THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF PSYCHOLOGY

# THE INFLUENCE OF REGULATORY BEHAVIOR STRATEGIES ON SELF-REGULATION OF PRESCHOOLERS

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SPRING 2013

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Psychology
with honors in Psychology

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# ABSTRACT

The development of self-regulation, or the management of one's reaction to environmental stimuli is crucial for a child's social and scholastic trajectory as well as the prevention of later mental health problems. Research has identified various components of self-regulation, including effortful control and inhibitory control, yet little observational data has looked into how a child utilizes self-regulation strategies during development. This thesis investigates the behavior regulation strategies children use during the Go-NoGo task to facilitate their performance, the relation it has to effortful control and self-regulation, and potential moderators (maternal behavior and affect and temperament) of this relation. Results showed that children used a certain set of behaviors that helped facilitate their performance on the Go-NoGo task, and were also associated with maternal behaviors but not their own performance in a subsequent task. Results suggest that individual differences in behavioral strategies are an important component of inhibitory control performance. The results imply that more research is needed beyond whether or not a child can self-regulate, but how a child can self-regulate. Future research should focus on these behavioral strategies as possible mechanisms that enhance self-regulation.

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# ACKNOWLEDGEMENTS

First, I greatly appreciate all the knowledge, time, and generosity that Dr. Buss has given me to help with my honors thesis. I would not have been able to do this without her, and I am very thankful for the opportunity to work with her.

Second, I want to thank everyone in the Emotion Development lab that was very encouraging throughout the entire process. It was so nice to have their support. In addition, the training I received from Dr. Jess Dollar was the foundation of my research experience, and I greatly appreciate learning from her.

Lastly, I would like to thank all my friends and family who were always so encouraging throughout this entire process.

# Chapter 1

## Introduction

The development of self-regulation is crucial for a child's social and scholastic trajectory as well as the prevention of later mental health problems (Blair & Razza, 2007; Liew, 2011). Self-regulation is broadly defined as managing one's reactions to environmental stimuli through integration of cognitive and behavioral processes (Rothbart & Rueda, 2005). Self-regulation consists of several components, including behavioral regulation and emotion regulation, of which researchers have developed numerous methodologies to study.

Children who develop adaptive self-regulatory abilities, including the regulation of emotions and behavior, are typically better prepared for learning advancements in math and reading within a school environment (Blair & Razza, 2007; McClelland & Cameron, 2011), create less classroom disturbances while generating more social competence with peers and teachers (Liew, 2011), and are less at risk to develop internalizing or externalizing behavioral problems (Allan & Lonigan, 2011; Buss, Kiel, Morales, & Robinson, 2013). Parents may observe self-regulation in children who are suppressing the desire to play with friends outside in order to finish their chores beforehand. Social encounters also require the self-regulation of emotions, such as anger and negativity, to allow the development of healthy peer relationships (Liew, 2011; Allan & Lonigan, 2011; Kochanska et al., 2000). Children who have difficulties with self-regulation may display more attention, social, or emotional deficits, which may manifest as deficiencies in school readiness or peer relations (Liew, 2011; Kochanska et al., 2000; Dollar et al., 2011a).

This thesis will focus on two closely related self-regulation components, effortful control and inhibitory control. Effortful control encompasses neural processes that inhibit dominant responses to allow for the execution of a less dominant response, assessment for error detection, and recruitment of planning strategies (Rothbart & Rueda, 2005). Inhibitory control is an effortful and active ability to control impulsivity (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996). These two processes enable the ability to attend to relevant stimuli by delaying actions and suppressing impulses (Kochanska, Murray, & Coy, 1997), resulting therefore in adaptive outcomes. However, difficulties in clearly defining the boundaries of effortful control and inhibitory control have created confusion between these terminologies (Kochanska Murray, & Harlan, 2000). For purposes of this thesis, we consider inhibitory control as control of impulsivity and approach using a specific set of behaviors that facilitate self-regulation and effortful control as a broader, more complex set of processes that index adaptive self-regulation.

This thesis aims to examine individual differences of preschool-aged children in the development of self-regulation, specifically its effortful control and inhibitory control components. The study investigates: (a) the influence of behavior regulation strategies on Go-NoGo performance, (b) the relation between these laboratory measures of self-regulation and effortful control, and (c) potential moderators (child temperament and maternal behaviors and affect) of this association.

## Self-Regulation and Effortful Control

In a temperament-based approach, the development of effortful control is measured through tasks gauging a child's ability to inhibit behavior and control attention at different ages (Liew, 2011). Kochanska and colleagues (2000) demonstrated that effortful control developed

from 22 months to 33 months of age by adapting an age-appropriate Stroop task to test for the regulation of dominant and subdominant responses. Additional research revealed effortful control development progresses between the ages of 2 and 7 years, and were confirmed by studies involving the anterior cingulate cortex and amygdala, demonstrating that the regulation of cognitive and emotional processing are refining to increase efficiency during this time (Rothbart & Rueda, 2005). Also, in children of 2.5 to 3.5 years old, the negative correlation between effortful control and later impulsivity measures suggests that effortful control dynamically develops to manage a range of behaviors and processes, including the regulation of impulsivity (Spinrad et al., 2011). Allan and Lonigan (2011) showed that individual differences in effortful control were associated with academic measures and may serve as a possible identifier for children at risk for developing behavioral problems with moderate association to internalizing and externalizing behaviors.

