associations between greater authoritarian parenting relative authoritative parenting may also have something to do with socio-cultural factors in the Korean mother-child relationship. East Asian countries (e.g., China and Korea) are known to have interdependent/collectivistic culture based on Confucianism (Markus & Kitayama, 1991). Parenting in these countries have also been known to emphasize children’s compliance and obedience to parents or teachers to a greater extent than in Western countries (Chao, 1995; Clarke-Stewart, Lee, Allhusen, Kim, & McDowell, 2006; Ho, 1986; Kim & Choi, 1994). Children, as socio-cultural beings, internalize social values transmitted by primary adults, such as parents and teachers, from very young ages (Abe & Izard, 1999; Kagan, 1984). For example, Chinese and Korean children have been shown to demonstrate higher levels of inhibition, partially originating from parenting practices emphasizing self-control and compliance, compared to Australian and Italian children even in toddlerhood (Rubin et al., 2006) and to show higher performances on behavioral inhibition tasks (e.g., delay of gratification) compared to American or English children in preschool period (Zelazo & Qu, 2005). Accordingly, if Korean children in the present sample interpreted maternal degrees of discipline towards them in daily contexts as a legitimate response or at least responded with compliant behaviors, maternal control perhaps would have enhanced children’s behavioral control over impulsive behaviors or pursuing immediate gratification. Supporting evidence from a previous study is a finding that forceful parental control was positively associated with situational compliance among children from interdependent culture (5-7 year-old Chinese; Huang & Lamb, 2014), controlling for the effects of child characteristics (age, gender, and temperament), and
that children in interdependent culture have shown higher degrees of compliance compared to their Western counterparts (Chen et al., 2003; Huang & Lamb, 2014). Also, maternal directive instructions in mother-child interactions positively predicted kindergarten children’s conscientiousness (Stright, Yang Herr, & Neitzel, 2009) among Hmong immigrants in the United States. Hmong families are known to have a traditionally interdependent culture and emphasize children’s obedience to parents and authority. Perhaps the combined force of maternal positive control and socio-cultural context might have generated the associations between more authoritarian parenting (relative to authoritative parenting) and higher behavioral inhibition in the present sample. The observed moderating effects of negative emotionality on the associations between parenting style and children’s performance on a cognitive task might have originated from the identical reasons (maternal positive control and socio-cultural context), which is discussed in the following section.

**The Moderating Role of Negative Emotionality in the Associations between Parenting and Children’s Performance on a Spatial Cognitive Task**

Theoretically, negative emotionality can interact with environment, in this case parenting style, in four different ways causing various developmental outcomes (Figure 1): (a) negative emotionality results in relatively worse child outcomes under negative environmental circumstances but better outcomes under positive environmental circumstances (the *differential susceptibility* model); (b) both high and low negative emotionality groups are susceptible to environmental influences but in opposite directions (*contrastive effects*); (c) negative emotionality causes worse outcomes only under negative environment with no disadvantage under positive
environment (the diathesis-stress/dual-risk model); or (d) negative emotionality functions only as a positive susceptibility factor generating better outcomes only (the dual gain model) (Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2007; van IJzendoorn & Bakermans-Kranenburg, 2012).

The overall pattern of associations among negative emotionality, parenting style, and performance on a challenging spatial cognitive task in the present study is congruent with the contrastive effects model, but not with the differential susceptibility hypothesis, in that two groups of children having the most distinct temperamental characteristics (the highest and lowest negative emotionality groups) evinced two contrastive patterns of association. Children who were high on negative emotionality (above the sample mean) performed relatively well on the puzzle task if their mothers were relatively more authoritarian and less authoritative. In contrast, children low on negative emotionality (better regulated children; below the sample mean) performed more poorly if their mothers were high on authoritarian parenting. Although not demonstrating the contrastive effects, a few other studies have also reported temperament’s moderation effects that are similar to the present study findings (e.g., Arcus, Gardner, & Anderson, 1992; Bates, Pettit, Dodge, & Ridge, 1998; Park, Belsky, Putnam, & Crnic, 1997). For example, Bates et al. (1998) reported that children’s temperamental resistance to control (associated with anger proneness) predicted subsequent externalizing behaviors more strongly when mothers were low in restrictive control than when high in control (i.e. prohibitions, warnings, scolding, etc.). Then, what might explain why the contrastive patterns were observed in the associations between parenting style and children with particular temperamental
qualities? As stated previously, these patterns might have derived from the way in which children growing up in interdependent culture responded to levels of parental control over their behaviors.

As described earlier, if reasonable degrees of parental discipline indeed fostered behavioral self-control in children, which in turn helped children to better concentrate on cognitive activities and better absorb more stimulations, the greater amount of authoritarian parenting (relative to authoritative parenting) would have led to higher levels of performance on a spatial cognitive task among children high on negative emotionality. Also, in relation to the cultural context where children’s compliance and obedience to authority figures (e.g., parents & teachers) are emphasized (Chao, 1995; Ho, 1986; Kim & Choi, 1994), high-negative-emotionality Korean children in the present sample possibly interpreted maternal degrees of discipline towards their emotionally unregulated behaviors as a legitimate response or at least responded with compliant behaviors, and maternal control perhaps would have enhanced children’s cognitive development with increase in concentration and learning.²

² Collectivistic/interdependent culture does not mean denying meritocracy or upholding the ideology of communism in which everyone should be equal regardless of individuals’ hard work. In combination of traditional Confucianism emphasizing lifelong learning and scholastic achievement, Chinese and Korean societies are typically viewed as having collectivistic/interdependent culture even though they have also long been known for their heavy emphasis on individual achievement, especially academic achievement. Although due to Westernization and industrialization, Korean society has been reported to become more individualistic, it has been found to still preserve collectivistic values to a greater extent than Western societies (Clarke-Stewart, Lee, Allhusen, Kim, & McDowell, 2006; Kim & Choi, 1994).
If this scenario was the case, why did the same level of positive control lead to lower performance on a spatial cognitive task among better-regulated children, who were low on negative emotionality? One possible explanation is that even low to moderate levels of maternal power assertion, if it was beyond situational demand, might have backfired, engendering emotional distress that interfered with children’s attentional control. Considering inverse associations between negative emotionality and emotional self-regulation (Zhou et al., 2009), children who were relatively less anger-prone and easier to soothe were those emotionally and behaviorally better regulated, and thus, maternal gentle instructions were presumably sufficient to elicit the optimal level of arousal for effective processing of cognitive input from the environment. In other words, for high-negative-emotionality children who with unregulated behaviors, parental control might have worked, whereas for low-negative-emotionality children who perhaps experienced parental discipline as over-control, similar level of parental control might have not worked well, leading experiences of being emotionally disturbed and cognitively interfered.

As a possible neurological underlying mechanism, anterior cingulate gyrus, which has been found to play a role in important cognitive functioning, such as error detection and conflict monitoring (e.g., Stroop task), has also been known to engage in controlling emotional distress (Posner & Rothbart, 2000). Also, the finding that the activation of anterior cingulate depends more on individuals’ subjective interpretation of intensity of sensory stimuli rather than the actual intensity (Rainville, Duncan, Price, Carrier, & Bushness, 1997) supports this possible explanation of why similar level of parental control might have been associated with different performance on a
spatial cognitive tasks between groups of children having low and high negative emotionality respectively. Another possibility is that for low-negative-emotionality children, relatively low levels of maternal control would have provided plenty of opportunities to develop the sense of autonomy and intrinsic motivation for social limits or cognitive activities (Deci & Ryan, 1991). Low-negative-emotionality children experiencing high control, however, may have attributed their abiding by rules or engaging in an activity to external reasons, damaging their self-efficacy, motivation and learning outcomes (Cordova & Lepper, 1996). In sum, the moderation effects of negative emotionality observed in the present study in general support the contrastive effects model, not diathesis-stress nor differential susceptibility models, indicating that at least in the present sample negative emotionality was neither a vulnerability factor nor a susceptibility factor – its effects varied depending on the environment (parenting). Also, cross-cultural differences in the mother-child relationship between Korea and other Western countries might have affected how Korean children in the study responded to maternal discipline and control, resulting in the contrastive pattern.

