

LINKING PARENTAL AUTONOMY SUPPORT AND PARENTAL STRUCTURE  
TO THE DEVELOPMENT OF INHIBITORY CONTROL IN 4-YEAR-OLDS

by

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(Under the Direction of Hui-Chin Hsu)

ABSTRACT

This study examined the main and joint effects of maternal autonomy support(AS) and maternal structure(ST) on preschoolers' inhibitory control, as well as the moderating effect of child emotional negativity on the relationship between parenting and preschoolers' inhibitory control. No significant main or joint effects of autonomy support and structure on child inhibitory control were found. However, child emotional negativity significantly moderated the effect of autonomy support in the etch-a-sketch task on preschooler's inhibitory control. Children high (vs. low or average) in emotional negativity displayed the highest or lowest inhibitory control when mothers displayed high or low autonomy support, respectively. A person-centered analysis revealed two clusters of mothers based on patterns of autonomy support and structure; preschoolers with mothers high in AS and ST had higher inhibitory control, whereas preschoolers with mothers low in AS and ST. Self-determination theory and the differential susceptibility hypothesis are discussed in relation to the findings.

INDEX WORDS: Inhibitory control, Autonomy support, Structure, Parenting, Preschoolers, Emotional Negativity, Joint effect, Context specific parenting, Moderation, cluster analysis, differential susceptibility, self-determination theory, person-centered approach

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B.S., The University of Georgia, 2010

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial  
Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE

ATHENS, GEORGIA

2012

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December 2012

## ACKNOWLEDGEMENTS

There are many people, both in and out of academia, whom I should thank and acknowledge; I shall try to name a few. Firstly, I must express my gratitude to Dr. Hui-Chin Hsu, without whom this thesis would not be. I truly appreciate your mentorship and cannot believe how far I've come as a researcher under your tutelage (though the ride is far from over). Thank you for your patience, your encouragement, your advice, and perhaps most of all, your wise guidance for my naïve and hopelessly idealistic mind. I would also like to thank Drs. Wickrama and Shaffer for their kind words of advice, nourishing encouragement, and amazing opportunities for academic growth. And thank you to Dr. Lewis, whose timely support and unsparing kindness is inexpressibly appreciated. Many thanks to Dianne, Carly, and the participants of this project; without your help, the study would not be complete.

To my closest friends, thank you for your ears, your hugs, your beers, and your love. I don't know how I found you, but I'm so very glad I did.

To my family, I love you always. Without you, I would not be where I am or who I am today. Everything I do, I do for you.

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## CHAPTER 1: INTRODUCTION

Inhibitory control refers to one's ability to control and filter thoughts, impulses, and behaviors. It is a component of higher order cognitive skills known as executive function (Center for the Developing Child at Harvard University (CDCHU), 2011). Together with the ability to hold important information for short-term use (i.e., working memory) and the ability to adapt to quickly changing external contexts (i.e., cognitive flexibility), these are the three basic components of executive functioning that work in conjunction. These foundational cognitive processes develop rapidly in the earlier years of life. The preschool years (i.e., 3 – 5 years) are particularly sensitive to growth (CDCHU, 2011).

Individual differences in executive function in general and inhibitory control in specific are linked to a variety of developmental outcomes. For example, higher executive function abilities in 4-5 year olds are associated with higher academic achievement in China and the U.S. (Lan, Legare, Ponitz, Li, & Morrison, 2011). Specifically, higher inhibitory control in preschoolers has been linked to higher mathematical abilities (Espy, McDiarmid, Cwik, Stalets et al., 2004). By contrast, deficits in executive function abilities are strongly linked to childhood onset psychological disorders (e.g., ADHD and OCD) (Zelazo & Muller, 2010), externalizing behaviors, impulsivity, cognitive difficulties, and/or problems in behavioral adjustment (Belsky, Feron, & Bell, 2007; Eisenberg, Cumberland, Spinrad, Fabes et al., 2001; Eisenberg, Spinrad, Fabes, Reiser et al., 2004; Hughes & Ensor, 2011; Logan, Schachar,

& Tannock, 1997). Given its developmental significance, this study focused on inhibitory control in 4-year-olds and the correlates of individual differences at this age.

A number of child, parental, and family factors have been shown to be associated with the development of inhibitory control. Higher family socioeconomic status is positively associated with better executive function in 8- to 12-year-old children. Extreme poverty, on the other hand, can inhibit growth of inhibitory control across the preschool years (Hughes & Ensor, 2007; Moilanen, Shaw, Dishion, Gardner et al., 2010; Raver, 2004; Sarsour, Sheridan, Joute, Nuru-Jeter et al., 2011). With respect to child characteristics, child verbal ability is significantly linked to better executive function abilities in general (Hughes & Ensor, 2007). Child gender may also play a role, as girls have been found to outperform boys in inhibitory control tasks (Kochanska, Murray, & Harlan, 2000). Child age is important to consider as well; as children get older, inhibitory control functions improve (Carlson, 2005).

In addition, several studies also suggest that parenting characteristics are important antecedents in the development of inhibitory control. Generally, parenting behaviors that reflect positive engagement, involvement, and structured and sensitive guidance are linked to promotion of executive function abilities, including inhibitory control (Hammond, Muller, Carpendale, Bibok, & Liebermann-Finestone, 2011; Karreman, de Haas, van Tuijl, van Aken et al., 2010; Moilanen et al., 2010). Characteristics of positive parenting such as warmth, sensitivity, responsiveness, and autonomy support have also been found to be positively associated with children's self-regulation, including inhibitory control and other executive functions (Bernier, Carlson, & Whipple, 2010; Grolnick & Farkas, 2002; Jennings, Sandberg, Kelley, Valdes, Yaggi

et al., 2008; Rodriguez, Ayduk, Aber, Mischel et al., 2005; Spinrad, Eisenberg, Gaetner, Popp et al., 2007). Studies have shown that parental scaffolding, specifically, autonomy support, promotes executive function development in preschoolers, even after controlling for child language ability (Bernier et al., 2010; Matte-Gagne & Bernier, 2011). In contrast, characteristics of negative parenting such as harshness, intrusiveness, high control, and negligence have been found to have a negative association with children's self-regulatory competence (Finkenauer, Engles, & Baumeister, 2005; Grolnick & Farkas, 2002; Kim, Ge, Brody, Conger et al., 2003; Wang, Pomerantz, & Chen, 2007).

Previous studies have often examined different parenting characteristics in the development of executive function, but without a theoretical guide. Recent research has begun to consider the usefulness of a self-determination theory framework in understanding the role of parenting in the development of executive function (e.g., Bernier et al., 2010). This theory was originally established as a macro-theory relevant across the lifespan by Deci and Ryan (1985) who asserted the importance of autonomy, relatedness, and competence as three fundamental human needs.

Grolnick, Kurowski, and Gurland (1999) extended these concepts to early childhood and posited that children need autonomy, relatedness, and competence for the development of self-regulation (Grolnick & Farkas, 2002; Deci & Ryan, 1985). When applying this concept to early development, unique relationships between each child need and specific parenting behaviors have been proposed. Specifically, parental autonomy support (or low intrusiveness and control) is related to the development of autonomy and independence, whereas parental structure helps the development of competence or mastery (Farkas & Grolnick, 2010; Grolnick et al., 1999). Finally, it has been suggested

that parental warmth is linked to relatedness as it instills a sense of connection to the surrounding social environment and individuals (Kagitcibasi, 2005). The development of autonomy and competence appear to be essential to children's executive function abilities (Bronson, 2000; Joussemet, Landry, & Koestner, 2008). Guided by the self-determination theory, this study examines parental autonomy support and parental structure as important contributors to 4-year-olds' inhibitory control development.

When examining the contribution of teachers' behaviors to students' self-regulation in learning, educational research has demonstrated that there is a synergistic relationship between autonomy support and structure (Sierens, Vansteenkiste, Goossens, Soenens et al., 2009). The co-occurrence of autonomy support and structure in teachers has the greatest impact on students' self-regulated learning as compared to the presence of either autonomy support or structure alone. Similarly, the joint effect of high parental support and high parental structure has also been found to be associated with different child outcomes such as autobiographical memory (Cleveland & Reese, 2005) and language skills (Britto, Brooks-Gunn, & Griffin, 2006). It was expected that these two parenting attributes would work in tandem in their contribution to children's inhibitory control development. Thus, the first aim of this study was to investigate the independent and joint effects of parental structure and parental autonomy support on inhibitory control in 4-year-olds.

Child temperament, which is comprised of innate and stable individual characteristics within the child, can have an important influence on parent-child interactions (Putnam, Sanson, & Rothbart, 2002). Current research indicates that child temperament can moderate the link between parenting behaviors and developmental

outcomes. Child emotional negativity is an important potential moderator during early childhood. Children high in emotional negativity are irritable and likely to be quick to anger, frustration, and sadness (Eisenberg, Valiente, Spinrad, Cumberland et al., 2005; Pluess & Belsky, 2011). Further, such highly emotionally negative children are likely to be more sensitive to negative parenting (e.g. overcontrol or intrusiveness) (Morris, Silk, Steinberg, Sessa et al., 2002; Pluess & Belsky, 2010). For example, emotional negativity moderated the impact of sensitive parenting such that elementary grade children who were high in emotional negativity, compared with those low in negativity, had the worst academic achievement outcomes when parents had exhibited low sensitivity (Pluess & Belsky, 2010).

A more recent study by Kim and Kochanska (2012) also demonstrated the moderating effect of child emotional negativity; highly emotionally negative infants, compared to less emotionally negative infants, had the worst effortful control and compliance abilities when parents were not supportive, uncoordinated, and insensitive. It should be noted that recent research demonstrates that the same highly emotionally negative children are also likely to be more sensitive to positive parenting (e.g., autonomy support or sensitivity) (Kim & Kochanska, 2012; Pluess & Belsky, 2010).

In sum, research shows that child emotional negativity likely alters the nature of the relationship between parenting behaviors and child outcomes. Thus, this study examined child emotional negativity as a potential moderator in the parenting-inhibitory control link. Specifically, it was expected that high emotional negativity (vs. low) would reduce the beneficial effect of parental autonomy support and parental structure on 4-year-olds' inhibitory control.

Parenting behaviors vary according to social contexts. For example, parents may exert greater control in a dangerous environment for the sake of the child's safety, or when parents perceive their child to be overly unruly relative to the social situation (e.g., throwing a tantrum in the grocery store). In observing parenting behaviors that reflect autonomy support and structure, previous studies have successfully used the puzzle game and etch-a-sketch game as parent-child dyadic interaction settings (Britto et al., 2006; Eley, Napolitano, Lau, & Gregory, 2010; van der Mark, Bakermans-Kranenburg, & van Ijzendoorn, 2002). These two social contexts present opportunities for the parent to be controlling or autonomy supportive of the child's behaviors (van der Mark et al., 2002), as well as opportunities for the parent to structure child's actions according to the task at hand (Eley et al., 2010). Thus, this study observed maternal behaviors when playing puzzle and etch-a-sketch games with their 4-year-olds.

### **Purpose of the Study**

In summary, building upon previous research and using self-determination theory as a guiding theoretical framework, this study examined (1) the independent and joint effects of parental autonomy support and parental structure on 4-year-old's inhibitory control development, and (2) child emotional negativity as a potential moderator of the relationship between these two aspects of parenting and 4-year-olds' inhibitory control. It was hypothesized that (1) high maternal autonomy support and high maternal structure would be linked to the highest inhibitory control in 4-year-olds, whereas low parental autonomy support and low parental structure would be linked to the lowest inhibitory control in 4-year-olds, after controlling for the potential covariates such as maternal education, as well as child's sex, age, and language ability; and (2) high child emotional

negativity would reduce the beneficial contribution of parental autonomy support and parental structure to 4-year-olds' inhibitory control.