In order to control urges to respond or react in certain situations, inhibition must develop to an efficient level (Rueda, Posner, & Rothbart, 2005). These characteristics of self-regulation are linked to functions such as, "the ability to delay, to focus attention, or to suppress immediate desires or impulses, and the component traits considered prototypical for constraint, such as deliberation, control of impulses, planfulness, or pursuit of distant goals," (Kochanska et al., 1997). For the behaviors facilitating self-regulation, Kochanska and colleagues (1997) found toddlers and preschoolers with high inhibitory control to display more internalization behavior during a series of laboratory tasks. Furthermore, neural measures of self-regulation components correlate with the anterior cingulate cortex and are studied as a possible neural correlate to tracking effortful control's functional development (Blair, Calkins, & Kopp, 2011; Rothbart & Rueda, 2005). In addition to neural measures, the development of temperament questionnaires and age-based laboratory tasks are designed to measure different components and measures of

effortful control and inhibitory control (Rothbart & Rueda, 2005). The current study focuses on the use of laboratory measures for self-regulation.

**Laboratory Measures**

Go-NoGo (GNG) tasks are one of the most common ways to measure the efficiency of inhibitory control (Rueda et al., 2005). GNG tasks challenge children to respond to one stimulus and withhold responses to related stimuli. Typically, the number of omissions and false alarms or a physiological index quantifies the inhibition measured by the task (Rueda et al., 2005). For example, similar methodology found the detection of an error could cause slower reaction times following the commission of an error (Rueda et al., 2005). However, behavioral data is absent which may show how the child reacted during the laboratory test. Children with developing inhibitory control may use different regulatory behaviors during the task that either aid or hinder in their responses.

Kochanska, and colleagues (2000) also developed tasks measuring different applications of effortful control such as delaying, slowing down motor activity, suppressing or initiating activity to signal, and effortful attention. In one example, the snack delay task measured the delaying component of effortful control by prompting the child to wait to consume their snack until the experimenter rang a bell (Kochanska et al., 2000). Blair, Granger, and Razza (2005) measured inhibitory control with a peg-tapping task where a child would tap the peg once after the experimenter tapped twice, and the child would tap twice after the experimenter tapped once. The exercise challenged children to suppress the inclination to mimic the experimenter, while applying new instructions held within their working memory (Blair et al., 2005). These tasks enabled researchers to better measure the development of children's effortful control and its

potential implications in social and academic settings. However, the characteristics of each child also indicate a relation between inhibitory control and effortful control.

## Child Characteristics

Through laboratory measures, effortful control was shown to correlate with certain traits in children. Kindergarteners generate sets of strategies to regulate their behavior while in a classroom setting (Nathanson, Rimm-Kaufman, & Brock, 2009). This age group learns to apply these strategies while learning to raise their hand and inhibit urges to speak out of turn, or staying in their seats to not disturb class (Nathanson et al., 2009). Low effortful control in children typically displayed more school adjustment difficulties (Nathanson et al., 2009). Children with high levels of effortful control show characteristics of higher levels of empathy, guilt or shame, and lower levels of aggressiveness (Rothbart & Rueda, 2005). Similarly, children high in effortful control were slower to anger and expressed lower intensities of anger (Kochanska et al., 2000). In a longitudinal study, infants displaying lower effortful control had increasing reactivity to fearful situations (Hill-Sunderlund & Braungart-Rieker, 2008). Self-regulation and effortful control can influence the traits children display during different situations. These characteristics may also account for a degree of individual differences observed between children.

## Temperament as a Moderator

In addition to effortful control, multiple factors may contribute to children's development and adaptive outcomes. Temperament is one key factor associated with variance in these outcomes. However, the incorporation of children's temperament—reactivity to different stimuli

pertaining to emotion, movement, and attention—as a moderator can validate the strength of relation between inhibitory and effortful control. Overall, measures of temperament provide great contributions into research of children's individual differences (Kochanska et al., 1997; Rothbart, Sheese, & Posner, 2007). Effortful control broadly encompasses the influences from voluntarily controlled self-regulation and involuntarily controlled temperament (Rothbart et al., 2007). While both are genetically based, temperament is the individual characteristics of reactivity to a stimulus that is stable across time, while self-regulation must develop over time (Rothbart & Rueda, 2005).

Researchers often describe temperaments by the elements of surgency and fearfulness. Surgency describes a temperament with greater activity level, extraversion, impulsiveness, and high-intensity pleasure (Rothbart et al., 2007). Fearful temperaments display more fear, sadness, frustration, and discomfort (Rothbart et al, 2007). These temperaments are often compared in research to show individual differences in how children respond to stimuli.

Fearful and surgent temperaments are widely tested throughout child development research (Dollar et al., 2011b; Rothbart et al., 2007). As mentioned by Dollar and colleagues (2011b), studies show the sets of behaviors and thoughts children develop, likely due to their temperaments, can place them at-risk for certain behavior problems. For example, fearful children are more at risk for developing internalizing behavior problems (Biederman et al., 2001; Dollar et al., 2011b), while surgent children are more at risk for developing externalizing behaviors (Stifter, Putnam, & Jahromi, 2008; Dollar et al., 2011b). When considering the relationship of temperament to effortful control, children with surgent temperaments were more at risk in exhibiting the externalization of behaviors (Buss et al., 2012). However, temperament is not the only influencing factor in children's trajectories, since some children within a categorized temperament displays the appropriate social behaviors while others develop maladaptive social behaviors (Dollar et al., 2011b). The strategies and development into how children form appropriate or maladaptive behaviors are not evident within research (Dollar et al., 2011b).