One last question that remains unanswered is why negative the interactions between emotionality and parenting predicted only children’s performance in the puzzle activity, not in assessments of executive functions. Children’s performance on a spatial cognitive task was assessed in the context of interacting with their mothers (although children’s independent performance was the focus of the assessment) whereas children’s EFs were assessed in a child-assessor one-on-one setting. The presence of the mother in the puzzle task may explain why the interaction between
parenting and temperament was observed in that context but not the EF assessment context. Note also that behavioral inhibition, such as inhibitory control or delay of gratification, is the most likely the dimension of EF to be affected by parenting practices emphasizing compliance and obedience, and the behavioral inhibition composite was indeed positively associated with greater authoritarian parenting relative authoritative parenting – although no interaction between parenting style and children’s temperament was found in predicting children’s EF. Definitely, this question should be further addressed in future research.

**Dispositional Anger and Unsootheability and Authoritarian Parenting**

Along with the positive associations between mothers’ parenting style and children’s EF, the other findings of this study may support a bidirectional view of parents’ and children’s behaviors. First, children who were relatively more prone to anger presumably expressed frustrated reactions more readily. This may have prompted mothers to respond in ways that were disciplinary or directive and controlling to a greater extent (authoritarian parenting). This finding is consistent with previous studies in which relatively high negative emotionality in children was associated with relatively low positive parenting behaviors (Bridgett et al., 2009; Katainen et al., 1997; Lengua, 2006; Lengua & Kovacs, 2005; Lerner & Galambos, 1985; Lipscomb et al., 2011). However, the opposite direction of influence might have also occurred: relatively more authoritarian parenting might have increased children’s anger proneness, as found in previous studies (Lengua, 2006; Lengua & Kovacs, 2005).
The finding that two negative temperamental traits, anger proneness and unsoothability, interacted with each other in predicting authoritarian parenting behaviors suggests children’s contribution to the relationship and thus also supports the notion of reciprocity in mother-child relationships. This finding is consistent with the hypothesis that parents are more likely to respond to a difficult-to-soothe child’s distress in a relatively more hostile and punitive way if the child is also easily angered than if the child is not also reactive to external stressor. Negative emotionality, particularly irritability and anger proneness – the most examined traits in relevant research (see Paulussen-Hoogeboom et al., 2007 for a list of relevant studies)— is well known to elicit disrupted parenting behaviors (Bridgett et al., 2009; Lengua, 2006; Lengua & Kovacs, 2005; Lipscomb et al., 2011; Shiner & Caspi, 2003). However, the present study findings imply that examining associations between parenting and only one negative temperament trait may miss an important piece of the interplay among temperamental traits and parenting. Two negative temperamental traits, such as predispositions for unsoothability and anger, may put children at a greater risk of negative parenting that is associated with increase in subsequent negative emotionality (Katainen et al., 1997; Lerner & Galambos, 1985) and externalizing behaviors (Colder et al., 1997; O’Leary et al., 1999), which in turn lead to heightened disciplinary parenting over time through reciprocity in the child difficult temperament-negative parenting associations (e.g., Lengua, 2006; Lengua & Kovacs, 2005). Highly reactive and easily upset children are in the greatest need of parents’ warmth and sensitivity to help them regulate their behaviors, but their very behaviors may diminish their chances of experiencing this kind of parenting. Their temperament may therefore set
in motion a self-reinforcing, negative developmental pathway. The current results reinforce a need for more studies that focus on how different configurations of child temperamental characteristics (both positive and negative traits) are associated with parenting behaviors.

**Associations among Parenting Style, Interactional Behaviors, and Children’s Negative Emotionality**

Overall, self-reported parenting styles (authoritative and authoritarian) were associated with children’s negative emotionality, probably because maternal parenting styles in daily interactions reflect a long-term relationship with the child, which is more strongly affected by the child’s temperamental characteristics.

The absence of significant associations between parent-reported parenting styles and observed interactional behaviors is inconsistent with prior findings (Carr & Pike, 2012; Mulvaney, McCartney, Bub, & Marshall, 2006). For example, Carr and Pike (2012) interviewed parents to measure parenting behaviors (i.e., affection, conflict (disagreement), and discipline (positive discipline (e.g., reasoning) and negative discipline (e.g., corporal punishment)) when their children were five years old. Then, after five years (child age = 10 years), the authors observed parent-child interactions in a block design task to measure maternal scaffolding behaviors. They found significant associations between self-reported positive parenting (characterized by affection and positive discipline by reasoning) and the rate of observed maternal scaffolding behaviors contingent on children’s performances.

There are a few possible explanations for the difference between the present study and previous studies. First, the lack of associations might be the result of a
social desirability bias. That is, due to mothers’ desire to behave in a socially desirable manner when being observed, the mothers in the study might have displayed a greater number of autonomy-supportive behaviors and fewer hostile and controlling behaviors during the observation than they might in a more private context. However, this does not seem to be the case since if there was a social desirability bias, mothers’ answers on the questionnaire would have also been affected and thus significant associations would have appeared between authoritative parenting style dimensions and autonomy-supportive interactional behaviors. Parenting styles regarding daily activities and interactional behaviors during a focused, purposeful activity in this study might have simply tapped discrete aspects of parenting behaviors.

**Moderation Effects of Maternal Education on Relations between Negative Emotionality and Parenting**

Maternal educational attainment in this study was not associated with parenting style and interactional behaviors, probably due to its narrow distribution (mostly highly educated mothers). Even with the narrow range, however, maternal education moderated the relation between children’s negative emotionality and mothers’ parenting style (Neitzel & Stright, 2004). Mothers with 2-year-college degrees displayed relatively more authoritarian parenting behaviors when their children were relatively high on negative emotionality (above the mean) compared to mothers with 4-year-college or graduate degrees, whereas the latter exhibited relatively less authoritative parenting compared to the former when children’s negative emotionality was relatively low (below the sample mean). Overall, the effect of children’s negative emotionality on parenting was stronger for mothers with
relatively low educational attainment: the degrees to which negative emotionality and parenting style are associated with each other was greater among 2-year-college mothers. The more educated mothers were less affected by their child’s difficult temperament.

Perhaps longer years of schooling better prepared mothers with social-emotional and cognitive skills to cope with difficulties and deal with their own emotional arousal in a challenging situation. It is also possible that maternal education is an indicator of mothers’ other characteristics (e.g., personality, self-efficacy, self-discipline, etc.) that help them react less negatively to children’s difficult temperament. South Korea was ranked the highest among OECD countries in terms of the percentage of 25 to 34 year-olds having college degrees (approximately 63%; including 2-year-college) (OECD, 2013). Taking into account such high college completion rate, it is likely that mothers with 2-year-college degrees and those with 4-year-college or graduate degrees are possibly distinguished from each other in other characteristics, such as self-discipline or conscientiousness. However, since this study did not collect information on other maternal characteristics, these possible explanations could not be assessed. Harder to explain is the finding in this study that less educated mothers’ authoritative parenting (relative to authoritarian parenting) was higher than that of more educated mothers when children’s negative emotionality was low (below the mean). Future research is needed to explore the dynamic interplay among children’s temperament, parenting behaviors, and children’s developmental outcomes, and especially to include maternal characteristics as possible moderators.
Cross-cultural Differences in Executive Functions