## CHAPTER 2: LITERATURE REVIEW

### **Executive Function Development in Preschool Aged Children**

Executive function focuses on the cognitive aspect of self-regulation, which is a larger, more comprehensive concept encompassing one's ability to regulate many aspects of the self, including emotional, behavioral, cognitive processes (Bronson, 2000; Kopp, 1982). Executive functioning has been considered in different arenas of research for several decades now, including neuropsychology (Welsh & Pennington, 1988), antisocial behaviors (Morgan & Lilienfeld, 2000), attention deficit and hyperactivity disorder (Wilcutt, Doyle, Nigg, Faroane et al., 2005). The early development of executive function is of most importance to this study, and is also a relatively younger branch of related research.

Researchers agree that executive function is a cognitive set of processes that act as control centers for thoughts and behaviors. There are three independent processes that function interactively or separately to the executive task at hand: working memory, cognitive flexibility, and inhibitory control (Best & Miller, 2010; CDCHU, 2011; Liew, 2011). *Working memory* is the capacity to which a child can remember a short term set of information, whether it be a phone number or set of directions to follow from the teacher (CDCHU, 2010). In the preschool years, working memory increases quickly between ages 3 to 5 and increases gradually beyond the preschool years until adulthood (Garon, Bryson, & Smith, 2008). *Cognitive flexibility* is the flexibility one has when being faced with differing sets of contextual rules (e.g., private vs. public social rules; CDCHU, 2010). Cognitive flexibility research considering the preschool years can be the most

complicated to untangle, as the shifting or flexibility required in cognitive flexibility often utilizes working memory and inhibitory control as well (see below for more details). Despite individual variations, children typically change from being able to hold single sets of mental rules at age 3 to being able to juggle differing, sometimes contradicting, sets of rules at age 5 (Garon et al., 2008). *Inhibitory control* is the ability to direct and filter thoughts and impulses that precede behavior, essentially the ability to inhibit one thought or reaction and express a thought or reaction that may be less dominant but more appropriate for the situation (CDCHU, 2010). Neurophysiological research suggests that the associations between abstract mental representation required for inhibitory control and the prefrontal cortex begin to appear in the preschool years (Garon et al., 2008). Preschoolers' inhibitory control abilities improve as they begin to be able to inhibit automatic or specific behavioral responses for longer periods of time.

Cross-cultural research further suggests that East Asian children's inhibitory control abilities are more advanced than those of European-American children (Oh & Lewis, 2008; Lan et al., 2011; Melendez, 2005). With theoretical implications of the role of socialization in the development of inhibitory control, these cross-cultural studies speak to the complex nature of executive function.

Executive function development between ages 3 to 5 is marked by rapid development (Bronson, 2000; CDCHU, 2011; Carlson & Wang, 2007; Garon et al., 2008; Kochanska, Murray, Jacques, Koenig, & Vandegest, 1996; Rhoades, Greenberg, & Comitrovich, 2009; Zelazo & Muller, 2010). During this developmental period, children have the ability to remember much more; they also have greater linguistic abilities and better control of their behavior and emotions (Bronson, 2000). Preschoolers also begin to

learn how to master self-initiated tasks and assigned tasks with greater persistence and organization (Bronson, 2000). These early achievements suggest great foundational development and potential internalization of specific motivational values that are essential in mastery of important goals later in life (e.g., academic- or career-related work) (Grolnick, 2009; Grolnick, Ryan, & Deci, 1991).

Due to rapid developmental change, researchers must choose measures carefully to avoid potential ceiling effects and lack of fit between conceptualization and operationalization (Carlson, 2005; Garon et al., 2008). Some researchers believe these executive functions to be best understood as separate constructs that have common underlying mechanisms but differing developmental trajectories (Diamond, 2006; Miyake, Friedman, Emerson, Witzki et al., 2000), whereas other researchers show that an aggregated measure, or a single dimension best measures executive function in early childhood (younger than 5 years) (Weibe, Sheffield, Nelson, Clark et al., 2011).

During the preschool years, executive function is typically studied as a composite variable of its subcomponents when related to developmental outcomes (e.g., Bernier et al., 2010; Clark, Pritchard, & Woodward, 2010; Hughes & Ensor, 2007). Studies considering executive function holistically (e.g., Hughes & Ensor, 2007) find strong links between higher executive function ability and better understanding of others' perspectives, as well as similar links to academic skills (Bernier et al., 2010; Clark et al., 2010). Each executive function (working memory, cognitive flexibility, and inhibitory control) has also been individually related to child developmental outcomes. As working memory incorporates the ability to hold important information during a brief time period or a short task, the developmental studies largely focus on academic outcomes (e.g.,

literacy and mathematical ability) when examining working memory. Better working memory is consistently linked with better academic oriented outcomes (Bull, Espy, & Wiebe, 2008; McClelland, Cameron, Connor, Farris et al., 2007; Noel, 2009). Cognitive flexibility has also shown its importance to developmental outcomes in similar arenas. Higher cognitive flexibility is significantly associated with language abilities (Deak, 2004) as well as the ability to understand other perspectives (i.e., theory of mind; Hughes & Ensor, 2007; Jacques & Zelazo, 2005). Inhibitory control, the focus of this study, has also been similarly linked to developmental outcomes in academic skills (Espy et al., 2004), theory of mind (Carlson, Moses, & Briton, 2002; Hughes & Ensor, 2007), and compliance (Dennis, 2006).

Understanding how the three separable components of executive function work in conjunction to aid the development of academic and social skills has been debated in the literature. Developmentally speaking, it may be that the executive function subcomponents specialize as they develop, but are still inextricably linked in early childhood (Wiebe, Johnson, Sheffield, Clark et al., 2012). Inhibitory control and working memory appear to emerge earlier than cognitive flexibility (Davidson, Amso, Anderson, & Diamond, 2006), suggesting that these two components may facilitate the development of cognitive flexibility (Best & Miller, 2010; Garon et al., 2008). Further, the stronger links of inhibitory control to theory of mind development, emotion regulation, and moral development over and above the influence of working memory (Carlson et al., 2002; Carlson & Wang, 2007; Dennis, 2006) suggests the salience of inhibitory control in both social and academic domains. Thus, this study focuses on the examination of individual

differences in inhibitory control and their correlates at age 4, a period of fastest growth and development.

Broadly speaking, there are many potential correlates of self-regulation development from gene by environment influences (Kochanska, Philibert, & Barry, 2009), to trait related influences (Martel, Nigg, Wong, Fitzgerald et al., 2007), and to biological stress reactivity (Obradović, Bush, Stamperdahl, Adler, & Boyce, 2010). However, specific characteristics of the child (e.g., age, sex, and temperament) and the parent (e.g., education, socioeconomic status, and parenting behaviors) are the proximal factors contributing to the early development of inhibitory control (Kopp, 1982; Bronson, 2000). Each of these proximal factors will be reviewed below.

### **Parental Autonomy Support and Parental Structure:**

#### **Linking Self-Determination Theory to Preschoolers' Inhibitory Control**

Shonkoff (2011) asserts that early childhood is a period with great potential for growth or stagnation, depending on external influences. Parents are an integral socializing agent for young children; they can provide proper opportunities for growth or can inadvertently delay development (Kopp, 1982). Specific to executive function development, recent research has shown the importance of maternal autonomy supportive behaviors (Bernier et al., 2010) and scaffolding behaviors (Hammond et al., 2011; Spinrad, Stifter, Donelan-McCall, & Turner, 2004). However, these two types of parental behaviors are examined often without a supporting theory as to why and how they facilitate children's inhibitory control, and whether they jointly contribute to children's inhibitory control. Self-determination theory provides insight into why and how these

parental behaviors may independently and jointly contribute to individual differences in children's inhibitory control.

### **Self-Determination Theory**

Self-determination theory was originally established as a macro-theory relevant across the lifespan (Deci & Ryan, 1985; Ryan & Deci, 2006). It posits that all humans innately need autonomy, competence, and relatedness for optimal individual self-regulation and well-being (Deci & Ryan, 1985; Ryan & Deci, 2000). Autonomy is characterized by having opportunities for self-direction, choice, and acknowledgement or validation of one's own feelings. Competence is characterized by feelings of self-mastery and confidence in one's abilities. Relatedness is characterized as being interconnected to significant others. Ryan and Deci (2000) theorized that the culmination of these needs results in intrinsic motivation of behaving and thinking according to self-endorsed beliefs and goals, which is optimal for individual functioning. Intrinsic motivation contrasts with extrinsic motivation, where one behaves according to externally prompted beliefs, goals, and rules. Empirical support shows direct links of autonomy and competence to intrinsically motivated and self-regulated behaviors (Ryan & Deci, 2000). For example, teachers who are autonomy supportive facilitate self-regulated behaviors for academic learning, which is reflective of the students' intrinsic motivation (Sierens et al., 2009).

Self-determination theory has been further extended into the developmental literature to guide the examination of early childhood environmental contexts that may be most conducive to the development of self-regulation. Building on Ryan and Deci's (1985) work, Grolnick, Kurowski, and Gurland (1999) expanded on the developmental process of achieving intrinsic motivation, which is necessary for optimal self-regulation.

They asserted that an environmental context that is supportive of the three innate psychological needs would best facilitate internalization and development of intrinsic motivation, and thus, of self-regulation. Given the hypothesized direct links to self-regulation development, parental autonomy support and parental structure address the children's needs of autonomy and competence, respectively.

Previous studies have demonstrated that the early development of self-regulation is linked to a range of parenting variables, including parenting styles (Calkins & Johnson, 1998), parental scaffolding (Spinrad et al., 2004; Hammond et al., 2011), maternal sensitivity, maternal mind-mindedness, and maternal autonomy support (Bernier et al., 2010; Bernier, Carlson, Deschenes, Matte-Gagne et al., 2012). Recent research on the early development of executive function in young children reveals that two specific dimensions of parenting are particularly salient: autonomy supportive behaviors and parental scaffolding behaviors, which are also considered as structuring behaviors (Farkas & Grolnick, 2010).

### **Parental Autonomy Support**

Recent updates to self-determination theory suggest that parental autonomy support, conceptualized as child-focused behaviors that promote independent thinking, exploration, and expression, addresses the need for autonomy, whereas negative parental control, marked by behaviors that are intrusive, controlling, and manipulative, denies the need for autonomy (Bernier et al., 2010; Dix, Steward, Gershoff, & Day, 2007; Grolnick et al., 1999; Grolnick, 2009; Grolnick & Pomerantz, 2009; Soenens, Vansteenskiste, & Sierens, 2009). Conceptually, these two parenting behaviors are considered opposites on a single dimension from low parental autonomy support/high parental control to high

autonomy support/low parental control (see Bernier, Whipple, & Carlson, 2010 for autonomy support example; see Lee, Yu, & Choi, 2010 for control example). Based on this conceptualization, several themes emerge as autonomy supportive behaviors (i.e., low control): providing of opportunities and choice to the child, encouraging a child's behaviors and task engagement, and taking a child-focused approach and perspective (Bernier et al., 2010). In contrast, several themes constitute low autonomy supportive behaviors (i.e., high control): interfering or attempting to control a child's thoughts or behaviors, manipulating a child's emotions, asserting power over the child, and using negative or critical comments that invalidate a child's behavior, competence, or emotions (Soenens & Vansteenkiste, 2010).

Empirical findings support the utility of self-determination theory in providing a theoretical understanding of the specific link of maternal autonomy support to children's executive function development. For example, Bernier, Carlson, and Whipple (2010) found maternal autonomy support to be the strongest predictor of executive function across three time points from ages 1 to 2 after controlling for parent education and child cognitive ability. The contribution of maternal autonomy support was above and beyond the effect of maternal mind-mindedness (i.e., maternal verbal reflections on child cognitive-related traits and behaviors) and maternal sensitivity (i.e., maternal appropriate and contingent response to child signal). In a subsequent study, Matte-Gagne and Bernier (2011) also found maternal autonomy support to be predictive of children's executive function even after controlling for child language ability. In these studies, maternal autonomy support was measured observationally by aggregating measures of sensitive intervention or guidance, encouragement, child-focused perspective taking, and provision

of opportunity. Finally, Neitzel and Stright (2003) found maternal education to be predictive of mothers' high autonomy support to their preschooler. Thus, maternal education was considered as a potential covariate in this study when examining the contribution of maternal autonomy support to 4-year-olds' inhibitory control.