Analyzing effortful control and temperament enabled researchers to pursue the associations of temperament on behavior (Rothbart & Jones, 1998). Surgent children, who express more frustration and aggression, tend to have low effortful control and self-regulation leading to a risk for developing behavioral problems (Stifter et al., 2008; Rothbart & Jones 1998). If surgent children learn to regulate frustration and approach, they can develop their effortful control and lower the risk of externalizing problems (Stifter et al., 2008). For fearful children, the inability to focus away from threatening may result in low levels of effortful control (Derryberry & Rothbart, 1997). Fearful children who developed higher levels of effortful control showed a higher likelihood of focusing to signals of relief (Derryberry & Rothbart, 1997). Therefore, balances between effortful control and temperament leading to adaptive self-regulation strategies may decrease the risk in developing psychopathology (Rothbart & Jones, 1998; Stifter et al., 2008, Derryberry & Rothbart, 1997). Beyond temperament and child characteristics, possible differences that may influence children's outcomes are types of parenting styles.

## Parental Support

The environment provided by parents may assist or hinder children's development of self-regulation and effortful control (Blair, Zelazo, & Greenburg, 2005). Studying parenting styles may help researchers understand its effects on children's effortful development (Blair et al., 2005). Although genetics affects a proportion of effortful control, children's quality of relationship with their mothers correlates with effortful control ratings (Eisenberg, 2005).

Parenting styles may influence a child's performance on laboratory tasks incorporating self-regulation. Kochanska and colleagues (2000) showed children scored higher levels of effortful control when mothers were more available to their children and showed more responsiveness. Supportive and affable parenting styles correlated with high levels of their child's

effortful control (Eisenberg, 2005). A mother's parenting behavior can help surgent children to down-regulate emotion and learn to focus on the task at hand, especially when incorporating positive affect and behaviors highlighting novelty in the task (Dollar, 2011b). Similarly, mothers using more commanding behaviors accompanied with positive vocal affect had children with higher effortful control than if the mothers used redirective behaviors with neutral vocal affect (Cipriano & Stifter, 2010). However, fearful children tend to display higher effortful control behaviors, and lower associations with parenting style influences (Cipriano & Stifter, 2010). Overall, mothers using positive affect and redirection behaviors in novel situations were associated with effortful control development in fearful and surgent children (Cipriano & Stifter, 2010). In the current study, parenting styles may moderate the relation of self-regulation and effortful control in children.

## Current Study

Little research featured the behavioral elements that children enlist while completing tasks testing their inhibition efficiency. This study investigates the relationship between the two aspects of self-regulation known as inhibitory control and effortful control, while incorporating analysis for individual differences. First, the study examines what behavior regulation strategies facilitate or hinder performance during a Go-NoGo task. For example, children may sit on their hands to prevent responding or look to engage the experimenter for additional guidance with the task. However, children with excessive fidgeting or those likely to engage in off-task behaviors may hinder their performance.

Second, this thesis will analyze children's self-regulation in relation to effortful control regulation during a transition from a high-energy to low-energy task. Analysis of the moderation of maternal behaviors and affect may show the extent of influence on this transition. For example,

mothers displaying higher levels of novelty and positive affect can help surgent children stop a high-energy task and engage in a new low-energy task, while others displaying overprotective behaviors may hinder their fearful child's ability to regulate and develop effortful control (Dollar, 2011a). However, the mother's approach to her surgent child may reveal difficulty in the child's ability to develop effortful control, if the child is unable to internalize self-regulation strategies. The maternal behaviors and affect may influence the level of self-regulation displayed by the child during a high-to-low energy transition task.

Finally, temperament will be analyzed between fearful, typical, and surgent children as a possible moderator of the relation between self-regulation tasks. Fearful children are expected to have higher ratings of self-regulation and effortful control due to higher error detection and feelings of guilt (Rueda et al., 2005; Rothbart & Rueda, 2005), and show more behaviors that reflect that internalization of thought such as hesitating and carefully responding to choices. Surgent children will likely have lower ratings of inhibition due to difficulties with suppressing dominant responses to the stimuli (Kochanska et al., 1997). Even though the mother's ability to convey parenting styles conducive to teaching the child, the child's temperament may be an important influence on individual differences of children within a categorized temperament.

This thesis is designed to help identify and predict behavior regulation strategies that may help or hinder Go-NoGo performance and their correlation to self-regulation in a high-to-low transition task. Additional analyses will look at the effects of maternal affect and behavior as well as children's temperament. Together, these concepts can influence children's ability to prepare for learning and predict which children are at-risk for developing behavioral problems (Kochanska et al., 2000; Allan & Lonigan, 2011; Buss et al., 2012).

# Chapter 2

# Method

## Participants

One hundred and twenty four preschool-aged children ($M_{age}$= 42.67 months; 49.6% male) and their parents participated as part of a longitudinal study examining emotion development. Participants were recruited from published birth announcements. The majority of participants were Caucasian (89.9% Non-Hispanic Caucasian, 5.0% Asian-American, 1.7% Hispanic, 0.8% African-American, 0.8% Indian-American, 1.7% Mixed/Other), and the majority of families were middle class (*M*= 50.1, *SD*= 10.5 on the Hollingshead index). The children and their parents participated in multiple laboratory visits (age 2, 3.5, and 5); however, the focus of this study is the 3.5 year visit.