Since this study did not include both Korean and Western samples, the findings of the study cannot directly answer the question of whether Korean preschoolers showed higher performances on EF measures than Western children, as found in prior cross-cultural studies with East Asian samples (e.g., Korea: Carlson & Choi, 2008; Oh & Lewis, 2008; China: Lan et al., 2011; Sabbagh, Xu, Carlson, Moses, & Lee, 2006). The observed performances of Korean preschoolers, however, can be compared to the average passing rates on EF tasks for Western children aged three to five years reported by Carlson (2005). Korean preschoolers in the present study demonstrated comparable or worse levels of EF skills, depending on the EF measure. Specifically, among Korean preschoolers whose age was older than 54 months and younger than 60 (n=24) (old 4 years), about 67% of the sample children passed the daynight task (12 out of 16), while the passing rate in Carlson (2005) for old 4 years was 68% (n=19); while about 71% of the old 4-year-old Korean children passed the Standard DCCS, the corresponding rate among Western counterparts was about 76% (n=38) (Carlson, 2005). On the other hand, average passing rate (84%) among Western children on the delay of gratification (waiting for full five minutes) were dramatically higher than that of the Korean sample children: in the present study only about 57% of the old 4-year-old children successfully waited, not peeking at the gift for the whole three minutes. As for working memory, 69% (n=13 for old 4-year-old and 5-year-old children combined) succeeded in saying 3 digits backward among Western children while about 71% (n=69, old-4- and young 5-year-old children combined) succeeded in saying three or more words backwards in the present study. However, due to a small
sample size of each age group in Carlson (2005) and the present study, the reported estimates cannot represent the average EF performance of Western and Korean children. Furthermore, the absence of average passing rates for 5-year-olds in Carlson (2005) made it difficult to cross-culturally compare the EFs of young five year-old children (from 60 to 66 months), who consisted of the majority of the present sample (45 out of 80). The passing rates of the 5-year-old children for each of the above tasks were 91% for the daynight task, 78% for backward word span, 71% for delay of gratification (no peeking for the three minutes), and 87% for the Standard DCCS.

Due to incongruence of EF measures used or lack of mean performance scores reported in the prior studies, the assessed levels of EF performance in the present study were not comparable to the previous cross-cultural studies with East Asian samples. One exception is a study by Oh and Lewis (2008). Although Oh and Lewis’ (2008) sample from Korea and England were only 3 to 4.5 years old – younger than the children in the present study —, their average performances in the daynight, hand game, backward word span, and DCCS tasks were all higher than the levels of performances found in the present study, probably because the percentage of both Korean and English children who were from upper-middle-class, professional families was greater than the percentage of the present study sample.

In sum, owing to the small number of prior studies examining differences in EFs between East Asian and Western children, along with the small sample size and the absence of needed information, it is not possible to draw a generalizable conclusion of the cross-cultural differences in EF based on the present study findings. That said, with caution in mind, overall the Korean sample children in this study...
displayed comparable levels of performance in inhibitory control, attention shifting, and working memory tasks to those of Western children contradicting the previous study findings, while worse outcome in delay of gratification. More large-scale cross-cultural research is in need.

**Limitations**

Before concluding this study, some important limitations should be noted. First, the present study had a cross-sectional design. Thus, study results were based on concurrent associations among variables, which limits drawing conclusions about causality or directionality of the observed associations. Therefore, longitudinal or experimental studies addressing the same issues are needed.

Second, information on children’s negative emotionality was solely based on parental report. Having information on children’s temperamental characteristics and parenting behaviors come from the same source (mother) might have led to overestimated associations between these two constructs. The results on these associations, therefore, need to be interpreted with this caveat in mind and findings should be replicated with observational data of temperament and parenting behaviors.

Third, observation of mother-child interactions was brief (only for about 10 minutes) and in an un-naturalistic setting (classroom, not home), and included only a limited scope of interactions (a puzzle activity). Thus, future studies should visit homes to observe mother-child interactions in a more naturalistic environment for a longer period of time, across various situations.

Fourth, the sample was relatively small and consisted of well-educated mothers from mostly middle- to upper-middle-classes. Future studies should establish whether
the findings of the present study can be generalized to samples from other socio-economic backgrounds. In addition, it is unknown whether the results can be generalized to fathers and joint parenting, since this study did not examine fathers’ parenting behaviors.

Finally, information on maternal personality characteristics was not collected in the present study. Considering that it is a significant factor that can moderate associations among variables, it would be desirable for future research to take into account the role of maternal personality in examining the interconnections among temperament, parenting, and children’s developmental outcomes.

Despite these limitations, this study makes significant contribution to existing literature and provides important implications for interventions and social policies.

**Conclusion**

The present study contributed to existing literature by shedding light on what has not been sufficiently illuminated in relevant research. First of all, this study is one of very few that examined how two difficult temperamental characteristics interact with each other in predicting parenting behaviors. Second, this study uncovered that maternal educational attainment – perhaps in relation to their personality traits – may play a role in how mothers’ responses to their children are associated with children’s difficult temperament. Next, this study revealed the moderating effects of negative emotionality on relations between parenting and children’s performance on a cognitive task – which has been heretofore under-researched. Finally, this study was conducted in Korea, thus providing an opportunity to examine questions related to interplay
among parents’ characteristics and parenting, and children’s temperament and EF in a non-Western sample.

The present study demonstrates that children’s cognitive development is associated with a complex interplay among temperamental features and maternal parenting behaviors and characteristics. The findings in general suggest reciprocity in mother-child relations in that maternal authoritarian parenting behaviors predicted children’s higher behavioral inhibition skills, while children’s temperament predicted maternal parenting style. The finding that maternal negative parenting behaviors varied depending on whether children are high on only one difficult temperamental trait versus two traits suggests that patterns of child characteristics may be more important to understand than individual characteristics. High predispositions for certain difficult temperamental characteristics may place children at a greater risk of increasingly negative parenting through a probable reciprocal cycle of difficult temperament and disciplinary parenting over time.

The present study findings suggest that culture may be another factor contributing to the complexity. Korean preschoolers who were relatively high on negative emotionality performed better on the cognitive task when mothers exerted relatively more control over children's behaviors. This is the opposite of what is suggested by previous research conducted in western cultures, in which relatively high levels of parental control are associated with poorer child performance (Shears, Whiteside-Mansell, McKelvey, & Selig, 2008; Watkins-Lewis & Hamer, 2012). Perhaps the Korean children in the study, who were raised in a society in which obedience is highly valued, perceived controlling behavior as legitimate and were thus
responsive to direction. Although hardly definitive, the findings remind us that the meaning, and thus the reaction to parents' behavior, is to some degree in the eye of the beholder, and that different cultural norms and expectations may result in the same parental behavior having different effects on children.

The study also contributes to the field by demonstrating that maternal educational attainment – or perhaps personality traits associated with educational attainment – may play a moderating role in how mothers respond to children’s difficult temperament. Even among well-educated Korean mothers different levels of educational attainment revealed discrepant patterns of associations between children’s negative emotionality and parenting styles. While 2-year-college mothers displayed relatively more authoritarian relative to authoritative parenting when children were temperamentally more difficult, children's negative emotionality was not associated with the parenting style of mothers who graduated from 4-year-college or had graduate degrees. This finding suggests the importance of measuring fine-grained differences in education although there may also be a cultural component to this finding as well. The difference between two- and four years of college may be more salient in a culture, such as Korea, which emphasizes academic achievement and has one of the world's highest college completion rate.

More studies examining associations between parenting and child characteristics and performance on cognitive tasks with culturally, ethnically, and socio-economically diverse populations would better inform the complex interplay among parenting, child outcomes, parents’ and children’s characteristics, and cultural context. Given that the current sample consisted of well-educated, middle to upper-
middle class mothers and that harsh authoritarian parenting behaviors were rare among them, further research with samples and information of more diverse socio-economic backgrounds in other cultural contexts with longitudinal or intervention designs is necessary to assess the generalizability of the current study findings.
References


Costa, P. T., & McCrae, R. R. (1992). *Revised neo personality inventory (neo pi-r) and neo-five-factor inventory (neo-ffii)*. Odessa, FL: Psychological Assessment Resources.


relations to quality of children’s social functioning. *Child Development*, 70(2), 513–534.