### **Parental Structure**

According to self-determination theory, competence is an equally important need for children to develop self-regulation. Parental structure provides a systematic framework that allows children to achieve competence (Farkas & Grolnick, 2010). When investigating the role of parenting in children's academic performance, Farkas and Grolnick (2010) found a unique contribution of parental structure to adolescents' academic engagement. They proposed that parental structure is a multifaceted construct with 6 components. The first component is *clear and consistent rules, guidelines, and expectations*, marked by parents' informing of task or situation relevant rules, guidelines, and expectations. The second component is *predictability*, which involves parents to clearly and consistently express and uphold consequences and contingencies for deviant behaviors. The third component is *task-focused feedback*, whereby parents provide task-specific verbal constructive feedback to encourage competence. The fourth component is *provision of opportunity to meet expectations/guidelines*, marked by parents' efforts to provide opportunities within tasks that their child can be successful in, or by reducing distractions that would deter their child's success. The fifth component is *rationales*, whereby parents offer explanations for the rules and expectations in order to provide children with the proper information about how their behaviors will impact others and their own future. The sixth and final component is *authority*, whereby parents take a

diplomatic leadership role and is able to properly discern when they must interfere with the child's behavior in order to prevent further consequence, and when they should not. The provision of parental structure is expected to be qualitatively different for children at different ages. For example, parental authority relating to curfew and drug use is more pertinent to structure for adolescents, but authority relating to safety (i.e., fire hazards) or social behaviors (i.e., yelling in public) may be more pertinent to structure for preschoolers. Specific to inhibitory control, parental structure ideally provides a controlled and predictive, yet flexible environmental setting that is necessary for the development of children's inhibitory control (Bronson, 2000).

As described above, parental structure incorporates elements of nonintrusive and developmentally appropriate guidance, sensitive structuring, encouragement, positive engagement, and constructive feedback, all of which have been considered as elements of parental scaffolding or positive parental control (Farkas & Grolnick, 2010; Hammond et al., 2011; Moilanen et al., 2010; Neitzel & Stright, 2003). Maternal scaffolding at age 2, as characterized by positive control, encouragement, and guidance, was uniquely predictive of executive function at age 4 (Hughes & Ensor, 2009). Parental scaffolding at age 3, as characterized by appropriate and sensitive guidance, timing, and management of child's frustration, not only directly predicted children's executive function at age 4, but also indirectly predicted children's executive function through their verbal ability (Hammond et al., 2011). Parental positive behavior support, as characterized by structure, positive reinforcement, and engagement, was found to link to faster growth of inhibitory control in children from age 2 to age 4 (Moilanen et al., 2010). Together, these studies

indicate that maternal behaviors reflective of parental structuring support preschoolers' development of executive function, including inhibitory control.

Though the studies reviewed above address the idea of parenting as a multidimensional construct (Grusec & Davidov, 2010; Skinner, Johnson, & Snyder, 2005), they were not guided by a unified theoretical framework for justifying their focus on specific parenting dimensions, and often excluded *a priori* research hypotheses. Further, the two different parenting dimensions were examined and/or explained separately without considering the potential interaction between them. Guided by the self-determination theory, this study intended to explore how parental autonomy support and parental structure might independently and jointly contribute to children's inhibitory control at age 4.

### **The Joint Effect of Autonomy Support and Structure**

Self-determination theory contends that fulfillment of competence is only meaningful when buttressed with the fulfillment of autonomy (Ryan & Deci, 2000). Thus, the parenting behaviors (i.e., parental autonomy support and parental structure) that facilitate both competence and autonomy are expected to optimally facilitate an environment that addresses both needs, thereby contributing to self-regulatory processes, including inhibitory control. Several studies also indicate that such a joint effect of autonomy support and structure can provide a more precise understanding of how these behaviors influence children's development.

Sierens and colleagues (Sierens, Vansteenkiste, Goossens, Soenens et al., 2009) showed that the benefits of teachers' structure are contingent upon the presence of their high autonomy support for adolescents' self-regulated learning in a classroom setting.

The co-occurrence of autonomy support and structure in teachers had the greatest impact on students' self-regulated learning as compared to the presence of autonomy support or structure alone, showing that a student-centered focus that was supportive of autonomy while still maintaining optimum levels of structure that was contingent to the students' current abilities provided the highest levels of self-regulated learning. Farkas and Grolnick (2010) also noted that parental structure and parental autonomy support jointly linked to young adolescents' academic engagement, such that low parental autonomy combined with low parental structure was linked with the lowest child academic engagement. This joint effect of parental autonomy supportive behaviors and parental structure behaviors has been documented in middle childhood as well (e.g., Pratt, Green, Macvicar, & Bountrogianni, 1992).

When applying the self-determination theory framework to investigate the association of maternal behaviors with preschoolers' reminiscing, Cleveland and Reese (2005) focused on both the main effects and the joint effect of maternal autonomy support and structure. First, they found that maternal autonomy support and structure to be unique and separable components making significant contributions to autobiographical memory in preschoolers. They also found that the combination of maternal autonomy support with structure further contributed to preschoolers' autobiographical memories. When mothers used styles that combined high structure and high autonomy support, their preschoolers exhibited the most autobiographical memories in conversations. Children with mothers who used low support and low structure demonstrated the least amount of autobiographical memories.

Autonomy support and structure have also been shown to contribute to preschoolers' language skills. In a study with a sample of African-American mothers, Britto and colleagues (Britto, Brooks-Gunn, & Griffin, 2006) investigated mothers who used specific teaching strategies that reflected levels of autonomy support and structure with their preschoolers' during a puzzle game task. Three groups of mothers were identified: those who used autonomy support and structure behaviors (i.e., supportive and encouraging with guidance and direction), those who were low on support but high on structure (i.e., encouragement with guidance and direction), and those who were low on support and on structure. They found that preschoolers were more likely to have higher language abilities (i.e., expressive language use and vocabulary skills) and school readiness scores when their mothers used teaching styles that incorporated both structure and autonomy support as compared to preschoolers whose mothers used either low structure with high support or low support with low structure.

The salience of a joint contribution of parental autonomy support and parental structure has also been demonstrated in the preschool years for some self-regulatory behaviors (i.e., task persistence and help-seeking behavior). For example, when examining the interactions between preschoolers and their mothers during problem-solving tasks, Neitzel and Stright (2003) focused on maternal scaffolding behaviors that reflected both autonomy supportive behaviors as well as structure behaviors. Cognitive support (i.e., structure) was measured by the amount of guidance that the mother provided relating to ideas about task management, ideas that expanded the child's understanding of the task at hand, and rationales for why specific strategies might work. Emotional support (i.e., autonomy support) was indexed by the mother's encouragement

of her child to complete the task and mothers' ability to transfer of responsibility appropriately. They found that cognitive support and emotional support during the preschool visit jointly contributed to later help-seeking behaviors in the classroom, which was conceptualized as an indicator of self-regulation. Mothers who displayed high cognitive and high emotional support had children who later sought assistance when necessary in the classroom, whereas mothers who displayed high cognitive support but low or no emotional support had children who later did not seek assistance when necessary.

Based on the theoretical and empirical evidence for the joint effect of parental autonomy support and structure on a variety of positive developmental outcomes, this study was an attempt to extend the current literature on linking maternal autonomy support and structure to individual differences in children's inhibitory control at age 4. Based on the studies reviewed above, it was hypothesized that maternal autonomy support and maternal structure would separately and jointly contribute to preschoolers' inhibitory control such that high maternal autonomy support and high maternal structure would be linked to the highest inhibitory control, whereas low maternal autonomy support and low maternal structure would be linked to the lowest inhibitory control in 4-year-olds, even after controlling for the potential covariates of child's sex, age, and language ability, as well as maternal education.

### **The Role of Child Characteristics in Inhibitory Control Development**

Temperament, an innate and relatively stable behavioral style in children, is a crucial, albeit complicated, characteristic to consider in early development. Constituted by different dimensions at different developmental stages across the life course,

temperament has been extensively studied in infants and children. At the preschool age, three broader temperamental dimensions are often studied in relation to parenting characteristics: extraversion/surgency, effortful control, and negative affectivity (Rothbart, Ahadi, Hershey, & Fisher, 2001). Surgency reflects impulsivity, activity level, intensity of pleasure, and low shyness. Effortful control refers to high attentional focus, low attention shifting, and high behavioral inhibitory control. Negative affectivity or emotional negativity (Pluess & Belsky, 2010) is characterized by anger, fear, sadness, discomfort, and low soothability (Putnam et al., 2002). These aspects of temperament have been shown to relate to each other. For example, highly surgent children are less likely to display equally high levels of effortful control (Cipriano & Stifter, 2010), indicating that children high in surgency may be lower in effortful control. To understand the contribution of parenting behaviors to developmental outcomes, emotional negativity has been shown to play a moderating role. Thus this study focused on emotional negativity as the potential contributor of child temperament in the moderating the relationship between parenting and cognitive inhibitory control.

### **Emotional Negativity**

Children with high temperamental negativity are considered to be “difficult” (e.g., Bradley & Corwyn, 2008). They tend to be irritable and at risk for internalizing and externalizing problems (Bradley & Corwyn, 2008; Eisenberg et al., 2005; Karreman et al., 2010; van Zeijl, Mesman, Stolk, Alink et al., 2007). Children’s emotional negativity has also been associated with the absence of parental autonomy supportive or structure behaviors (Bates, Petit, Dodge, & Ridge, 1998).

Further, children high in emotional negativity seem to be more sensitive to negative parenting behaviors (i.e., insensitive guiding, intrusiveness) (Pluess & Belsky, 2010; Putnam et al., 2002) and may suffer greater deficits from low maternal structure and low maternal autonomy support. Studies show that child emotional negativity alters the relationship between parenting and children's externalizing and internalizing behaviors. Morris and colleagues (2002) found that child temperament moderated the link between negative parenting and externalizing problems. Specifically, greater parent-reported child anger and frustration strengthened the negative link between controlling parenting (i.e., low autonomy support) and children's externalizing behavior in first and second grade. In a larger longitudinal study by Gilliom and Shaw (2004), children's trajectories for internalizing and externalizing behaviors were jointly explained by child temperament and negative parental control from ages 1.5 to 6 across 4 time points. Highly negative children who had mothers who displayed high negative control (i.e., low autonomy support) had consistently high externalizing behaviors and increased internalizing behaviors across the four time points, whereas children low in negativity with high controlling mothers had overall lower levels of externalizing and internalizing behaviors. Bradley and Corwyn (2008) found similar relationships when examining infants from 1 to 54 months (4.5 years). High parental intrusiveness, expressions of anger, annoyance, and physical punishment predicted the highest externalizing behaviors in highly negative 4.5-year-old children compared to children with lower levels of negativity. Low parental sensitivity also predicted the highest externalizing behaviors in highly negative 4.5-year-old children when compared to children with lower levels of negativity.

Pluess and Belsky (2010) found that high parenting quality, as consisting of support for autonomy, constructive and sensitive guidance, non-intrusiveness, positive regard, and warmth aggregated across 5 time points between 6 and 54 months, was predictive of children's academic skills between the ages 10 to 11. Importantly, this relationship was stronger with children with a difficult temperament. When studying preschoolers who were born prematurely and with very low birth weight, Davis, Harris, and Burns (2010) found the effect of parental autonomy support on their attention regulation abilities was significantly moderated by emotional negativity. Relative to children with low emotional negativity, children with high emotional negativity showed greater improvements in attention regulation when their parents exhibited high autonomy support, however, they exhibited more deficits in attention regulation when their parents exhibited lower autonomy support.

Stright, Gallagher, and Kelley (2008) found negativity measured at 6 months together with parental supportive presence, hostility, and autonomy support at 30 months, 54 months, and in first grade jointly predicted children's social adjustment to school. Low autonomy support, supportive presence, and high hostility predicted the lowest academic competence, social skills, and quality of teacher-child relationship in children with a difficult temperament compared to children who were not considered difficult. The above studies show that child emotional negativity has been documented to moderate the relationship between parenting behaviors and a variety of developmental outcomes.