The participants were screened at 18 months using the Infant Toddler Social and Emotional Assessment (ITSEA; Carter, Briggs-Gowan, Jones, & Little, 2003) to oversample for children rated higher in fear. The internalizing domain consisting of inhibition to novelty, separation distress, and general anxiety categorized the children rated higher in fear (Carter et al., 2003). The externalizing domain consisting of activity/impulsivity, aggression/defiance, and peer aggression categorized children rated higher in surgency (Carter et al., 2003). For the 42-month visit, the ITSEA was reexamined to include children with surgent temperaments as described in Dollar (2011a). The total sample after screening included 42 children identified as fearful, 28 as surgent, and 46 as typical.

## Procedures

The preschoolers and their parents were invited to participate in a laboratory visit that lasted approximately 2 hours in total duration and were video recorded. The visit consisted of multiple assessments of the child's emotions and behaviors during tasks that measure inhibitory control, disappointment, and positive emotions (Dollar, 2011a). Mothers and fathers also participated in tasks to assess parent-child interactions during the visit (Dollar, 2011a). The procedure included the following sequence of episodes: *Disappointment Task, Pop-Up Snakes, CELF, Risk Room, Candyland, Go-NoGo, Mom/Dad Teaching Task, Air Hockey, Go-NoGo, Hippity Hop, Reading Task, Attention Task, and Triadic Free Play and Clean-up.* The *Go-NoGo* task occurred twice within the visit, once after *Candyland* and the other after *Air hockey*. The farm and zoo *Go-NoGo* task order was counterbalanced across participants. We will focus on the two tasks that were designed to measure self-regulation: *Go-NoGo* and *Hippity Hop-Book Reading* transition, as well as *Risk Room* to distinguish temperament profiles.

Children completed two computer *Go-NoGo* tasks that had a theme of farm or zoo animals. The experimenter instructed the child to help catch the animals that had escaped from their pens by pressing a button, but to not catch the dog (for farm trials) or the monkey (for zoo trials) that was helping the farmer or zookeeper, respectively. Pictures of animals appeared one at a time with a blank screen appearing between each animal as shown in Figure 2.1. The experimenter helped the child understand the task during five practice trials before beginning the task (25% NoGo trials; 60 trials total). Experimenters reminded the child of the instructions halfway through the task during a brief pause.

In the *Hippity Hop-Book Reading* transition, the experimenter and child played on hippity hop balls, or large plastic balls with handles on the top for support, while the mother sat in the corner of the room. The experimenter encouraged the child to hop across the room, jump high,

and have fun for two minutes. During this time, a second experimenter entered the room to hand the mother a picture book that did not include any written words. The mother was advised to read the book with her child either sitting in the chair or on the pillow right next to the chair. After the instructions, the second experimenter left the room. Soon after, the first experimenter told the child he/she forgot something in the other room and left the room while leaving the hippity hops. The *Book Reading* portion of the task aimed to assess the efficiency of the child's regulation of emotion and behavior from a high-energy to low-energy task. The task also aimed to assess the mother's influence on the child's regulation.

During the *Risk Room* episode, the experimenter led the child and mother into a room, and instructed the child to play however he or she would like. The mother was instructed to stay uninvolved. The room included a wooden balance beam, long tunnel, set of stairs with a mattress beside it, a large black wooden box with eyes painted on it and a hole cut to look like a mouth, and a rubber gorilla mask displayed on a cardboard pedestal. After three minutes, the experimenter re-entered the room and prompted the child to interact with each of the stimuli. The *Risk Room* task was designed to assess behavioral inhibition according to varying levels of risk objects based on the work from Jerome Kagan (Coll, Kagan, Reznick, 1984).

## Measures

### Child Behaviors

The *Go-NoGo* tasks were coded for inhibitory control behaviors, which aimed to measure the efficiency of the child's self-regulation. When the task started, behaviors were coded in intervals lasting from the onset of one stimulus to the end of the blank screen before the next stimulus appeared in an attempt to include the behaviors that reacted to the previous stimulus.

The behaviors were divided into three subcategories: *quality of response*, *behaviors,* and *communication* (See Table 2.1 for behavior descriptions). *Quality of response* consisted of thoughtful, not effortful, cautious, miss, and off-task responses that measured the child's type of response to the stimulus ($\kappa$=.64). *Behaviors* consisted of looks general, looks to experimenter, withdraw, hesitation, physical restraint, fidgeting, and behavioral off-task that measured the frequency of occurrence of these behavioral displays ($\kappa$=.78). *Communication* consisted of verbalizations, labeling, self-talk, recognition of mistakes, refusal, and verbal off-task that aimed to measure the type of verbal or nonverbal communication the child displayed ($\kappa$=.70). When a verbal communication behavior was used, the child's affect was also coded for the presence of positive, negative, or neutral qualities ($\kappa$=.82). Trial types were also identified as go or no-go trials during coding ($\kappa$=.90). The interrater reliabilities were calculated on 15% of the total sample. Proportions were calculated by dividing the number of intervals for each behavior and trial type by the total number of intervals for that trial type.

In addition to behavioral data, *Go-NoGo* tasks provided quantitative measurements of inhibitory control, a component of self-regulation. Reaction times were collected from the onset of the stimulus until the child pressed the button or until the stimulus was presented for 3500 milliseconds. Reaction times were used to decipher the mean incorrect and correct response times. The number of commission errors was used to calculate the mean reaction time during a commission error and the percentage of commission errors.