Valiente, C., Eisenberg, N., Smith, C. L., Reiser, M., Fabes, R. A., Losoya, S., Guthrie, I. K., & Murphy, B.C. (2003). The relations of effortful control and


Appendix 1_Script for Participant Mothers

Thank you for participating. I’m going to get your son (daughter) from the classroom and bring him/her here to you. But before doing that, I want to briefly explain the purpose of the study and what you’re going to do with your child in a little while.

As you already heard from the director (teacher), this research is to see how parenting behaviors are associated with children’s self-regulation. Since mother’s ways of interacting with and disciplining a child are widely various and also, this is not to judge your parenting style, it is important to provide accurate information. Information from you will not be shared with anyone else.

[Pointing to the cube puzzle on the table] You and your son (daughter) will be playing with this puzzle for about 10 minutes. This puzzle consists of these wooden cube blocks having different shapes on each of the six dimensions. [Showing the two big images of a dog face and a palace composed of the cubes] Your child is going to construct a dog face first by rotating cubes, finding right pieces, and assembling them. If s/he is done with constructing the dog face within 10 minutes, s/he can proceed to the next task and construct this palace image. You can intervene in the activity, just as you usually do in your home when you play with your child. If you usually leave your child working on an activity on his/her own and rarely intervene, you can do so. In contrast, if you usually actively participate in the activity, you can do so as well. Again, I want you to interact with your child just as you usually do at home. The interaction between you and your child will be video-recorded. I will be outside this room and come back after about 10 minutes. Do you have any questions?

[Handing the parent consent form and parent survey] After the 10-minute interaction is over, you will be asked to sign on this consent form and fill out this questionnaire. This consent has more detailed information on this research, benefits, protection of the information you provide, and my contact information. If any new questions come up while reading this form or completing the questionnaire, you can ask me later. This survey contains items about your general style of interactions with your child and family socio-demographics, and your child’s temperamental characteristics. Again, your honest answers will be appreciated and firmly protected. When you are done with completing the consent form and the questionnaire, please put them in this envelope and hand it to me sealed. I will be waiting outside this room after returning your child to the classroom. Do you have any questions?

Now I’m going to bring your child from the classroom. In the mean time, you can familiarize yourself with the puzzle or read the consent form.
Appendix 2_Parent Survey

Parent Survey

Hello,
Thank you for agreeing to participate in this research study. This study is on how parenting styles affect young children’s self-regulation skills.

This survey consists of two sections: 1) your general style of interactions with your child, and 2) your child’s temperamental characteristics. At the end of the survey, you will also be asked about socio-demographics, such as family income and educational attainment. Any information from the survey will NOT be shared with anyone outside of the research team. There are “no” correct answers: mother’s ways of interacting with and disciplining a child are widely various. Thus, please provide accurate information.

It will take approximately 10 minutes to complete this survey. After you are done with the survey, please put it back into the envelope and give it back to the researcher, as sealed. Thank you so much for your help!

If you have any questions regarding this survey, please contact:

Kijoo Cha, e-mail: kijoocha@stanford.edu
Name of the preschool/center your child attends: ________________________

<table>
<thead>
<tr>
<th>Child’s name (Please print)</th>
<th>Child’s sex</th>
<th>boy (   ) girl ( )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child’s birth date</td>
<td>_____ / _____ / ____ (Month/Day/Year)</td>
<td></td>
</tr>
<tr>
<td>Child’s birth order</td>
<td>1st / 2nd / 3rd / 4th child, Total number of sons_____ &amp; daughters_____</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(example: 1st child among sons_1_ &amp; daughters_1_ )</td>
<td></td>
</tr>
<tr>
<td>How long has your child attended preschools?</td>
<td>________ Years __________ Months</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(including past child care centers or preschools before the present one)</td>
<td></td>
</tr>
<tr>
<td>Relationship with the child</td>
<td>Today’s Date</td>
<td></td>
</tr>
</tbody>
</table>

**Section 1: Parenting Style**

Presented below are different statements concerning the preschool child in your family and your behavior with him/her. Please read each statement and circle the number characterizing your typical interactions with the child: (1) never true; (2) rarely true; (3) sometimes true; (4) most of the time true; (5) always true.

<table>
<thead>
<tr>
<th>How true are these statements of your interaction with your children?</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Most of the time</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I yell or shout when child misbehaves.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. I know the names of child’s friends.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. I give praise when child is good.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. I give child reasons why rules should be obeyed.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. I use physical punishment as a way of disciplining my child.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. I encourage child to talk about the child’s troubles.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. I punish by taking privileges away from child with little if any explanation.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>How true are these statements of your interaction with your children?</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Most of the time</td>
<td>Always</td>
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</tr>
<tr>
<td>8. I am aware of problems or concerns about my child in preschool</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. I explode in anger towards child.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10. I express affection by hugging, kissing, and holding child.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11. I demand that child do things.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>12. I scold and criticize to make child improve.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>13. I spank when my child is disobedient.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>14. I punish by putting child off somewhere alone with little if any explanation.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>5</td>
</tr>
<tr>
<td>15. I give comfort and understanding when child is upset.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>16. I show sympathy when child is hurt or frustrated.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>17. I tell child what to do.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>18. I am responsive to child’s feelings or needs.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>19. I argue with child.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>20. I help child to understand the impact of behavior by encouraging child to talk about the consequences of his/her own actions.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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</table>

<table>
<thead>
<tr>
<th>How strongly agree or disagree with these statements?</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither disagree nor agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>
21. It is all right for my child to disagree with me.  

22. Children must be carefully trained early in life or their natural impulses will make them unmanageable.  

23. Children should always obey their parents.  

24. Children should not question the authority of their parents.  

25. Children will be bad unless they are taught what is right.  

Section 2: Your Child’s Temperamental Characteristics  

Presented below are different statements concerning your child’s reactions to a number of situations. Please read each statement and circle the number characterizing your child’s reactions within the past six months: (1) extremely untrue of your child; (2) quite untrue of your child; (3) slightly untrue of your child; (4) neither true nor false of your child; (5) slightly true of your child; (6) quite true of your child; & (7) extremely true of your child.  

1. Gets angry when told s/he has to go to bed.  

2. Rarely gets irritated when s/he makes a mistake.  

3. Has temper tantrums when s/he doesn't get what s/he wants.  

4. Gets quite frustrated when prevented from doing something s/he wants to do.  

5. Gets mad when even mildly criticized.  

<table>
<thead>
<tr>
<th></th>
<th>Extremely untrue</th>
<th>Quite untrue</th>
<th>Slightly untrue</th>
<th>Neither untrue, nor false</th>
<th>Slightly true</th>
<th>Quite true</th>
<th>Extremely true</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>1</td>
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<td></td>
<td>Extremely untrue</td>
<td>Quite untrue</td>
<td>Slightly untrue</td>
<td>Neither untrue, nor false</td>
<td>Slightly true</td>
<td>Quite true</td>
<td>Extremely true</td>
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<tr>
<td>6. Gets angry when s/he can't find something s/he wants to play with.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>7. Gets angry when called in from play before s/he is ready to quit.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>8. Gets mad when provoked by other children.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>9. Rarely gets upset when told s/he has to go to bed.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>10. Becomes easily frustrated when tired.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>11. Gets irritable about having to eat food s/he doesn't like.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>12. Rarely protests when another child takes his/her toy away.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>13. Easily gets irritated when s/he has trouble with some task (e.g., building, drawing, dressing).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>14. Has a hard time settling down for a nap.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>15. Calms down quickly following an exciting event.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>16. Can be &quot;cheered up&quot; by talking about something s/he is interested in.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>17. Has a hard time settling down after an exciting activity.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Extremely untrue</td>
<td>Quite untrue</td>
<td>Slightly untrue</td>
<td>Neither untrue, nor false</td>
<td>Slightly true</td>
<td>Quite true</td>
<td>Extremely true</td>
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</tr>
<tr>
<td>18. When angry about something, s/he tends to stay upset for ten minutes or longer.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>19. Seems to forget a bump or scrape after a couple of minutes.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>20. Changes from being upset to feeling much better within a few minutes.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>21. Falls asleep within ten minutes of going to bed at night.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>22. If upset, cheers up quickly when s/he thinks about something else.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>23. Is easy to soothe when s/he is upset.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>24. Is very difficult to soothe when s/he has become upset.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>25. Has a hard time going back to sleep after waking in the night.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>5</td>
<td>6</td>
<td>7</td>
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<tr>
<td>26. Rarely cries for more than a couple of minutes at a time.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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</table>

**Section 3: Family Socio-demographics & Child Activity**

This is a final section of the survey. The items below are about your and your husbands’ socio-demographic information and your child’s weekly activities. Again,
this information will be used only for research purpose, not revealed to anyone else outside the research team.