These studies together indicate that the contribution of parenting behaviors reflective of autonomy support and structure to child developmental outcomes is contingent on child emotional negativity, such that children high in emotional negativity

may strengthen the link of parenting to child developmental outcomes. While none of the above studies examine cognitive inhibitory control as the dependent variable, they do shed light onto how child emotional negativity may lessen the contributions of positive parenting behaviors. Thus, it was hypothesized that high (vs. low) child emotional negativity would reduce the beneficial contribution of maternal autonomy support and maternal structure to child cognitive inhibitory control.

In addition to child emotional negativity, child gender has also shown to be significantly associated with inhibitory control, such that girls tend to be better than boys at inhibitory control tasks (Kochanska et al., 2000; Kochanska, Coy, & Murray, 2001). Child language ability has also been shown to be a significant predictor of preschoolers' executive function performance (Hughes & Ensor, 2007). Therefore, child gender and language ability are potential covariates that need to be accounted for when examining parenting behaviors in relation to individual differences in inhibitory control development.

### **Current Study**

The purpose of this observational study was to examine the independent and joint contributions of maternal autonomy support and maternal structure to cognitive inhibitory control in preschoolers, while also considering child emotional negativity as a moderator to the relationship between parenting behaviors and 4-year-olds' inhibitory control. Based on the prior review, it was hypothesized that (1) maternal autonomy support and maternal structure would separately and jointly contribute to preschoolers' inhibitory control. High maternal autonomy support and high maternal structure was hypothesized to be linked to the highest inhibitory control in 4-year-olds, whereas low maternal

autonomy support and low maternal structure was hypothesized to be linked to the lowest inhibitory control in 4-year-olds, after controlling for the potential covariates of maternal education and child's sex, age, and language ability. Finally, (2) high child emotional negativity was hypothesized to reduce the beneficial contribution of maternal autonomy support and/or maternal structure to cognitive inhibitory control.

## CHAPTER THREE: METHODS

### **Participants**

As part of a larger longitudinal project, 84 mothers and their 4-year-olds (48 - 56 months; 47% girls) participated in the current study. The mothers were predominantly White (84%), middle-class, well-educated ( $M=16.4$  years; range= 9 – 27 years), married (93%), and from a southeastern suburban area. The children in this study were healthy and normally developing.

### **Procedure**

The mother-child dyad was greeted in the parking lot near the laboratory by a trained research assistant. Then the mother-child dyad was introduced to a playroom where the mother and her child engaged in interaction in a variety of contexts mimicking everyday situations, including free play, book reading, separation-reunion, snack time, and teaching puzzle and etch-a-sketch. This study focuses on observing mother-child interaction during the puzzle and etch-a-sketch tasks. The puzzle task lasted for about 5 – 7 minutes. Mothers were instructed to assist the child to complete a difficult puzzle that was slight beyond the child's age level. The etch-a-sketch task also lasted for 5 to 7 minutes. Mothers and children were to work together to recreate a simple picture of a one-story house with one window using an etch-a-sketch that was provided. An etch-a-sketch is a drawing toy that uses an internal drawing magnet controlled by two dials, one that coordinates vertical movement and one that coordinates horizontal movement. Mothers were directed to only use the right dial, which controls movement from right to

left of the drawing magnet. Children were instructed to only use the left dial, which controls vertical movement of the drawing magnet.

During the second hour of the visit, children were seated directly across the researcher alone in the playroom. A trained female research assistant conducted a variety of inhibitory control tasks with the child. In a different room, mothers completed a battery of questionnaires, including family demographics and child temperament. After completing the entire lab visit, the mother was given \$40 for compensation of time and to defray the transportation cost, and the child was given small toys throughout the lab visit. The entire visit was videotaped for later behavioral coding and speech transcription.

## **Measures**

### **Covariates**

Mothers' years of education and child's sex, age, and verbal ability were measured to be used as potential control variables. Children's verbal ability was measured by computing the mean length of utterances (MLU) based on the verbatim transcripts of maternal and child speech during puzzle and etch-a-sketch tasks. MLUs have previously been used as an indicator of sophistication of preschoolers' expressive language ability (Crain-Thoreson & Dale, 1992; Hughes, 1998). MLU is calculated using a program called CLAN (Computerized Language ANalysis; see MacWhinney, 2011).

### **Maternal Parenting Behavior Measures**

Maternal behaviors of autonomy support and structure were coded during the puzzle and etch-a-sketch tasks. Previous studies have successfully used these two contexts to measure parental autonomy supportive behaviors and structuring behaviors,

as these two contexts present situations where the parents have opportunities to express a range of behaviors (Eley et al., 2010; van der Mark et al., 2002).

*Maternal autonomy support.* Autonomy support refers to mother's dialogue and behavior that (1) take child's interests into account, (2) promote independent expression, thinking, and decision-making, and (3) facilitate self-initiated exploration, expression, and action based upon the child's true interests. Autonomy support and control are conceptualized as the two opposite poles of a continuum. High maternal autonomy support indicates low maternal control, and low maternal autonomy support indicates high maternal control.

Autonomy support in mothers was evaluated on 7 different components every 30 seconds using a 4-point scale: (1) *provision of initiative*, whereby the mother provides opportunities for the child to attempt a new activity or task; (2) *expansion*, whereby the mother encourages or expands on the child's current activity or conversation; (3) *constraint*, whereby the mother attempts to interfere with the child's current activity or conversation; (4) *validation*, whereby the mother encourages or validates the child's feelings, abilities, and/or motives, (5) *manipulation*, whereby the mother assertively changes or constrains the child's feelings or focuses on her own emotions; (6) *power assertion*, whereby the mother forces the child to continue on the task or otherwise controls the task by asserting power, and (7) *critical correction*, whereby the mother criticizes and disapproves of the child's behavior, competence, and/or sense of self. Table 1 provides a brief summary of the 7 behavioral components of maternal autonomy support.

The scores of these 7 components were standardized then averaged to create an overall autonomy support measure. The scores for maternal constraint, manipulation, power assertion, and critical correction were reversed when creating the composite score. The reliability measures of internal consistency indexed by Cronbach's  $\alpha$  were .79 and .77 for the puzzle and etch-a-sketch tasks, respectively. Twenty percent of the sample was randomly selected and coded independently by another trained coder for inter-rater reliability checking. The single-measure intra-class correlations were both .91 for the puzzle and etch-a-sketch tasks.

*Maternal structure.* Maternal structure refers to mothers' statements and/or actions that provide sensible scaffolding and guidance to the child, enabling him/her to perform optimally and/or complete the task. Seven different components of maternal structure were evaluated every 30 seconds using a 4-point scale: (1) *clarity of guidelines*, whereby the mother provides clear and appropriate guidance for child's behavior; (2) *coordination/appropriateness*, whereby the mother times her assistance appropriately so that her assistance matches her child's needs; (3) *informative feedback*, whereby the mother monitors the child's actions and provides appropriate verbal feedback about correct or desired behaviors; (4) *opportunity*, whereby the mother structures the environment or task for the success of the child; (5) *rationale*, whereby the mother provides explanations for requests, expectations, goals, and consequences; (6) *resourceful leadership*, whereby the mother engages the child in the task using age-appropriate, creative, and adaptive strategies, and (7) *consistency*, whereby the mother consistently and appropriately reminds and repeats guidance and expectations of the task. Consistency was measured as a global measure on a scale from 1 to 10, across all 30-second intervals

in a single task due to the nature of the concept. These categories have been constructed based off of the earlier descriptions of structuring behaviors exhibited by mothers and teachers (Britto et al., 2006; Farkas & Grolnick, 2010; Neitzel & Stright, 2003; Sierens et al., 2009). Table 1 provides a brief summary of the 7 behavioral components of maternal structure.

The scores of the 7 components were standardized then averaged to create an overall structure measure. The reliability measures of internal consistency indexed by Cronbach's  $\alpha$  were .90 and .91 for the puzzle and etch-a-sketch tasks, respectively. Twenty percent of the sample was randomly selected and coded independently by another trained coder for inter-rater reliability checking. The single measure intra-class correlations were both .44 for the puzzle and etch-a-sketch tasks. The low inter-rater reliability may suggest the need for a more rigorous training in coding maternal structure, rather than problems in the coding system. Maternal structure as measured with this coding system has significantly correlated with several linked concepts in observed measures in the larger longitudinal project that the current study stems from. For example, greater maternal structure observed during the etch-a-sketch task at age 4 was significantly correlated ( $r=.30, p<.05$ ) with maternal structure in free play at 12 months of age as measured in the larger longitudinal project using the Emotional Availability Scales (Biringen, Robinson, & Emde, 2000). Maternal verbal communication acts of informing (e.g., giving related information) observed during pretend play at 30 months of age was also significantly correlated with greater maternal structure observed during the puzzle task at age 4 ( $r=.29, p<.05$ ).

Table 1

*A Brief Summary of the Behavioral Components in Maternal Autonomy Support  
and Maternal Structure*

<i>Composite Variable</i>	<i>Behavioral Component</i>	<i>Definition</i>
Autonomy support	Promotion of initiative	How mothers support children's initiative and choices (Bernier et al., 2010; Grolnick, 2009)
	Expansion	How mothers expand on and respond to child's current activity or dialogue (Cleveland & Reese, 2005)
	Constraint	Mothers' unintentional or intentional altering child's activity or verbal expression (e.g., interrupting child's attention to mother's preferences) (Grolnick, 2009)
	Validation	How mothers encourage or validate child's feelings, abilities, motivations, or perspective
	Manipulation	How mothers attempt to change or constrain child's emotional state (e.g., ignoring child's feelings) (Grolnick & Pomerantz, 2009)
	Power assertion	How mothers attempt to control task, task materials, or child's action through physical or verbal tactics (Degnan et al., 2008)
	Critical correction	How mothers execute corrections, particularly if the corrections negatively focus on child's personality or sense of self instead of on child behaviors (Grolnick & Pomerantz, 2009)
Structure	Clarity/ specificity of guidelines	How clear and specific mothers' guidelines are (Farkas & Grolnick, 2010)
	Coordination/matching	How mothers coordinate, or match, their guidelines and assistance according to child's need or ability
	Informative feedback	How mothers provided feedback on child's task-specific actions (i.e., discussing progress in relation to overall task; Neitzel & Stright, 2003)

Opportunity	How mothers create opportunities for child to be successful (e.g., placing etch-a-sketch comfortably at child's vision level)
Rationale	Mothers' provision of rationale or explanation of task goals (i.e., why turning the dial left moves the etch-a-sketch cursor to the left)
Resourceful leadership	Mothers' flexibility and inventiveness in engaging or reengaging child to task (e.g., pointing to the picture to indicate similarities between the template house and their etch-a-sketch)
Consistency	Mother's ability to consistently display high quality structuring behaviors from start to finish of a task (i.e., specific guidelines and appropriately timed feedback).

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### **Emotional Negativity**

Children's Behavioral Questionnaire (Rothbart et al., 2001) was used in this study to measure maternal perception of child temperament. This widely used questionnaire has been shown to be valid and reliable (Rothbart et al., 2001). Emotional negativity is the proneness of a child to anger, irritability, and general negative reactivity when faced with negative circumstances (Eisenberg et al., 2005; Pluess & Belsky, 2010). The subscale of anger/frustration (13 items;  $\alpha = .81$ ) was used to index child emotional negativity.

### **Child inhibitory control tasks**

Child inhibitory control was measured by five inhibitory control tasks that have been used in previous studies with 4-year-olds: (1) mean vs. good puppets, (2) turn-taking tower game, (3) delay of gratification, (4) an animal stroop-like task, and (5) toys on a tray task. The review of the literature shows that all of these tasks have not shown

ceiling effects by 4 years of age (Carlson, 2005). Within the current sample, however, the delay of gratification task and the mean vs. good puppets task showed very little variability in individual differences and a high success rate. This may be due to the fact that the mothers and children participating in the current study were low-risk and fairly homogenous in their demographic backgrounds (90% of mothers had a college education or higher). Thus, the final standardized and aggregated measure consisted of three inhibitory control tasks: turn-taking tower game, animal stroop task, and the toys on a tray task.