The *Hippity Hop-Book Reading* transition was coded for the child's effectiveness in transitioning to the *Book Reading* task. The on-task code required the child to disengaged from the hippity hop ball, and direct full attention to reading the book with his or her mother. Split attention referred to situations where the child may be reading the book with his or her mother, yet the child may be sitting on the ball or holding the ball. Off-task coding meant the child was not partaking in reading the book, and was still bouncing on the hippity hop ball. Verbal refusal

occurred when the child refused to read the book and kept playing with the hippity hop ball. Child unobservable occurred when the child could not be seen in the video frame. The behaviors were coded in 5-second intervals. Reliability was collected in 15% of the total sample. The overall kappa for coding reliability for this task ranged from .93-.97. Proportions were calculated from the intervals for each behavior divided by the total intervals.

For *Risk Room,* Lab-TAB protocol (Buss & Goldsmith, 2000) was used for coding total time spent with each item in the room, the latency to touch each object, and the total number of items touched. In 5-second intervals, the tentativeness of play, activity levels, and vocal and facial affect was also scored. The Lab-TAB behaviors and tentativeness of play created a composite for wariness (Dollar, 2011a). The wariness composite, activity, positive affect, and negative affect were analyzed to create an overall profile of temperament for the participants as described by Dollar (2011a).

**Maternal Behaviors**

During the *Hippity Hop-Book Reading* transition, maternal behaviors and affect were coded to look at the methods mothers used to engage their child in reading the book. The behaviors were selected based on those thought to facilitate the child to efficiently down-regulate their emotion and energy during the high- to low-energy transition. These behaviors included attention-grabbing, verbal command, redirection, on-task, encouraging approach, positive discussion, overprotection, downplaying, and reassurance as developed by Dollar et al. (2011b). These behaviors were coded in 5-second intervals. Reliability was collected in 15% of the total sample with an overall kappa ranging from .92-1.0. Proportions for each behavior were calculated by dividing the frequency of intervals in which the behavior was coded by the total intervals. An additional coding team scored affective intensity peaks for vocalizations and facial expressions

during 5-second intervals. These ratings for affect included high positive, low/moderate positive, neutral, low/moderate negative, and high negative. The kappa reliability was .83. This affect data was then paired with the coded behaviors. Proportions for each general affect category (neutral, positive, negative) of the behaviors were calculated by dividing these frequencies by the total intervals.

Figure 2.1 Sample *Go-NoGo* Task Procedure

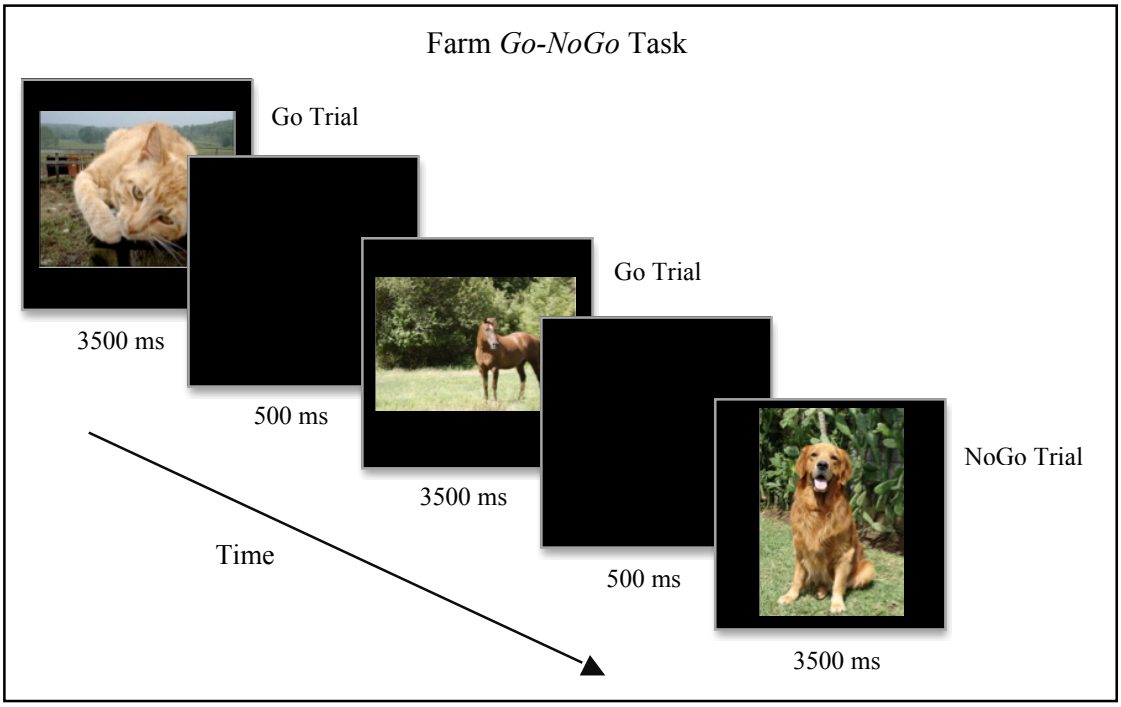


*Figure 2.1* Example of trials within the Farm *Go-NoGo* task. Trial type labels of Go or NoGo determined whether the child should press the button or not press the button, respectively. Go and NoGo trials were presented for 3500 ms, while the black screens were presented for 500 ms as intertrial intervals. The Zoo *Go-NoGo* task included the same parameters but substituted zoo pictures as the stimuli.