1. What is your highest level of educational attainment?
   1) Elementary school    2) Middle school    3) Some high school
   4) High School Diploma    5) 2-Year College    6) 4-Year College
   7) Graduate Degree(s)    7) Other (Please specify: ____________)

2. Do you have a job?     1) Yes    2) No (Please skip No. 2.1 and go to No. 3)

   2.1. If you have a job, what kind of job is it?
       1) Manager
       2) Professional
       3) Clerical
       4) Service industry
       5) Retail business
       6) Agriculture, forestry, or fishery
       7) Technician/Engineers
       8) Manufacturing/Assembling
       9) Laborer
       10) Military
       11) Other (Please specify: ________________)

3. What is your husband’s highest level of educational attainment?
   1) Elementary school    2) Middle school    3) Some high school
   4) High School Diploma    5) 2-Year College    6) 4-Year College
   7) Graduate Degree(s)    7) Other (Please specify: ____________)

4. Does your husband have a job?
   1) Yes
   2) No (If he had a job before, please answer based on his past occupation. Otherwise, please skip No. 4.1 and go to No. 5)
4.1. If your husband has a job, what kind of job is it?

1) Manager
2) Professional
3) Clerical
4) Service industry
5) Retail business
6) Agriculture, forestry, or fishery
7) Technician/Engineers
8) Manufacturing/Assembling
9) Laborer
10) Military
11) Other (Please specify: __________________)

6. What is your annual household income?

1) Less than $10,000
2) $10,000-$19,999
3) $20,000-$29,000
4) $30,000-$39,999
5) $40,000-$49,999
6) $50,000-$59,999
7) $60,000-$69,999
8) $70,000-$79,999
9) $80,000-$89,999
10) $90,000-$99,999
11) Greater than $99,999

Please check back to make sure you have completed all items.
Thank you so much for your help!
Appendix 3_Description of EF Measures

EF Tasks

1) **Day/Night** (inhibitory control). The experimenter engages children in a conversation about when the sun comes up (in the day) and when the moon and stars come out (in the night). She then presents a white card with a yellow sun drawing on it and a black card with a white moon and stars on it. Children are instructed that in this game they are to say night for the sun card and day for the moon/stars card. After a brief warm-up, there are 16 test trials with each card presented (from beneath the table) in a fixed, pseudorandom order. There are no breaks or rule reminders. Accuracy (number correct out of 16) is recorded. Carlson (2005) reported that in aggregated data from a few studies, U.S. young and old 4 year-olds’ overall passing rates in this task were 48% and 68% respectively with 12 successful trials among 16 as a passing criteria. By contrast, Oh & Lewis (2008) reported that 4 year-old and 4.5 year-old Korean children showed nearly ceiling performance on this task: the average number of successful trials among 16 trials in total was 14.90 and 15.35 for 4 year-olds and 4.5-year-olds respectively. Thus, applying the same passing criteria from Carlson (2005), Korean samples in Oh & Lewis (2008) showed 100% passing rate for both 4- and 4.5 year-olds.

2) **Luria’s Hand Game** (inhibitory control). Children are instructed to make the same hand motion as the experimenter (fist or pointed finger). After reaching a criterion of 6 correct trials, the experimenter explains that children are to make a gesture opposite to the one she makes (e.g., children should point a finger when she makes a fist). Fifteen of these anti-imitation test trials follow after a brief practice. Scores are the number of correct trials out of 15. Although Carlson (2005) did not report 4 year-olds’ passing rate in this task, the Day/Night task, which taps EF subcomponent similar to this hand game, displayed about the passing rate of 48% among U.S. 4 year olds. By contrast, Oh & Lewis (2008) reported that 4 year-old Korean children showed nearly ceiling performance on this task and all 4.5 year-olds reached at the ceiling.

3) **Backward Word Span** (auditory working memory). The experimenter introduces children to a puppet named Ernie and says that whatever she says, Ernie likes to say it backward. She demonstrates, saying “Rabbit, Cup” and then make Ernie say “Cup, Rabbit.” Children are invited to try (using the same example). The experimenter then suggests they do some more like that, explaining that whatever she says, the child should say it backward. She begins with two words and increases the number of words until the child errs on three consecutive trials. The highest level of success is recorded (two, three, four, or five words). (One is assigned when children fail at two words.). In Oh & Lewis (2008), the mean number of words that Korean children could successfully recite backward was 4.32 (4-year-olds) and 4.82 (4.5-year-olds) with 7 words as the maximum, which were higher than those of British children (3.53 for 4-year-olds, 3.81 for 4.5-year-olds). However, the backward word span task was not included in Carlson (2005) where U.S. children’s general performance was comprehensively analyzed, it is unknown how generalizable the British children’s
performance in Oh & Lewis (2008) can be. However, the passing rate of the backward digit span task’s passing rate (with the three digit or more as the passing criteria) among 4 year-old Western children was in between 17% and 37% (Carlson, 2005).

5) **Corsi Block Tapping** (visuo-spatial working memory). Children are first required to observe the sequence of blocks "tapped" by the experimenter, and then repeat the sequence in order (Kessels et al. 2000). The following instruction will be given: “I will tap a block sequence on this board. When I have finished tapping, I want you to tap these blocks in the same serial order. After this, I will tap another sequence. The sequences will gradually increase in length.” The task starts with tapping two blocks and gradually increases in length up to eight blocks. Two trials are given per block sequence of the same length. If at least one of these is repeated correctly, the next two trials of a sequence of an increased length are administered. The assessor touches with the index finger at a rate of approximately 1 block per sec (with no pauses between the individual cubes). If a child starts the task while the assessor is still busy tapping blocks, the following instruction will be given: “Please wait until I have finished.” The test is terminated if the child fails to reproduce two sequences of equal length. Only a completely correctly repeated sequence was scored as correct; self-corrections are permitted here. Since this task has not been used in studies with young children as frequently as other EF tasks, no anticipation can be made about the performance of the sample children in the present study. However, in Kessels et al. (2000) with healthy adults in the 30s, the average block span (the number of blocks that were tapped successfully in the same order as the sequence by the assessor) was 6.2. Thus, no ceiling effect is expected.