*Turn-Taking Tower Game.* This game was originally developed by Kochanska and colleagues (1996) and has been used to measure inhibitory control successfully (e.g., Hammond et al., 2011). Children were invited to build a tower with the experimenter using 12 blocks. First, the experimenter explained turn taking and did a practice trial with the child to make sure that the child understood turn taking. After the practice trial, the experimenter suggested that they play again, but this time the experimenter did not remind the child of the turn-taking rule. Instead, the experimenter waited until the child explicitly prompted her that it was the experimenter's turn to build a block (e.g., pointed at experimenter or said it is your turn). Two tower building trials were completed with each child. The actual proportion of blocks used by experimenter relative to the ideal proportion of blocks used by the experimenter ratio (i.e., .5) was used to reflect child inhibitory control. The closer the ratio is to .5, the greater inhibitory control the child exhibited.

*Animal stroop task.* In this task, the experimenter showed four animal pictures one by one with matching heads and bodies and asked the child to name the animal to

confirm that the child knew the names of the animals. The experimenter confirmed a child's correct response, and corrected a child's incorrect response. Only when the child was able to identify all four animals correctly did the experimenter move forward. Then, the experimenter presented four animal pictures, one by one, that had bodies with a circle as a head, asked the child to identify the animal based on the body, and repeated the confirmation process from the first step. Finally, the experimenter explained that the following 12 pictures would be "strange pictures" because in each picture the animals' heads and bodies were mismatched. The child was asked to identify the animal based on the head as quickly and accurately as he/she could. The ratio of correct responses to incorrect responses in the third, "strange animal" trial will represent child inhibitory control. This stroop task has previously shown to be effective in measuring child inhibitory control (Wright, Waterman, Prescott, & Murdoch-Eaton, 2003).

*Toys on a tray task.* The experimenter presented a tray with toys covered with a piece of cloth and told the child that he/she could choose one of the toys underneath the cloth. She instructed the child to keep his/her hands in his lap and told the child that when she uncovered the tray the child needed to verbally tell her which toy he/she wanted. Once the child put hands in his/her lap, the experimenter uncovered the tray. If the child used hands to reach for toys, the experimenter would remind the child to keep hands in the lap. The child was given up to 30 seconds to decide on a toy to choose. Once the child chose a toy, the experimenter handed the toy to him/her saying that he/she chosen a good toy. Based on the codes used by Kochanska and colleagues (Kochanska, Murray, Jacques, Koenig et al., 1996) in a similar task measuring inhibitory control in preschoolers, children's behavior is given a code from 0 to 4: 0=grabs a toy, 1=touches a

toy but does not take it out, 2=reaches for a toy but self-corrects, 3=removes hands from lap but does not point, and 4=does not remove hands from his or her lap (i.e., follows the directions).

## CHAPTER FOUR: RESULTS

### **Preliminary Analysis**

The children's verbal ability and performance on the three inhibitory control tasks suggested that they were developing normally. Table 2 displays means, standard deviations, and the statistical range for the child and maternal variables.

*Effect of Contexts.* To examine the effect of tasks (puzzle and etch-a-sketch) on maternal behaviors (i.e., autonomy support and structure), using the original rating scores two repeated measures MANOVAs were conducted separately to determine whether across-context aggregation was appropriate. For maternal autonomy support, there was a significant main effect for all the 7 behavioral components across contexts and the effect size was large,  $F(7, 75) = 17.73$ , partial  $\eta^2 = .62$ ,  $p < .01$ . Pairwise comparisons using the Bonferroni adjustment indicated that mothers exhibited significantly greater levels of autonomy support in the puzzle task than in the etch-a-sketch task across all behavioral components (see Table 2 for descriptive statistics).

For maternal structure, there was also a significant main effect for all the 7 behavioral components across contexts and the effect size was large,  $F(7,75)=14.277$ , partial  $\eta^2=.57$ ,  $p<.01$ . Pairwise comparisons using the Bonferroni adjustment indicated that with the exception of clarity of guidelines and rationale, mothers displayed greater levels of structure in the components of coordination, informative feedback, opportunity, resourceful leadership, and consistency during the puzzle task when compared to maternal behaviors during the etch-a-sketch task. Mothers showed less clarity of

guidelines in the puzzle task when compared to the etch-a-sketch task, and mothers displayed no significant difference in rationale across the two tasks (see Table 2 for descriptive statistics).

Results from the MANOVAs suggested that mothers' behaviors were context specific. Thus, composite scores for maternal autonomy support and structure variables were created separately for the puzzle and etch-a-sketch tasks to be used in subsequent analyses. In subsequent analyses, the seven component scores for autonomy support and structure were first standardized and then averaged for each task.

Table 2

*Descriptive Statistics for Child and Maternal Variables*

<i>Variable</i>	<i>Mean</i>	<i>SD</i>	<i>Range</i>
<b>Child</b>			
Age (years)	4.18	.22	3.92 – 4.90
Verbal ability (MLU)	3.24	.77	.50 – 5.62
Inhibitory control (aggregated standardized score)	.00	.68	-1.61 – .98
Task 1: Toys on a tray	2.33	1.59	0.00 – 4.00
Task 2: Turn taking tower	4.89	1.28	2.00 – 6.00
Task 3: Animal stroop task	9.11	2.79	1.00 – 12.00
Emotional negativity	4.39	.88	2.54 – 6.31
<b>Mother</b>			
Education (years)	16.49	2.79	9.00 – 27.00
Autonomy support (aggregated standardized score)	.00	.55	-1.27 – .92
Puzzle task (aggregated standardized score)	.00	.66	-1.87 – 1.38
Promotion of initiative	2.93	.42	1.89 – 3.70
Expansion	3.06	.32	2.09 – 3.89
Constraint*	1.31	.34	1 – 2.47
Validation	1.37	.31	1 – 2.33
Manipulation*	1.02	.06	1 – 1.38
Power assertion*	1.98	.42	1 – 3.41
Critical correction*	1.06	.10	1 – 1.38
Etch-a-sketch task (aggregated standardized score)	0.00	.65	-2.16 – 1.28

Promotion of initiative	2.42	.42	1.60 – 3.35
Expansion	2.86	.39	1.78 – 3.76
Constraint*	1.68	.46	1.00 – 2.80
Validation	1.25	.26	1.00 – 2.00
Manipulation*	1.06	.12	1.00 – 1.57
Power assertion*	2.11	.20	1.35 – 2.70
Critical correction*	1.11	.20	1.00 – 2.00
Structure (aggregated standardized score)	0.00	.62	-1.20 – 1.70
Puzzle task (aggregated standardized score)	0.03	.78	-1.25 – 2.69
Clarity of guidelines	2.51	.52	1.00 – 3.42
Coordination	2.78	.36	1.83 – 3.73
Informative feedback	1.98	.45	1.04 – 3.14
Opportunity	2.63	.22	2.23 – 3.86
Rationale	1.90	.52	1.00 – 3.43
Resourceful leadership	2.67	.41	1.54 – 3.50
Consistency	6.13	1.67	3.00 – 9.00
Etch a sketch task (aggregated standardized score)	-.03	.78	-2.05 – 1.51
Clarity of guidelines	2.67	.34	1.60 – 3.30
Coordination	2.61	.38	1.62 – 3.38
Informative feedback	1.69	.42	1.00 – 3.00
Opportunity	2.46	.22	1.63 – 3.15
Rationale	1.80	.48	1.00 – 3.31
Resourceful leadership	2.46	.45	1.00 – 3.38
Consistency	5.55	1.60	3.00 – 9.00

\* Original scores reported

*Bivariate Correlations.* Bivariate correlation analysis was conducted to show the relations among the child and maternal variables investigated in this study (see Table 3). Child's age and mother's years of education were both significantly and positively correlated with child's inhibitory control abilities at age 4. By contrast, child language ability (i.e., MLU) was not significantly correlated with individual differences in preschoolers' inhibitory control in this sample. In addition, boys and girls were not significantly different in their inhibitory control,  $t(80)=1.47, ns$ . Mothers' years of education was also significantly and positively correlated with maternal autonomy

support in both tasks, and was significantly and positively correlated with child's verbal ability.

Finally, maternal structure and autonomy support in the etch-a-sketch task, but not in the puzzle task, were significantly and positively correlated with child's inhibitory control abilities. Maternal autonomy support and maternal structure in the two contexts were significantly and positively correlated, with the exception of structure in the puzzle task and autonomy support in the etch-a-sketch task having a very low and non-significant correlation.

Table 3

*Correlations Among Child and Maternal Variables*

Variable	1	2	3	4	5	6	7	8	9
1. Child age (years)	--	--	--	--	--	--	--	--	--
2. Child verbal ability (MLU)	-.19	--	--	--	--	--	--	--	--
3. Child inhibitory control	.33**	.07	--	--	--	--	--	--	--
4. Child emotional negativity	-.01	-.10	-.12	--	--	--	--	--	--
5. Maternal education (years)	.21	.26*	.27*	-.17	--	--	--	--	--
6. Maternal autonomy support – Puzzle	-.05	.07	.14	.02	.22*	--	--	--	--
7. Maternal structure – Puzzle	-.16	.03	-.12	.01	-.10	.38**	--	--	--
8. Maternal autonomy support – Etch-a-sketch	.06	.13	.30**	-.24*	.31**	.40**	.07	--	--
9. Maternal structure – Etch-a-sketch	.12	.10	.31**	-.13	.20+	.37**	.28*	.60**	--

+  $p < .10$       \* $p < .05$       \*\*  $p < .01$

## **Independent and Joint Contributions of Maternal Autonomy Support and Structure**

To test the first set of hypotheses focusing on the main and joint effects of maternal autonomy support and maternal structure on child inhibitory control, hierarchical regression analyses were conducted separately for each set of task-specific (puzzle or etch-a-sketch) maternal parenting behaviors. Based on the literature and empirical evidence, child age, child sex, child language ability, and maternal education were included as the covariates.

*Puzzle Task.* In the first model predicting preschoolers' inhibitory control, the covariates were entered first,  $F(4,76) = 4.47, p=.003$ . Maternal autonomy support and maternal structure were added next. The results indicated that both maternal behaviors were not significantly linked to children's inhibitory control,  $F(2,74) = .78, ns$ . The interaction of the two maternal variables (autonomy support x structure) was entered last and was also non-significant,  $F(1,73)=.03, ns$  (see Table 4).

*Etch-a-sketch Task.* In the second model predicting preschoolers' inhibitory control, the covariates were entered first,  $F(4,76) = 4.47, p=.003$ . Maternal autonomy support and maternal structure were added next, which did not significantly improve the model,  $F(2,74)=2.29, ns$ . The interaction of the two maternal variables (autonomy support x structure) was entered last and was also non-significant,  $F(1,73)=.77, ns$  (see Table 4).

Overall, in both interaction contexts, the proposed hypotheses were not supported by the data. After accounting for the influence of the covariates, maternal autonomy support and maternal structure did not directly or jointly contribute to preschoolers'

inhibitory control in this sample. Thus, the first set of hypotheses was not supported in this study.

Table 4

*Hierarchical Regression Testing Main and Joint Effects of Maternal Autonomy Support and Structure on Child Inhibitory Control at age 4*

Task	Predictors	$R^2$	$\Delta R^2$	$\beta$ at final step
Puzzle	1. Covariates	.19	.19**	
	Child age			.29**
	Maternal education			.20
	Child verbal ability			.05
	Child sex			-.25+
	2. Autonomy support	.21	.02	.13
	Structure			-.11
	3. Autonomy support x Structure	.21	.00	.03
	Etch a sketch	1. Covariates	.19	.19**
Child age				.27*
Maternal education				.17
Child verbal ability				.04
Child sex				-.16
2. Autonomy support		.18	.05	.06
Structure				.19
3. Autonomy support x Structure		.27	.01	-.10
+ $p < .10$		* $p < .05$	** $p < .01$	

### **Child Emotional Negativity as the Moderator**

To test the second set of hypotheses considering the moderating effect of child emotional negativity in the effects of maternal autonomy support and maternal structure on child inhibitory control, hierarchical regression analyses were conducted separately

for each task (puzzle or etch-a-sketch) and for each aspect of maternal behavior (autonomy support or structure).