Table 2.1 Inhibitory Control Behaviors

| Behavior | Description |
|---|---|
| **Quality of Response** | |
| *Thoughtful* | Any response where the child allows time to comprehend the stimulus and without cautious behaviors |
| *Cautious* | Any response that reflects a cautious behavior such as slowly or softly presses the button, checking keyboard before responding |
| *Not Effortful* | The child is usually not displaying effort in the task by quickly pressing the button to pass the trials, quickly pressing the button, strongly hitting the keyboard |
| *Miss* | When the child does not respond to the question in the allotted time or has missed the trial, but the child is still engaged in the task. The child may be looking away from the screen and not at the computer, or waiting for a response from the experimenter |
| *Off-Task* | The child is distracted by other objects or has refused to participate |
| **Behaviors** | |
| *Looks General* | Any attempt where the child disengages eye contact from the task, such as looking away from the computer screen to their clothes, other objects in the room, etc. This does not include looking at the keyboard to see where button is located, unless it is done in an off-task manner or when they are not trying to press a button |
| *Looks to Experimenter* | Any attempt for the child to look at the experimenter |
| *Withdraw* | Any movement within the body or hand that retracts or moves away from the keyboard or stimulus. These may include leaning back in the chair, leaning head back, or pulling hand away |
| *Hesitation* | Visible gestures seen when a child is deliberating whether or not to press the button. Hesitation may occur when the child reaches to press the button and then pulls their arm back, pauses hand above keyboard before pressing or hovering above the keyboard |
| *Physical Restraint* | When the child is using his/her body or an object to restrain from pressing the button. This may include sitting on his/her hands, holding arms behind the back of the chair, or putting their hand in his/her mouth |
| *Fidgeting* | Excess movement such as squirming in the chair |
| *Off-Task* | When the child is no longer engaged in the activity or is not completing the task due to refusal |

*Continued on the following page.*

| **Communication** | |
|---|---|

| | |
|---|---|
| *Verbalizations* | Talking to engage the experimenter. For example, "Look at the elephant!" or "What animal is this?" |
| *Labeling* | Labeling trials either by naming the animal or naming the trial. Examples include "Go, Go, Wait, Go, Go," or "dog, pig, cat." |
| *Self-Talk* | Repeating instructions, positive affirmation, narrating the situation or whispering to his/herself. Examples include "I can do this, I know!"; "Wait" or "Stop" (During NoGo trials); "Don't touch any keys other than this one" "Nope! I have to wait." |
| *Recognition of Mistakes* | Admitting an error during the trials which may include the child saying things like, "Whoops," "Uh-Oh," or "I went passed the doggy." |
| *Refusal* | Vocalizations referring to giving up on the task or no longer playing such as, "I'm half three and just a little being; I can't do this," or "I don't want to play." |
| *Off-Task* | Any vocalizations that do not pertain to the task such as sharing stories or going on tangents. "I saw Uncle Justin this weekend" or "I've seen a zebra at the zoo." |
| | **Verbal Affect** |
| *Negative* | Display of negative affect during communication. |
| *Positive* | Display of positive affect during communication. |
| *Neutral* | Display of neutral affecting during communication. |

# Chapter 3

# Results

## Missing Data

Of the 124 participants, 108 children completed the Farm episode *Go-NoGo* task (87.1%) and 110 children completed the Zoo episode *Go-NoGo* task (88.7%). The most common reasons for missing trials were due to technical errors and experimenter errors. Missing data in these cases was resolved via pairwise deletion. For children who did not complete the entire task due to refusing to participate in individual trials, proportions for each behavior were calculated from the total trials per trial type that they completed.

## Correlations and Descriptive Statistics for Inhibitory Control Behaviors

Proportions for each inhibitory control (IC) behavior were used to calculate the means, standard deviations, and intercorrelations separated by each *Go-NoGo* task and trial type as shown in Table 3.2, Table 3.3, Table 3.4, and Table 3.5. Thoughtful responses were significantly positively correlated with cautious and hesitation behaviors during go trials, while thoughtful responses significantly positively correlated with looks to experimenter, withdraw, physical restraint, and self-talk during NoGo trials. Paired t-tests were calculated for these correlated behaviors for each episode as shown in Table 3.1. The t-tests revealed a difference between trial types with NoGo trials resulting in more behaviors.

Composites of IC behaviors combined NoGo trials of thoughtful, looks to experimenter, withdraw, physical restraint, and self-talk within each episode. The composites for IC behaviors

were then used in paired t-tests that revealed the farm episode to have more occurrences than the zoo episode, $t(103) = 9.83$, $p = .000$. Therefore, the composite for the farm episode was used as the measure for inhibitory control behaviors.

### Inhibitory Control Behaviors and Inhibitory Control Performance

The correlations between the IC behavior composite and IC performances per episode are summarized in Table 3.6. In the Farm *Go-NoGo* task, the IC farm behaviors were positively correlated with the mean reaction time for correct responses such that a higher proportion of IC behaviors was associated with longer reaction time. The IC farm behaviors were also negatively correlated with the mean reaction time for incorrect responses and the percentage of commission errors. Higher proportions of IC behaviors were associated with fewer errors but faster responses during errors.

### Inhibitory Control Behaviors and Book Reading Transition

The IC behavior composite was compared to the child behaviors during *Book Reading* using bivariate correlations as summarized in Table 3.6. No significant correlations were found between the IC behaviors composite and whether the child was on-task, off-task, unobservable, had split attention, or verbally refused. IC behaviors were not associated with child behaviors during the *Book Reading* transition.