6) **Dimensional Change Card Sort** (DCCS) (cognitive flexibility). Children are introduced to two boxes and cards. Target cards (e.g., a red boat and a blue rabbit) are affixed to the boxes. During demonstration phase, the experimenter presents two cards (red rabbit and blue boat) and instructs children to place the red rabbit in the box with the blue rabbit and to place the boat in the box with the red boat in the “shape game,” while the red rabbit card in the red boat box and the blue boat card in the blue rabbit box in the “color game.” After the demonstration phase (2 trials), 6 consecutive pre-switch trials are followed (either color or shape game). If the child shows successful performance on the five consecutive trials out of the total six, the experimenter announces that they will stop playing the shape (color) game and now play the “color (shape) game.” The experimenter should label a card by the relevant dimension only (“Here is a red one”) when presenting a card, and then hands the card to the children. There are six post-switch trials. The total number of correct post-switch trials is recorded. Scores are the total number of correct trials. In Oh & Lewis (2008), the passing rate of Korean children in the DCCS was 68.2% for 4 year olds and 100% for 4.5 year olds, while the passing rate of British children was 86.7% and 81.3% respectively. In Carlson (2005), the passing rate of young and old 4 year-olds was 48% and 76% respectively. Just in case Korean children in this proposed study show ceiling or near-ceiling performance, the border version of the DCCS will be administered. In the border version of the DCCS, children are introduced to the same cards but some of them have a black border around the object on each card.
And, the child is asked to play the color game for the cards having a border while playing the shape game for the cards without a border. 12 trials are administered for the border version of the DCCS and the number of correct trials are scored. This protocol is based on Zelazo (2006). In the end, performances on the three versions of the DCCS are combined into a final score of 0 to 3: 1) 0 point when the child did not pass the color sorting task (fewer than 5/6 items correct); 2) 1 point when the child passed the color sorting task but failed on shape sorting task (at least 5/6 items correct on color sorting but fewer than 5/6 items correct on shape sorting); 3) 2 points when the child passed the shape sorting task but failed on the border version task (at least 5/6 items correct on both color and shape sorting but fewer than 9/12 items correct on border sorting); & 4) 3 points when the child passed the border sorting task (at least 5/6 items correct on both color and shape sorting and at least 9/12 items correct on border sorting) (Zelazo, 2006).

7) **Thank-you Gift (Delay of gratification).** Children are told they did a great job and that they are going to receive a prize. However, the experimenter “forgot” to wrap their present. The experimenter asks children to sit still, not peeking the gift until the experimenter comes back in 3 minutes with a wrapping paper so that she can wrap the present “so it will be a big surprise.” Then, the experimenter leaves the room while placing the gift covered with a cloth in front of the child. When children peeks a gift by lifting a cloth is recorded (video-recording). In Oh & Lewis (2008), on a similar delay of gradation measure (asking the child to sit turning back not peeking, while the experimenter is wrapping the gift making a noise), the majority of older 3- and young 4-year-old Korean children (72.5%) were at ceiling (delaying for 150 s). By contrast, in Carlson (2005), the corresponding aged U.S. children’s passing rate with a maximum delay time of 60 seconds, which is less than half of the delaying time in Oh & Lewis (=150s), was 48% and 53% for younger 3 and older 4 years old respectively. Based on these previous study results, to prevent ceiling effect in this proposed study, the experimenter will leave the room leaving the child alone and come back after three minutes (180s).
Appendix 4_Scatterplots for Separate Groups of Children and Mothers Regarding the Observed Interaction Effects

1. Interaction between Anger-proneness and Unsoothability in predicting Authoritarian Parenting

When Children’s anger proneness is 1SD & 2SDs below the mean:

*Note. reactivity=unsoothability; “highanger=0” indicates the lower anger group (below the mean)

When Children’s anger proneness is 1SD & 2SDs above the mean:

*Note. reactivity=unsoothability; “highanger=1” indicates the higher anger group (above the mean)
2. Interaction between negative emotionality and parenting style in predicting children’s performance on a cognitive task

When Children’s negative emotionality is 1SD & 2SDs below the mean:

“highneg=0” means a low negative emotionality group (below the mean)

When Children’s negative emotionality is 1SD & 2SDs above the mean:

“highneg=1” means a high negative emotionality group (above the mean)
3. Interaction between maternal education and negative emotionality in predicting parenting style

When mothers have a 2 year-college degree:

When mothers have a 4-year-college or a graduate degree:
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean: 58.58/SD: 4.51</th>
<th>Max: 66/ Min: 45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child’s age (in months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child’s sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girl: 42.5% (n=34)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boy: 57.5% (n=46)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child’s center experiences (in months)</td>
<td>Mean: 23.60/SD: 10.65</td>
<td>Max: 44/Min: 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Educational attainment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school</td>
<td>3.75% (n=3)</td>
<td>3.8% (n=3)</td>
</tr>
<tr>
<td>2-year college</td>
<td>23.75% (n=19)</td>
<td>11.39% (n=9)</td>
</tr>
<tr>
<td>4-year college</td>
<td>58.75% (n=47)</td>
<td>62.03% (n=49)</td>
</tr>
<tr>
<td>Graduate degree (master/doctorate)</td>
<td>13.75% (n=11)</td>
<td>21.52% (n=17)</td>
</tr>
<tr>
<td>Working status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>28.75% (n=23)</td>
<td>98.75% (n=79)</td>
</tr>
<tr>
<td>No</td>
<td>71.25% (n=57)</td>
<td>1.25% (n=1)</td>
</tr>
<tr>
<td>Family income (per month)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$2,000-$2,999</td>
<td>5.00%</td>
<td></td>
</tr>
<tr>
<td>$3,000-$3,999</td>
<td>8.75%</td>
<td></td>
</tr>
<tr>
<td>$4,000-$4,999</td>
<td>20.00%</td>
<td></td>
</tr>
<tr>
<td>$5,000-$5,999</td>
<td>21.25%</td>
<td></td>
</tr>
<tr>
<td>$6,000-$6,999</td>
<td>8.75%</td>
<td></td>
</tr>
<tr>
<td>$7,000-$7,999</td>
<td>7.50%</td>
<td></td>
</tr>
<tr>
<td>$8,000-$8,999</td>
<td>3.75%</td>
<td></td>
</tr>
<tr>
<td>$9,000-$9,999</td>
<td>11.25%</td>
<td></td>
</tr>
<tr>
<td>&gt;$9,999</td>
<td>13.75%</td>
<td></td>
</tr>
</tbody>
</table>
### Table 2

**Analysis Protocol for Maternal Scaffolding**

<table>
<thead>
<tr>
<th>Maternal behaviors</th>
<th>Level 1</th>
<th>Level 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cognitive scaffolding</strong></td>
<td></td>
<td>Description of behaviors</td>
</tr>
<tr>
<td></td>
<td>Elaborative utterances</td>
<td>Explaining, guiding (evaluating), etc.</td>
</tr>
<tr>
<td></td>
<td>Indirect support</td>
<td>Telling the child the approximate locations of a right piece</td>
</tr>
<tr>
<td><strong>Emotional scaffolding</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compliment/Motivating Utterances</td>
<td>Saying praise or any kinds of encouraging/motivating words, including “yes/no or correct/incorrect”</td>
</tr>
<tr>
<td></td>
<td>Acknowledging Utterances</td>
<td>Acknowledging the child’s emotional state &amp; intention</td>
</tr>
<tr>
<td></td>
<td>Warm gestures</td>
<td>Stroking the child’s head, cheek, etc.</td>
</tr>
<tr>
<td></td>
<td>Asking opinions</td>
<td>Any kinds of actions of asking the child’s opinion in the activity</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td>Directive utterances, on task</td>
<td>Explicitly telling the child what to do while the child is on task</td>
</tr>
<tr>
<td></td>
<td>Directive utterances, off task</td>
<td>Explicitly telling the child what to do while the child is off task</td>
</tr>
<tr>
<td></td>
<td>Directive utterances, next step</td>
<td>Explicitly telling the child what to do next (pointing to the next spot)</td>
</tr>
<tr>
<td></td>
<td>Direct support</td>
<td>Picking up the piece directly, putting the piece on her own</td>
</tr>
<tr>
<td></td>
<td>Suggesting next step</td>
<td>Suggesting the child what to do next (“What about finding a piece for this place?”)</td>
</tr>
<tr>
<td><strong>Hostility</strong></td>
<td>Ignore/reject</td>
<td>Ignore or rejects signs, bids, comments of the child</td>
</tr>
<tr>
<td></td>
<td>Hostile gestures</td>
<td>Showing any kind of hostile gestures (e.g. sarcastic tone of voice, reprehending, scolding)</td>
</tr>
<tr>
<td>Maternal Sensitivity</td>
<td>Very untrue</td>
<td>Rather untrue</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------</td>
<td>---------------</td>
</tr>
<tr>
<td>1. Monitors the child’s actions during the interaction</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2. Appears to tune out and not notice bids for attention (R)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3. Responds to the child’s distress and non-distress signals</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4. Non-synchronous interactions with the child, i.e., the timing of M’s behavior out of phase with the child’s behavior (R)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5. Is animated when interacting with the child</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>6. Realistic expectations regarding the child’s self-control of affect</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7. Responds to the child’s signals</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>8. Builds on the focus of the child’s attention</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>9. Distressed by the child’s demands (R)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>10. Display of affect does not match the child’s display of affect (e.g., smiles when the child is distressed) (R)</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maternal Autonomy support</th>
<th>Very untrue</th>
<th>Rather untrue</th>
<th>Neither True nor False</th>
<th>Rather true</th>
<th>Very true</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Intervenes according to the child’s needs and adapts the task to create an optimal challenge</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Encourages the child in the pursuit of the task, gives useful hints and suggestions, and uses a tone of voice that communicates to the child that she is there to help</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Takes the child’s perspective and demonstrates flexibility in her attempts to keep the child on task</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Follows the child’s pace, provides the child with the opportunity to make choices, and ensures that the child plays an active role in the completion of the task</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