*Puzzle Task.* In the model examining the role of maternal autonomy support and child emotional negativity in children's inhibitory control development, the covariates were entered first,  $F(4,75) = 4.41, p = .003$ . Maternal autonomy support and child emotional negativity were added next. The results indicated that neither maternal autonomy support nor child emotional negativity was significantly predictive of children's inhibitory control,  $F(2,73) = .75, ns$ . The interaction term between autonomy support and child emotional negativity was entered last, and was also non-significant,  $F(1,72) = .19, ns$  (see Table 5).

In the model predicting children's inhibitory control from maternal structure and child emotional negativity, the covariates were entered first,  $F(4,75) = 4.41, p = .003$ . Maternal structure and child emotional negativity were entered next. The results indicated that neither maternal structure nor child emotional negativity contributed significantly to children's inhibitory control,  $F(2,73) = .29, ns$ . Finally, the interaction term between maternal structure and child emotional negativity was entered and was also non-significant,  $F(1,72) = .04, ns$  (see Table 5).

Table 5

*Hierarchical Regression Testing the Moderation Effect of Child Emotional Negativity on the Contribution of Maternal Autonomy Support and Structure to Child Inhibitory Control*

Maternal Parenting Behavior	Predictors	Puzzle Task			Etch-a-Sketch Task		
		$R^2$	$\Delta R^2$	$\beta$ at final step	$R^2$	$\Delta R^2$	$\beta$ at final step
Autonomy Support	1. <i>Covariates</i>	.19	.15**		.19	.19**	
	Child age			.30**			.30**
	Maternal education in years			.20			.19
	Child verbal ability			.05			.05
	Child sex			-.17			-.18+
	2. Autonomy Support	.20	.01	.08	.22	.03	.17
Child emotional negativity			-.05			-.06	
3. Autonomy support x Child emotional negativity	.20	.00	-.05	.25	.03+	.18+	
Structure	1. <i>Covariates</i>	.15	.15**		.19	.19**	
	Maternal education in years			.27*			.27*
	Child age			.22+			.21+
	Child verbal ability			.05			.30
	Child sex			-.20+			-.16
	2. Structure	.16	.01	-.07	.23	.04	.20
Child emotional negativity			-.04			-.05	
3. Structure x Child emotional negativity	.16	.00	-.02	.24	.01	.10	

+  $p < .10$ \*  $p < .05$ \*\*  $p < .01$

*Etch a Sketch Task.* When considering the role of maternal autonomy support and child emotional negativity on children's inhibitory control, the covariates were entered first,  $F(4,75) = 4.41, p=.003$ . Maternal autonomy support and child emotional negativity were added next. The results indicated that both maternal autonomy support and child emotional negativity was not significantly predictive of children's inhibitory control,  $F(2,73) = 1.59, ns$ . The interaction of the two variables (autonomy support x child emotional negativity) was entered last. This step revealed that there was a marginally significant moderation effect of child emotional negativity on the contribution of maternal autonomy support to child inhibitory control,  $F(1,72)=2.84, p=.09$  and  $\Delta R^2 = .03, p=.096$  (see Table 5).

To probe this significant interaction effect, simple slope analyses were performed, with +/- 1 standard deviation and around the mean as the low, average, and high levels of child emotional negativity (Aiken & West, 1991). The unstandardized simple slope for children 1 standard deviation below the mean of child emotional negativity (low emotional negativity) was not significant ( $B=.15, ns$ ). The unstandardized simple slope for children with a mean level of child emotional negativity was significant ( $B=.28, p<.02$ ), and the unstandardized simple slope for children with 1 standard deviation above the mean of child emotional negativity (high emotional negativity) was also significant ( $B=.42, p<.02$ ) (see Figure 1).

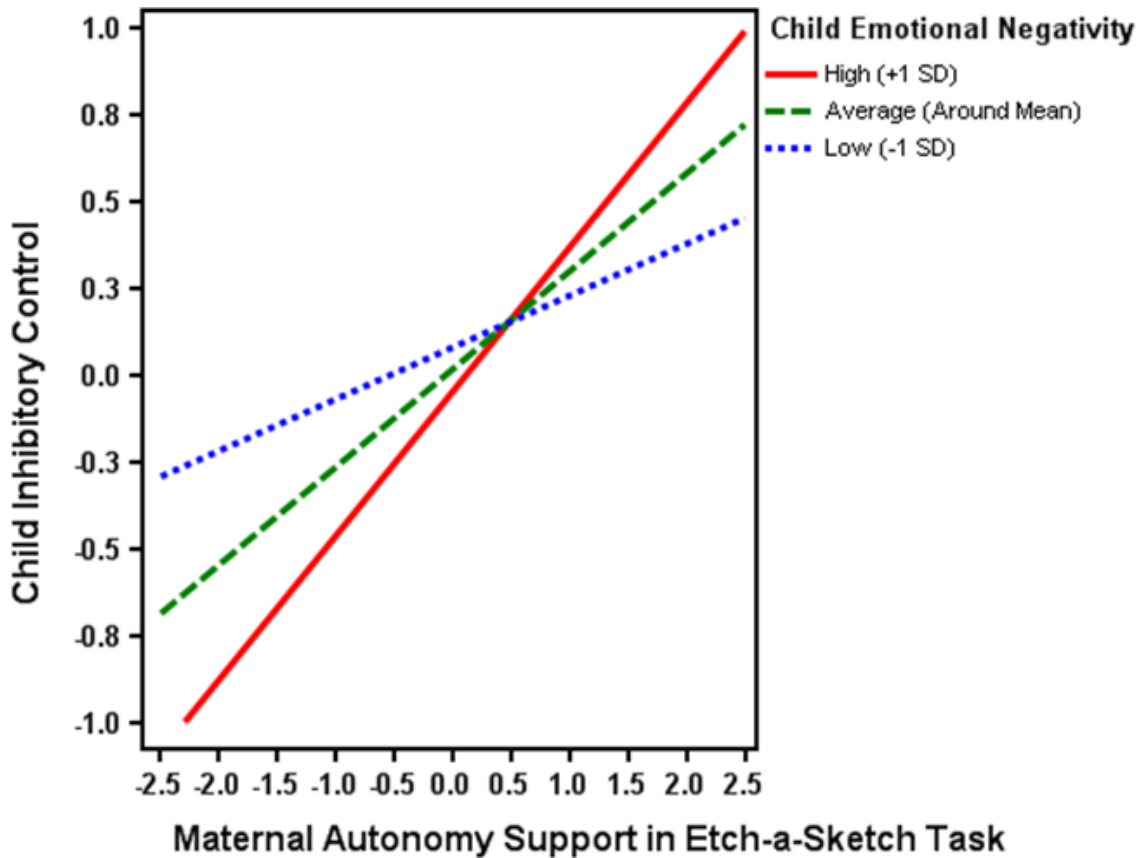


Figure 1. Child emotional negativity moderates the effect of maternal autonomy support in Etch-a-sketch task on child inhibitory control at age 4.

Overall, the results showed that children’s emotional negativity altered the contribution of maternal autonomy support to children’s inhibitory control development. Specifically, maternal autonomy support was significantly associated with individual differences in preschoolers’ inhibitory control for children with average and high levels of emotional negativity, but not for those with low emotional negativity. Children with high emotional negativity demonstrated the lowest or highest levels of inhibitory control depending on whether their mothers displayed higher or lower levels of maternal autonomy support. Compared to those with low or average emotional negativity, children with the highest emotional negativity had the lowest inhibitory control scores when their

mothers displayed lower autonomy support. However, when their mothers demonstrated higher autonomy support, children with highest emotional negativity also had the highest inhibitory control scores. Compared to those with low or high emotional negativity, children with average emotional negativity had an average level of inhibitory control. Children with low emotional negativity displayed the least sensitivity to maternal autonomy support, compared to children average or high in emotional negativity. The contribution of mothers' autonomy support to these children's inhibitory control was not significant.

In the model predicting children's inhibitory control with maternal structure in the etch-a-sketch task and child emotional negativity, the covariates were entered first,  $F(4,75)=4.413, p=.003$ . Maternal structure and child emotional negativity were entered next, and the model was not significantly improved from the first step,  $F(2,73)=2.03, ns$ . Finally, the interaction of maternal structure and child emotional negativity was entered, and was non-significant,  $F(1,72)=.78, ns$  (see Table 5).

The proposed hypotheses of moderation effect of child emotional negativity were largely unsupported. With respect to the puzzle task, child emotional negativity did not moderate the effect of maternal behaviors (autonomy support or structure) on child inhibitory control. In the etch-a-sketch task, whereas the effect of maternal structure on child inhibitory control was not moderated by child emotional negativity, the moderating effect of child emotional negativity on the effect of maternal autonomy support on child inhibitory control was marginally significant. The follow-up analyses further revealed that the proposed hypotheses that high child emotional negativity would dampen the potential benefits of maternal autonomy support to children's inhibitory control was only

partially supported. Specifically, children with highest emotional negativity when experienced low maternal autonomy support had the worst child inhibitory control outcomes as hypothesized. But, when children with high emotional negativity experienced high maternal autonomy support, they exhibited the highest inhibitory control outcomes. This moderation effect reflects of children's sensitivity to parenting, both positive and negative, rather than a dampening effect as originally proposed.

### **Patterns in Maternal Autonomy Support and Maternal Structure Across Contexts**

In this study, significant contextual effects were found in mothers' structure and autonomy support behavior, suggesting that mothers changed their behaviors according to demands of the context. In an effort to better understand the holistic and configural patterning in maternal behaviors across contexts and its association with the development of preschoolers' inhibitory control, a post-hoc cluster analysis was conducted. Different from the analyses presented above using variables as the unit of analysis, this person-centered approach focused on mothers as individuals, which would allow the identification of mothers who share similar behavioral patterns.

Using the *MCLUST* program (Fraley & Raftery, 2012) in the statistical package of *R* (Venables, Smith, & the *R* Core team, 2012), a model-based cluster analysis was conducted to classify mothers based on their aggregated standardized scores of maternal autonomy support and maternal structure derived from both puzzle and etch-a-sketch tasks. Model-based cluster analysis is an inferential statistical technique for identifying "groups" or "types" of individuals based on patterns of variables. This technique can be used with a relatively small sample size as long as the identified clusters are approximately equal in size. Model-based cluster analysis is a form of mixture modeling

and can thus provide a more structured approach to cluster analysis when compared to hierarchical cluster analysis or a *k*-means cluster analysis. Because the number of clustering solutions is determined by the distribution of the variables entered, a benefit of this technique over other clustering techniques is that it requires no *a priori* specification of cluster numbers. Also, model-based clustering allows for simultaneous comparison of multiple clustering solutions. Model fit indices, specifically the Bayesian Informative Criterion (BIC) and certainty of cluster assignments, are calculated for each model tested to determine what number of clusters best fits the model (Fraley & Raftery, 2012). Better fit is indicated by greater BIC indices (i.e., the least negative value) and greater differences between indices of different models (differences of 0 to 2, 2 to 6, and 6 to 10 representing weak, positive, and strong evidence of fit, respectively), from which one can decide on a number of clusters that is both conceptually meaningful and empirically sound. Certainty of cluster assignment is then examined based on the posterior probability of cluster assignment for each participant.

In this study, cluster models with the 2-group (BIC = -688.05) and 4-group (BIC = -696.10) solutions fit the data the best. The 2-group classification, which had the least negative BIC value and an absolute difference of 8.05 when compared to the 4-group solution, was selected. The distribution patterns of maternal behaviors by cluster are displayed in Figure 2.