Child behaviors during *Book Reading* were also tested against inhibitory control performance as summarized in Table 3.6. No significant correlations were found. Child behavior during *Book Reading* was not associated with inhibitory control performance.

## Inhibitory Control Behaviors and Temperament as a Moderator

Inhibitory control behavior composites and temperament profiles were analyzed using a one-way analysis of variance (ANOVA). In contrast to predictions, the IC behavior composite did not vary by temperament profiles, $F(2, 203) = .33$, $p = .72$. Correlation analyses were used to study maternal behavior and affect and its relation on child performance across tasks (refer to Table 3.6). Maternal behaviors and affect were compared to the IC farm behavior composite. The IC behavior composite positively correlated with maternal on-task behavior during *Book Reading* showing a higher proportion of IC behaviors was associated with more on-task maternal behaviors. The IC behavior composite also negatively correlated with maternal redirection, positive redirection, and negative prohibitive statements such that a higher proportion of IC behaviors was related to lower proportions of redirection, positive redirection, and negative prohibitive statements. Higher proportions of IC behaviors were associated with more maternal on-task behaviors and less redirection and prohibitive statements.

Regression analyses were performed to see the extent that the IC behavior composite, maternal behavior, and their interaction predicted child *Book Reading* behavior. None of the models were significant.

Table 3.1 Descriptive Statistics and T-Tests

| Behavior | Trial Type | Mean (SD) | 95% Confidence Interval | | T-Test | df | Sig. (two-tailed) |
|---|---|---|---|---|---|---|---|
| | | | LL | UL | | | |
| *Farm Episode* | | | | | | | |
| Thoughtful | NoGo | .06 (.20) | .02 | .10 | 3.06 | 107 | .003 |
| Thoughtful | Go | | | | | | |
| Cautious | NoGo | -.03 (.06) | -.04 | -.02 | -5.08 | 107 | .000 |
| Cautious | Go | | | | | | |
| Hesitation | NoGo | .05 (.09) | .04 | .08 | 6.05 | 107 | .000 |
| Hesitation | Go | | | | | | |
| Looks to Exp. | NoGo | .22 (.25) | .17 | .26 | 9.02 | 107 | .000 |
| Looks to Exp. | Go | | | | | | |
| Withdraw | NoGo | .31 (.30) | .25 | .36 | 10.63 | 107 | .000 |
| Withdraw | Go | | | | | | |
| Physical Rest. | NoGo | .05 (.10) | .03 | .65 | 4.74 | 107 | .000 |
| Physical Rest. | Go | | | | | | |
| Self-Talk | NoGo | .06 (.10) | .04 | .75 | 6.01 | 107 | .000 |
| Self-Talk | Go | | | | | | |
| *Zoo Episode* | | | | | | | |
| Thoughtful | NoGo | .13 (.27) | .08 | .19 | 5.22 | 109 | .000 |
| Thoughtful | Go | | | | | | |
| Cautious | NoGo | -.03 (.10) | -.05 | -.01 | -2.87 | 109 | .005 |
| Cautious | Go | | | | | | |
| Hesitation | NoGo | .08 (.12) | .10 | .10 | 7.03 | 109 | .000 |
| Hesitation | Go | | | | | | |
| Looks to Exp. | NoGo | .22 (.25) | .17 | .27 | 9.19 | 109 | .000 |
| Looks to Exp. | Go | | | | | | |
| Withdraw | NoGo | .32 (.30) | .26 | .37 | 11.07 | 109 | .000 |
| Withdraw | Go | | | | | | |
| Physical Rest. | NoGo | .04 (.10) | .02 | .06 | 4.31 | 109 | .000 |
| Physical Rest. | Go | | | | | | |
| Self-Talk | NoGo | .07 (.13) | .04 | .09 | 5.49 | 109 | .000 |
| Self-Talk | Go | | | | | | |

*Note*. Results are a summary from the calculated paired t-tests for each episode. Looks to Exp. = Looks to Experimenter. Physical Rest. = Physical Restraint. LL = Lower Limit of Confidence Interval. UL = Upper Limit of Confidence Interval.