* (R) = reverse-coding required when calculating the total score and the average
Table 4  
*Analysis protocol for child behaviors*

<table>
<thead>
<tr>
<th>Child’s Behaviors</th>
<th>Level 1</th>
<th>Description of behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Correct</strong>*</td>
<td>Correct-pickup</td>
<td>Selecting a correct piece</td>
</tr>
<tr>
<td></td>
<td>Correct-placement</td>
<td>Placing the piece at a right spot</td>
</tr>
<tr>
<td></td>
<td>Correct-answer</td>
<td>Answering a question correctly</td>
</tr>
<tr>
<td><strong>Incorrect</strong>*</td>
<td>Incorrect-pickup</td>
<td>Selecting an incorrect piece</td>
</tr>
<tr>
<td></td>
<td>Incorrect-placement</td>
<td>Placing the piece at a wrong spot</td>
</tr>
<tr>
<td></td>
<td>Incorrect-answer</td>
<td>Answering a question incorrectly</td>
</tr>
<tr>
<td><strong>Irrelevant</strong></td>
<td>Irrelevant behaviors</td>
<td>Showing irrelevant behaviors</td>
</tr>
<tr>
<td></td>
<td>Irrelevant utterances</td>
<td>Making irrelevant utterances</td>
</tr>
<tr>
<td><strong>Struggle</strong></td>
<td>Struggling signs</td>
<td>Keep searching with no achievement</td>
</tr>
<tr>
<td></td>
<td>Asking questions</td>
<td>Asking questions</td>
</tr>
<tr>
<td></td>
<td>Asking for help</td>
<td>Any signs of asking for help (saying “difficult”)</td>
</tr>
<tr>
<td><strong>Reassurance</strong></td>
<td>Asking for reassurance</td>
<td>Any signs of asking for reassurance for his/her current actions (e.g., looking at his/her Mom to seek reassurance)</td>
</tr>
<tr>
<td><strong>Expressing Opinions</strong></td>
<td>Suggesting</td>
<td>Suggesting what to do next or participating in the activity</td>
</tr>
<tr>
<td></td>
<td>Signaling next steps/intentions</td>
<td>Explicitly or implicitly revealing his/her intentions or plans, say, of what to do next</td>
</tr>
<tr>
<td><strong>Agreeing</strong></td>
<td>Agreeing with his/her Mom</td>
<td></td>
</tr>
<tr>
<td><strong>Disagreeing</strong></td>
<td>Disagreeing with his/her Mom</td>
<td></td>
</tr>
<tr>
<td><strong>Refusing to do the task</strong></td>
<td>Explicitly refusing to do/keep doing the task</td>
<td></td>
</tr>
<tr>
<td>Score</td>
<td>Description of the corresponding levels of child performance</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Can finish the first puzzle within 10 minutes&lt;br&gt; Rarely depend on Mom’s help (perform above 80% of the task independently) (=21 to 25 pieces)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Can finish above 80% of the first puzzle within 10 minutes&lt;br&gt; Perform between 61% and 80% of the task independently without Mom’s help (=16 to 20 pieces))</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Can finish above 50% of the puzzle within 10 minutes&lt;br&gt; Struggling somewhat but being able to keep going with Mom’s help (independent performance: between 41% to 60% (=11 to 15 pieces)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Mostly count on Mom’s help throughout the task (between 20% and 40% of the task (=6 to 10 pieces))</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Cannot progress without Mom’s help (independent performance (=0~5 pieces))&lt;br&gt; Consistently displaying explicit signs of struggle throughout the task (e.g., losing attention from the task, asking for help, saying “difficult”)</td>
<td></td>
</tr>
</tbody>
</table>
Table 6
*Inter-coder Reliability for the Observed Mother-child Interactional Behaviors*

<table>
<thead>
<tr>
<th></th>
<th>Cohen’s Kappa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal cognitive scaffolding</td>
<td>Mean: 0.96 (Max: 0.98/Min: 0.94)</td>
</tr>
<tr>
<td>Maternal emotional scaffolding</td>
<td>Mean: 0.96 (max: 0.99/min: 0.93)</td>
</tr>
<tr>
<td>Maternal controlling behaviors</td>
<td>Mean: 0.95 (Max: 0.99/Min: 0.91)</td>
</tr>
<tr>
<td>Child’s correct performance</td>
<td>Mean: 0.92 (Max: 0.96/Min: 0.86)</td>
</tr>
<tr>
<td>Child’s incorrect performance</td>
<td>Mean: 0.97 (Max: 0.99/Min: 0.96)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Intra-class Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rating of maternal sensitivity</td>
<td>0.85</td>
</tr>
<tr>
<td>Rating of maternal autonomy support</td>
<td>0.74</td>
</tr>
</tbody>
</table>

*Note.* Kappa was calculated for frequency-based measures (maternal cognitive and emotional scaffolding & controlling behaviors and children’s correct and incorrect performances) while ICC (intra-class correlation) for rating-based measures (maternal sensitivity and autonomy support).
### Table 7
**Descriptive Statistics of Parenting, Child Temperament & Developmental Outcomes**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
<th>Cronbach’s Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parenting Styles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Authoritative Parenting</td>
<td>3.76</td>
<td>0.37</td>
<td>2.92</td>
<td>4.67</td>
<td>0.78</td>
</tr>
<tr>
<td>Authoritarian Parenting</td>
<td>2.23</td>
<td>0.42</td>
<td>1.42</td>
<td>3.13</td>
<td>0.81</td>
</tr>
<tr>
<td><strong>Temperament</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anger/Frustration</td>
<td>3.60</td>
<td>0.69</td>
<td>2.31</td>
<td>5.23</td>
<td>0.82</td>
</tr>
<tr>
<td>Unsoothability</td>
<td>3.42</td>
<td>0.52</td>
<td>2.23</td>
<td>4.69</td>
<td>0.72</td>
</tr>
<tr>
<td><strong>Executive Functions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhibitory Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daynight</td>
<td>13.13</td>
<td>2.20</td>
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Table 9
Zero-order Correlations among Child Temperament, Authoritative and Authoritarian Parenting, Observed Maternal Behaviors, Child Outcomes, and Socio-demographics

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Note. †p<.10, *p<.05, **p<.01, ***p<.001; N=78-80
Table 10
Zero-order Correlations among Composites (EF, Parenting, & Negative Emotionality), Child Outcomes (Puzzle Performance, & Vocabulary), Child’s age and sex, and Socio-demographics