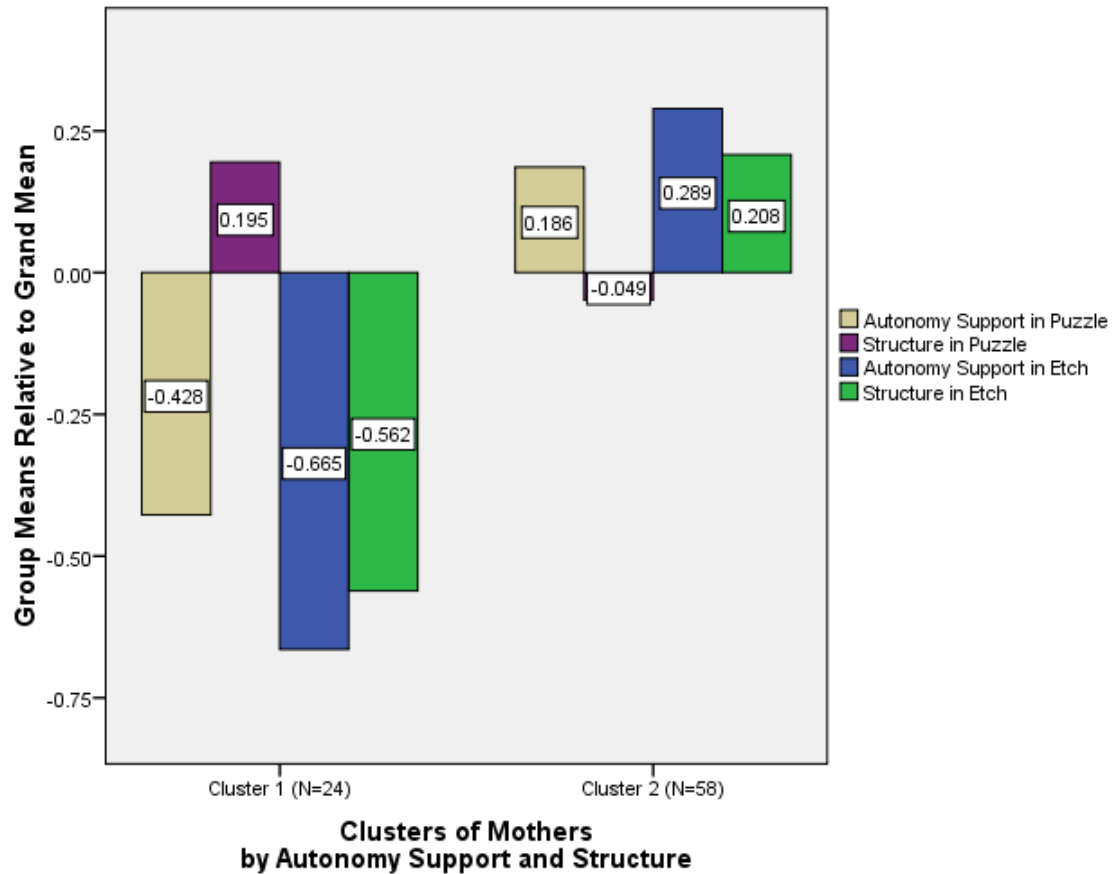


Figure 2. Distributions of averaged standardized scores of autonomy support and structure across contexts for mothers in the two clusters.

A MANOVA was performed to examine behavioral differences in the two groups of mothers. Box's M test indicated that the covariance between the two clusters was significantly different,  $p < .01$ , thus the Pillai's Trace Criterion was used instead of Wilk's Lamda (Tabachnick & Fidell, 2007, p.252). There was a significant multivariate main effect for cluster identification, Pillai's Trace = .62,  $F(4,77)=31.49$ ,  $p < .001$ , partial  $\eta^2 = .62$ . Univariate tests and pairwise comparisons showed that mothers in Cluster 1 ( $N=24$ ) had significantly lower autonomy support scores in puzzle ( $M = -.43$ ,  $SD = .89$ ),

$F(1,80) = 21.27, p < .01$ , and etch-a-sketch ( $M = -.67, SD = .62$ ),  $F(1, 80) = 77.27, p < .01$ , relative to mothers in Cluster 2 ( $N = 58$ ) for puzzle ( $M = .19, SD = .41$ ) and etch-a-sketch ( $M = .29, SD = .39$ ). Mothers in Cluster 1 ( $M = .19, SD = .86$ ) had higher structure scores in the puzzle task compared to mothers in Cluster 2 ( $M = -.04, SD = .75$ ), but this mean difference was not significant,  $F(1, 80) = 1.214, n.s.$  However, mothers in Cluster 1 ( $M = -.56, SD = .76$ ) had significantly lower structure scores in the etch-a-sketch task compared to mothers in Cluster 2 ( $M = .21, SD = .65$ ),  $F(1,80) = 25.93, p < .01$ . Thus, Cluster 1 was identified as the low autonomy support and structure cluster, and Cluster 2 was identified as high autonomy support and structure cluster.

A second MANOVA was conducted to examine the differences on maternal and child covariates (i.e., maternal education, child age, and child language ability) as well as child emotional negativity. Results showed that mothers in Cluster 1 had significantly less education than those in Cluster 2,  $F(1,79) = 4.96, p < .05$  (see Table 6), and no other significant difference was found. A separate  $2$  (mother cluster)  $\times 2$  (child sex) chi-square test revealed that there was no difference in child sex between clusters,  $\chi^2(1, N = 82) = 2.64, n.s.$

Before accounting for the potential covariates, mother's cluster identification accounted for significant differences in children's inhibitory control at age 4,  $F(1,79) = 5.67, p < .05$ , partial  $\eta^2 = .07$ . Mothers in Cluster 1 had children with significantly lower inhibitory control scores ( $M = -.27, SD = .69$ ) than mothers in Cluster 2 ( $M = .10, SD = .64$ ). Given that mothers in the two clusters differed in their education, an ANCOVA was conducted to examine whether mothers' cluster classification accounted for group differences in child's inhibitory control, with maternal education as the covariate. The

ANCOVA results indicated that after controlling for maternal education, the effect of mothers' cluster classification was marginally significant in accounting for group differences in preschoolers' inhibitory control,  $F(1, 79) = 3.44, p < .10$ , partial  $\eta^2 = .042$ . Children with mothers in Cluster 1 had lower inhibitory control scores than children with mothers in Cluster 2. However, mothers' cluster classification accounted for just 4.2% of the variance in preschoolers' inhibitory control.

Table 6

*Descriptive Statistics of Child and Maternal Variables by Maternal Cluster*

<i>Variable</i>	<i>Group 1: Low Support &amp; Structure (n=24)</i>			<i>Group 2: High Support &amp; Structure (n=58)</i>			<i>F (1, 79)</i>
	<i>Mean</i>	<i>SD</i>	<i>Range</i>	<i>Mean</i>	<i>SD</i>	<i>Range</i>	
Maternal education (years)	15.44	2.48	10.0 – 20.0	16.92	2.81	9.0 – 27.0	4.96*
Child age (years)	4.17	.21	4.00 – 4.75	4.18	.22	3.92–4.92	.07
Child verbal ability (MLU)	3.13	.61	1.74 – 4.23	3.29	.83	.50 – 5.62	.88
Child emotional negativity	4.49	.65	2.15 – 3.38	4.34	.87	2.54 – 6.31	.56
Child inhibitory control <sup>A</sup>	-.27	.69	-1.61–.87	.11	.64	-1.33–.98	5.67*

<sup>A</sup>Standardized values

\*  $p < .05$

## CHAPTER FIVE: DISCUSSION

The purpose of this study was twofold: (1) to examine the potential main and joint effects of maternal behaviors exhibited during the puzzle and etch-a-sketch tasks on preschoolers' inhibitory control abilities at age 4, and (2) to examine the potential moderating effect of child emotional negativity on the contribution of maternal behaviors to individual differences in preschoolers' inhibitory control. Mother's autonomy support and structure behaviors were hypothesized to have main effects and a joint contribution to children's inhibitory control. Further, child emotional negativity was hypothesized to make an independent contribution to children's inhibitory control, and to moderate the link between the maternal behaviors examined and preschoolers' inhibitory control.

A statistically significant context effect was found in maternal behaviors between puzzle and etch-a-sketch tasks. Thus, the context was taken into account in subsequent analyses. The contribution of maternal behaviors and child negative emotionality to inhibitory control was analyzed separately for each context.

With respect to the first research goal, whereas the bivariate correlations analysis demonstrated the expected relationships for autonomy support and structure in the etch-a-sketch context, subsequent hierarchical regression analysis controlling for maternal and child covariates did not support the original hypothesis. Regression analysis indicated no main or joint contributions of autonomy support and structure of children's inhibitory control.

With respect to the second research goal, child emotional negativity did significantly moderate the link of maternal autonomy support in the etch-a-sketch task to child inhibitory control. No other significant moderation relation was found for maternal autonomy support in puzzle task or maternal structure in both puzzle and etch-a-sketch tasks. Children with high emotional negativity displayed the highest inhibitory control when mothers displayed high autonomy support, but children high in emotional negativity also exhibited the lowest inhibitory control with mothers who displayed low autonomy support. Children with average emotional negativity also displayed higher inhibitory control when mothers displayed high autonomy support, and these children displayed lower inhibitory control when mothers displayed low autonomy support. Children with low emotional negativity were the least affected by quality of autonomy support compared to children high or average in emotional negativity.

Post-hoc cluster analysis indicated that mothers significantly clustered into two patterns of maternal behaviors across the puzzle and etch-a-sketch tasks: (1) a low autonomy support and structure cluster: mothers in this group displayed relatively lower autonomy support across puzzle and etch-a-sketch and lower structure in etch-a-sketch, and (2) a high autonomy support and structure cluster: mothers in this cluster displayed relatively higher autonomy support across puzzle and etch-a-sketch and higher structure in etch-a-sketch.

An ANCOVA with maternal education serving as the covariate showed that children with mothers in the low autonomy support and structure cluster had relatively lower inhibitory control scores, whereas children with mothers in the high autonomy support and structure cluster had relatively higher inhibitory control scores. Implications,

limitations, and future directions of study building from the current study will be discussed below.

### **Context Specificity: Individual and Joint Goal-Oriented Tasks**

When examining the observed maternal behaviors, significant differences between the contexts of puzzle and etch a sketch were found. Previous studies have used both contexts to observe parenting behaviors successfully (Britto et al., 2006; Eley, Napolitano, Lau, & Gregory, 2010; van der Mark, Bakermans-Kranenburg, & van Ijzendoorn, 2002), though there is not extensive explanation of the potential meaning of these contexts in relation to the parenting variables observed. While both contexts are goal-oriented tasks, the two tasks were structurally different. Whereas the puzzle task was intended as an individual goal-oriented task, the etch-a-sketch task was a joint goal-oriented task. The success of the puzzle task depended largely on the child's mastery of the puzzle, although the mother was encouraged to provide guidance to the child if the mother felt compelled to do so. The etch-a-sketch task, on the other hand, was specifically designed as a joint goal-oriented task. The mother was assigned one dial and the child was assigned the other dial. Both parties needed to cooperate to maneuver the dials to create a simple two-dimensional picture of a house.

In this study, mothers displayed greater autonomy support and greater structure across most behavioral components in the puzzle task than they showed in the etch-a-sketch task. Keeping in mind that the puzzle task was an individual mastery task, mothers likely inherently understood that the task was child specific and that the mother's role during the task was that of a supportive teacher, more than an active player in the task. This type of role would naturally cue autonomy supportive behaviors (i.e.,

encouragement of child's initiative, low control). Comparatively, in the etch-a-sketch task, a joint task, the mother's role shifts from being a supportive teacher to an active participant in the task at hand. The goal of the mother is no longer simply to ensure that her child is successful at the task, but rather, to jointly finish the task at hand with a goal of mutual success as a dyad. In other words, the mother shifts from being solely child-focused to being focused on the task, as a dyad. Autonomy supportive and structuring behaviors may be less salient when mothers are filling this role. Notably, mothers displayed more clarity of guidelines, which is a behavioral component of structure, in the etch-a-sketch task than they did in the puzzle task. This may be because of the dyadic nature of the etch-a-sketch task; joint tasks would need more cooperation and conversation to discuss how to complete at the task at hand together. solely child-focused to being focused on a mutual succes

Bivariate correlations showed that maternal autonomy support and structure were significant predictors of preschoolers' inhibitory control in the etch-a-sketch task, but not in the puzzle task. These findings may suggest that maternal autonomy support is especially salient during tasks or contexts that call for working jointly with children.

While these contextual differences were unexpected, they provide important insight into the current study, and have important implications for future studies using observational data to examine maternal autonomy support and structure as they relate to child development. Studies using observational data must take into consideration that parenting behaviors observed are context-specific, and that parenting behaviors shift depending on contextual cues.

## **Role of Autonomy Support and Structure in Preschoolers' Inhibitory Control**

In this study, maternal autonomy support and maternal structure did not separately or jointly account for significant variations in child inhibitory control after controlling for the covariates. However, this should not detract from the potential importance of these two variables in examining the role of parenting in child inhibitory control for several reasons.

Firstly, the homogeneity and relatively small sample size of the current study must be taken into consideration. The study participants were largely from low-risk families, with mostly white, well-educated, married, middle class mothers, which reduced the amount of variance within the parenting measures. Additionally, children in this study were observed to be healthy and normally developing, which also restricts the amount of variance to account for. Studies examining at-risk children or children from low-income demographics have found meaningful relationships between parenting variables and child inhibitory control (Davis et al., 2010; Moilanen et al., 2010). It could be that the original hypotheses would be observed in larger, more representative samples with a wide range of socioeconomic backgrounds (e.g., Bernier et al., 2010; Raver, 2004).

Secondly, self-determination theory, the theoretical basis of the chosen parenting characteristics, refers to a third characteristic of parental warmth that was not examined in the current study. It has been suggested that parental warmth meaningfully contributes to a supportive childhood environment that promotes self-regulatory development, which involves child inhibitory control. Empirical evidence also supports the significance of parental warmth in preschoolers' inhibitory control. For example, Moilanen and

colleagues (2010) found that parental hostility (as characterized by displays of anger, blaming the child, ignoring or rejecting the child) significantly and negatively impacted preschoolers' inhibitory control outcomes at age 4. As such, parental warmth is also an important aspect of the supportive parenting environment to consider. Future studies will need to observe parental warmth together with autonomy support and structure in order to consider the full "supportive parenting" environment.

Finally, the original hypotheses might not account for other individual mechanisms that parenting variables operate through which influence children's inhibitory control. Because the data was cross-sectional, any parenting influence that would have occurred prior to age 4 was unaccounted for. Longitudinal data are more appropriate for examining developmental processes, as parenting in toddlerhood have proven to be important to children's development of self-regulatory abilities (Conway & Stifter, 2012; Rhoades, Greenberg, Lanza, & Blair, 2011; Spinrad, Eisenberg, Silva, Eggum, et al., 2012). A longitudinal design with multiple assessments of parenting behavior and child inhibitory control will be necessary in future studies.

Furthermore, Bernier, Carlson, Deschenes, and Matte-Gagne (2012), have recently found support for considering early attachment security in infancy and toddlerhood as a potential individual mechanism through which parenting contributes to later children's executive function at the preschool age. The effect of early attachment security on later child executive function was over and above the influence of parenting and other social characteristics. These findings suggest that in addition to the external influences (i.e., parenting), there are important developmental processes internal to the child (e.g., attachment security) that may be already in play prior to the preschool years,

and the contribution of parenting to children's inhibitory control or other executive function abilities may operate through these underlying processes. To better understand the role of parenting in the early development of children's executive function and inhibitory control, it is important for future research to examine the underlying mechanisms that mediate the relation between parenting and inhibitory control.

### **Child Emotional Negativity Moderates the Link between**

### **Maternal Autonomy Support and Preschoolers' Inhibitory Control**

Despite that the main effect of child emotional negativity on inhibitory control as well as the interaction effects of child emotional negativity in amplifying or reducing the strength of the relation between maternal structure and child inhibitory control were non-significant, a meaningful moderation effect of child emotional negativity on the relation between maternal autonomy support in the etch-a-sketch task (but not in the puzzle task) and child inhibitory control was observed. It appeared that children high in emotional negativity showed an increased sensitivity to both low and high maternal autonomy support, such that children high in emotional negativity displayed the lowest and highest inhibitory control abilities depending on whether mothers' displayed low or high autonomy support, respectively. Children with average emotional negativity also displayed higher inhibitory control with high maternal autonomy support and lower inhibitory control with low maternal autonomy support. Children with low emotional negativity were not significantly influenced by maternal autonomy support. The original hypothesis, thus, was only partially supported by these findings as the original hypothesis did not account for children high in emotional negativity displaying the highest inhibitory control with mother high in autonomy support.

The findings of the moderating effect of child emotional negativity align well with the differential susceptibility argument (Belsky & Pluess, 2009). A differential susceptibility explanation would argue that compared to children with low or average emotional negativity, those high in emotional negativity are more sensitive to poor and positive parenting, such that the benefits and detriments of either may be magnified in children with high emotional negativity. Recently, Kim and Kochanska (2012) also found that child emotional negativity moderated the relationship between a positive parent-child relationship (i.e., parent-child mutually responsive orientation) and the child's self-regulatory outcomes (i.e., compliance) 10 months later. These findings suggest that emotional negativity in children may not simply reflect vulnerability, but rather it may be conceptualized as a trait that implies a "sensitivity-to-context" (Kim & Kochanska, 2012, p.11). As theorized by the differential susceptibility account, emotional negativity reflects a child's sensitivity to both the benefits and detriments of high and low autonomy support by parents.

In this study, children's emotional negativity was based on maternal reports, which might be subject to maternal bias. Future studies could consider other salient aspects of early temperament such as extraversion/surgency and effortful control (Rothbart et al., 2001) and incorporate biological markers as the indices for emotional negativity to buttress these findings. Children's biological reactivity to stress as indexed by cortisol and vagal tone has been related to anger and frustration (e.g., Spinrad, Eisenberg, Granger, Eggum et al., 2009), and thus would be an appropriate biological marker to consider in relation to parental autonomy support, child emotional negativity, and inhibitory control development.

The interacting nature of child emotional negativity and maternal autonomy support in a joint goal-oriented task (i.e., etch-a-sketch) also reflects the necessarily reciprocal nature of parenting and child temperament (Kiff, Lengua, Zalewski, 2011). A mother who is in tune with her child may notice high emotional negativity earlier, and adjust her parenting to coordinate with her child's needs as a sort of fine-tuning process. In contrast, a mother who is less sensitive may not notice her child's very emotionally negative nature and not match her parenting appropriately, or may herself feel overwhelmed with a very emotionally negative child, which may reinforce negative parenting behaviors (i.e., insensitivity, intrusiveness). In either case, there is no clear beginning point at which parenting influences child temperament, or vice versa. Rather, the process is reciprocal and interactive. In the case of self-regulatory abilities, such as inhibitory control, individual differences in development may reflect this reciprocal and interactive process of parenting and child temperament. As such, unpacking the transactional nature of the parenting and temperament relationship over time is essential in understanding preschoolers' inhibitory control development.

### **Patterns of Maternal Autonomy Support and Structure:**

#### **A Person-Centered Approach**

The examination of independent and joint effects of maternal and child attributes on a developmental outcome refers to a variable-centered approach. By contrast, person-centered approaches, such as cluster analyses, identify clusters of individuals within a sample that share specific attributes, which can in turn address questions holistically by considering a multitude of attributes. For example, a recent study by Rhoades, Greenberg, Lanza, and Blair (2011) showed how meaningful groups, referred to as "risk

profiles”, of early parenting and childhood contexts are significantly predictive of children’s executive function abilities later on. This study considered family and demographic risk measures, such as prenatal smoking and household income/poverty, to create children’s risk profiles. Further, they examined how parent-child interaction quality (i.e., parental engagement, intrusiveness) mediates these various risk factors to affect children’s executive function abilities differently depending on their respective risk profiles. For example, exposure to poverty was particularly detrimental for executive function in Caucasian children living in low-income single-parent families relative to Caucasian children living two-parent families but who had also been exposed to poverty. Together, variable-centered and person-centered approaches can complement each other in understanding developmental phenomenon.

Focusing on maternal autonomy support and structure, Britto and colleagues (2006) were able to identify distinct groups of mothers by examining the nature of the task and the method of parenting (i.e., low vs. high support, low vs. high teaching). Using this person-focused approach of classifying mothers into groups, Britto and colleagues (2006) demonstrated that mothers who have high support, high teaching, and were more verbally expressive during a storybook reading task had children with better language skills. In addition to investigating relations between maternal and child variables, patterns of parenting were also examined in this study using a model-based cluster analysis. Two groups of mothers were determined to be meaningfully representative of the parenting patterns. The first cluster consisted of mothers who displayed relatively low autonomy support and structure, while the second cluster consisted of mothers who displayed relatively high autonomy support and structure.

After accounting for the influence of maternal education, mothers' cluster classification significantly accounted for differences in preschoolers' inhibitory control. Children with mothers who displayed lower autonomy support and structure (Cluster 1) had relatively lower inhibitory control scores, while children with mothers who displayed higher autonomy support and structure (Cluster 2) had relatively higher inhibitory control scores. These findings provide support for a self-determination explanation in understanding how parenting may influence preschoolers' inhibitory control development. Autonomy supportive (i.e., encouraging initiative, diminishing manipulation or control, and expanding on child's focus) and structuring (i.e., providing clear guidelines, monitoring child's progress, and maintaining consistency) behaviors in parents may facilitate the development of autonomy and competence by providing an environment that promotes independent thinking and expression within a systematic framework that is geared towards the child's success (Farkas & Grolnick, 2010; Ryan & Deci, 2000). Promotion of autonomy and competence may in turn contribute to the development of self-regulatory processes, such as preschoolers' inhibitory control (Ryan & Deci, 2000).

It should be noted, however, that mothers' cluster identification only accounted for 4.2% of the variance in preschoolers' inhibitory control. This may be because other aspects of parenting, such as parental warmth, were not considered in this study. A person-centered analysis identifying patterns across the three parenting behaviors that are highlighted in self-determination theory (i.e., autonomy support, structure, and warmth) would be a natural and important next step. Finally, it is interesting that meaningful links that were not observed between autonomy support and structure and preschoolers'

inhibitory control using a variable-centered approach were observed while using a person-centered approach.

In conclusion, despite the obvious limitations of this study, the findings significantly contribute to the literature in several ways. First, the significant moderating effect of child emotional negativity on the link between maternal autonomy support and preschoolers' inhibitory control provides further support for the differential susceptibility argument in explaining the significance of negative emotionality in augmenting or deterring children's inhibitory control development. Next, the importance of dimensionality in parenting and context specificity in observing parenting behavior is highlighted by the significant bivariate association of child inhibitory control with maternal autonomy support (not maternal structure) observed in the etch-a-sketch task, which is a parent-child collaborative activity, but not in the puzzle task, which is a parent scaffolding and child learning activity. These findings echo Grusec and Davidov's (2010) view that parenting is a multidimensional concept marked by different aspects of the parent-child relationship with each dimension of parenting with different parenting behaviors is uniquely linked to a developmental outcome.

Finally, the person-centered approach identified mothers with distinctive behavioral patterns of autonomy support and structure into relatively high and relatively low autonomy support and structure. This finding reinforced the understanding of autonomy support and structure as separate but interrelated dimensions of parenting behaviors. More importantly, group differences in preschoolers' inhibitory control development suggested that the pattern of high autonomy support and high structure is optimal for preschoolers' inhibitory control development, which supports a self-

determination argument for understanding the link between parenting and children's self-regulatory development.

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