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*Note. †p<.10, *p<.05, **p<.01, ***p<.001; Ns are 77-80; a: 0=boy, 1=girl
Table 11
Regression Models Predicting EF Composites and Performance on a Spatial Cognitive Task

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<td>P</td>
<td>p&lt;.000</td>
<td>p&lt;.05</td>
<td>P</td>
</tr>
</tbody>
</table>

Note. †p≤.1, *p≤.05, **p≤.01, ***p≤.001
Table 12
Regression Models Predicting Authoritarian Parenting

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Model G β</th>
<th>Model H β</th>
<th>Model I β</th>
<th>Model J β</th>
<th>Model K β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anger proneness</td>
<td>0.25***</td>
<td></td>
<td>0.16**</td>
<td>0.15**</td>
<td></td>
</tr>
<tr>
<td>Unsoothability</td>
<td>.11</td>
<td></td>
<td></td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Authoritative</td>
<td></td>
<td>-.65***</td>
<td>-.57***</td>
<td>-.57***</td>
<td></td>
</tr>
<tr>
<td>parenting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>0.16</td>
<td>0.02</td>
<td>0.33</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>F</td>
<td>15.38</td>
<td>1.46</td>
<td>38.31</td>
<td>25.48</td>
<td>16.96</td>
</tr>
<tr>
<td>(df)</td>
<td>(78)</td>
<td>(78)</td>
<td>(78)</td>
<td>(77)</td>
<td>(76)</td>
</tr>
<tr>
<td>P</td>
<td>&lt;.001</td>
<td>0.231</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

*Note. †p≤.1, *p≤.05, **p≤.01, ***p≤.001*
Table 13
*Regression Models Predicting Authoritarian Parenting with Interaction between Anger Proneness and Unsoothability*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Model L β</th>
<th>Model M β</th>
<th>Model N β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anger proneness</td>
<td>.24***</td>
<td>-.57</td>
<td>-.53</td>
</tr>
<tr>
<td>Unsoothability</td>
<td>.02</td>
<td>-.83*</td>
<td>-.66†</td>
</tr>
<tr>
<td>(Anger) × (Unsoothability)</td>
<td>.24*</td>
<td>.20*</td>
<td></td>
</tr>
<tr>
<td>Authoritative parenting</td>
<td></td>
<td></td>
<td>-.55***</td>
</tr>
<tr>
<td>R²</td>
<td>0.17</td>
<td>0.21</td>
<td>0.44</td>
</tr>
<tr>
<td>F</td>
<td>7.62</td>
<td>6.91</td>
<td>14.45</td>
</tr>
<tr>
<td>(df)</td>
<td>(77)</td>
<td>(76)</td>
<td>(75)</td>
</tr>
<tr>
<td>P</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

*Note.* †p ≤ .1, *p ≤ .05, **p ≤ .01, ***p ≤ .001
Table 14
Regression Models Predicting EF Composites and Performance on a Cognitive Task with Interactions between Parenting Style and Negative Emotionality

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Memory/Attention composite</th>
<th>Behavioral Inhibition composite</th>
<th>Performance on a Cognitive Task</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model O β</td>
<td>Model P β</td>
<td>Model Q β</td>
</tr>
<tr>
<td>Parenting Style (composite)</td>
<td>.09</td>
<td>1.43</td>
<td>- .43*</td>
</tr>
<tr>
<td>Negative Emotionality (NE)</td>
<td>- .50†</td>
<td>.05</td>
<td>.03</td>
</tr>
<tr>
<td>(Parenting Style) × (NE)</td>
<td>- .42</td>
<td>- .05</td>
<td>-1.07*</td>
</tr>
<tr>
<td>R²</td>
<td>0.00</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>F</td>
<td>0.17</td>
<td>2.81</td>
<td>1.22</td>
</tr>
<tr>
<td>(df)</td>
<td>(75)</td>
<td>(75)</td>
<td>(73)</td>
</tr>
<tr>
<td>P</td>
<td>0.58</td>
<td>0.17</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Note. †p≤.1, *p≤.05, **p≤.01, ***p≤.001
Table 15

**Regression Models Predicting Parenting Style with Interaction between Maternal Education and Negative Emotionality**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Model X</th>
<th>Model Y</th>
<th>Model Z</th>
<th>Model AA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Education</td>
<td>-.04</td>
<td>-.06</td>
<td>-2.73**</td>
<td></td>
</tr>
<tr>
<td>Negative emotionality (composite)</td>
<td>-.46**</td>
<td>-.47**</td>
<td>-3.27**</td>
<td></td>
</tr>
<tr>
<td>(Maternal Edu) × (NE)</td>
<td></td>
<td></td>
<td></td>
<td>.77**</td>
</tr>
<tr>
<td>R²</td>
<td>0.00</td>
<td>0.10</td>
<td>0.11</td>
<td>0.20</td>
</tr>
<tr>
<td>F</td>
<td>0.10</td>
<td>8.88</td>
<td>4.59</td>
<td>6.12</td>
</tr>
<tr>
<td>(df)</td>
<td>(78)</td>
<td>(78)</td>
<td>(77)</td>
<td>(76)</td>
</tr>
<tr>
<td>P</td>
<td>0.72</td>
<td>p&lt;.01</td>
<td>p&lt;.05</td>
<td>p&lt;.001</td>
</tr>
</tbody>
</table>

*Note. *p ≤.1, *p ≤.05, **p ≤.01, ***p ≤.001*
Solid lines represent children having no susceptibility factor while dotted lines those having susceptibility factor; Model b depicts a case in which moderation effects by a susceptibility factor are absent—that is, environmental influence does not affect the developmental outcome while two groups display different outcomes.

Figure 1

*Graphical Display of Differential Susceptibility in Comparison with Other Moderation Effects* (Source of Models a, b, & c: Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2007; Source of Model d: Bakermans-Kranenburg, & van IJzendoorn, 2007)
Note. RQ1 concerns associations between both general and interactional parenting and children’s EF and performance on a spatial cognitive task, in spite of one arrow between them to reduce visual complexity. Children’s inhibitory control and delay of gratification were dropped from the analyses due to observed ceiling performance among participant children (discussed in the results section), thus not being included in the figure.

Figure 2
The Conceptual Map between Main Study Variables and Research Questions
Figure 3
*Pictures of the Cube Puzzle Used for the Observation of Mother-Child Interactions*
Note. A black solid line represents children with anger proneness above the mean (+1SD and +2SDs; n=23), and a gray line represents children with anger-proneness below the mean (-1SD and -2SDs) (n=27). Authoritarian parenting was assessed on a 5-point scale, with 1=never and 5=always.

Figure 4
Moderating Effects of Anger proneness in Relations between Unsoothability and Authoritarian Parenting
Note. NE=Negative Emotionality; A parenting style composite is the difference between authoritative & authoritarian parenting (“authoritative parenting (average)” minus “authoritarian parenting (average)”), with mean of 1.5 and standard deviation of 0.7.; Children’s performance on a puzzle task was rated on 5 point scale with higher scores meaning children’s performance depending on mothers’ help to a lesser degree within the given time (10 minutes). The respective number of children for each negative emotionality group is: 1SD & 2SDs below the mean (n=20), the mean (n=35), & 1SD & 2SDs above the mean (n=25).

Figure 5
Moderating Effects of Negative Emotionality in Relations between Parenting and Performance on a spatial cognitive task
A negative emotionality composite is the average of anger proneness & unsoothability, with mean of 3.5 and standard deviation of about 0.5; A parenting style composite is the difference between authoritative & authoritarian parenting (“authoritative parenting (average)” minus “authoritarian parenting (average)”), with mean of 1.5 and standard deviation of 0.7. There were 19 mothers having 2 year-college degrees and 47 mothers and 11 mothers with 4-year-college and graduate degrees respectively.

Figure 6
Moderating Effects of Maternal Education in Relations between Children’s Negative Emotionality and Parenting Style