Table 3.2 Inhibitory Control Behavior Correlations for Farm Episode, Go Trials

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. T** | -- | | | | | | | | | | | | | | | | | | | | |
| 2. NE | **-.87**** | -- | | | | | | | | | | | | | | | | | | | |
| **3. C** | **.27**** | **-.44**** | -- | | | | | | | | | | | | | | | | | | |
| 4. M | **-.20*** | -.03 | .07 | -- | | | | | | | | | | | | | | | | | |
| 5. QOT | **-.31**** | -.10 | -.10 | .03 | -- | | | | | | | | | | | | | | | | |
| 6. LG | -.17 | .05 | -.09 | **.36**** | .17 | -- | | | | | | | | | | | | | | | |
| 7. LE | **-.21*** | .10 | -.09 | **.39**** | .12 | **.25**** | -- | | | | | | | | | | | | | | |
| 8. W | -.07 | -.03 | .14 | **.23*** | .03 | .14 | **.31**** | -- | | | | | | | | | | | | | |
| **9. H** | .18 | **-.28**** | **.50**** | **.24*** | -.11 | .16 | **.20*** | **.21*** | -- | | | | | | | | | | | | |
| 10. F | **-.20*** | .08 | -.14 | .30** | .15 | **.23*** | .15 | **.27*** | -.10 | -- | | | | | | | | | | | |
| 11. PR | .08 | -.17 | **.27**** | .07 | .02 | .09 | **.21*** | **.41**** | **.24*** | .05 | -- | | | | | | | | | | |
| 12. BOT | **-.45**** | **.27**** | **-.19*** | .09 | **.47**** | .17 | .23* | -.06 | -.14 | .09 | -.05 | -- | | | | | | | | | |
| 13. Pos | -.05 | -.02 | .08 | .10 | -.01 | .06 | .17 | **.43**** | .10 | .05 | **.46**** | -.06 | -- | | | | | | | | |
| 14. Neu | -.15 | .00 | -.08 | **.35**** | .20* | .23 | **.51**** | **.30**** | .02 | .16 | **.30**** | .19 | **.36**** | -- | | | | | | | |
| 15. Neg | -.11 | .06 | -.06 | **.26**** | .03 | -.05 | .18 | .04 | -.04 | .09 | -.04 | -.04 | .01 | -.01 | -- | | | | | | |
| 16. ST | .03 | -.02 | .10 | .04 | -.06 | .02 | **.26**** | **.33**** | .16 | -.02 | **.43**** | -.16 | **.44**** | **.29**** | .03 | -- | | | | | |
| 17. L | -.04 | -.04 | -.08 | **.32**** | .05 | **.22*** | .18 | .07 | -.03 | .11 | .13 | -.07 | **.34**** | **.76**** | -.10 | .12 | -- | | | | |
| 18. V | -.12 | .06 | .09 | .13 | .02 | .03 | **.41**** | **.42**** | .16 | .02 | **.53**** | -.01 | **.53**** | **.42**** | **.20*** | **.46*** | .02 | -- | | | |
| 19. MR | .13 | -.15 | .19 | .14 | -.13 | -.03 | **.32**** | .12 | .17 | -.02 | .16 | -.11 | .08 | .12 | .14 | .12 | -.06 | .10 | -- | | |
| 20. R | -.10 | -.01 | -.11 | .15 | **.24*** | .03 | .13 | **.28**** | -.10 | .15 | -.02 | **.22*** | .11 | **.23*** | **.47**** | .03 | .04 | .12 | -.13 | -- | |
| 21. VOT | **-.21*** | .01 | -.08 | .14 | **.29**** | .15 | **.38**** | .16 | .00 | .11 | .10 | **.21*** | **.29*** | **.44**** | .01 | .11 | -.01 | **.32**** | .12 | -.04 | -- |
| Mean | .44 | .41 | .04 | .06 | .05 | .03 | .08 | .02 | .01 | .05 | .00 | .11 | .02 | .10 | .01 | .01 | .03 | .04 | .01 | .02 | .02 |
| *SD* | .30 | .30 | .07 | .07 | .14 | .04 | .07 | .07 | .02 | .06 | .01 | .20 | .04 | .10 | .05 | .03 | .07 | .05 | .02 | .06 | .04 |

*Note*. Significant behaviors used for IC behavior analyses are shown in boldface. *N*=108. T=Thoughtful, NE=Not Effortful, C=Cautious, M=Miss, QOT=Quality Off-Task, LG=Looks General, LE=Looks to Experimenter, WD=Withdraw, H=Hesitation, F=Fidgeting, PR=Physical Restraint, BOT=Behavioral Off-Task, Pos=Positive Affect, Neu=Neutral Affect, Neg=Negative Affect, ST=Self-Talk, L=Labeling, V=Verbalization, MR=Mistake Recognition, R=Refusal, VOT=Verbal Off-Task.
**p* < .05, ***p* < .01

Table 3.3 Inhibitory Control Behavior Correlations for Farm Episode, NoGo Trials

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. T** | -- | | | | | | | | | | | | | | | | | | | | |
| 2. NE | **-.95**** | -- | | | | | | | | | | | | | | | | | | | |
| 3. C | .10 | -.14 | -- | | | | | | | | | | | | | | | | | | |
| 4. M | -.06 | .03 | -.04 | -- | | | | | | | | | | | | | | | | | |
| 5. QOT | **-.27**** | -.03 | -.07 | .01 | -- | | | | | | | | | | | | | | | | |
| 6. LG | **.21*** | **-.22*** | **.26**** | -.09 | .00 | -- | | | | | | | | | | | | | | | |
| **7. LE** | **.54**** | **-.54**** | .08 | .06 | -.07 | -.18 | -- | | | | | | | | | | | | | | |
| **8. WD** | **.77**** | **-.74**** | **.23*** | -.07 | **-.23*** | **.24*** | **.53**** | -- | | | | | | | | | | | | | |
| 9. H | **.42**** | **-.40*** | **.26**** | -.08 | -.16 | .17 | .14 | **.49**** | -- | | | | | | | | | | | | |
| 10. F | **.21*** | **-.22*** | .01 | -.10 | .02 | **.23*** | **.27**** | **.29**** | -.10 | -- | | | | | | | | | | | |
| **11. PR** | **.31**** | **-.30**** | .18 | -.04 | -.08 | .10 | **.25*** | **.45**** | **.25**** | .17 | -- | | | | | | | | | | |
| 12. BOT | **-.29**** | .17 | -.12 | .07 | **.42**** | -.11 | -.16 | **-.34**** | **-.20*** | -.06 | -.17 | -- | | | | | | | | | |
| 13. Pos | .03 | -.03 | .26** | -.04 | -.06 | -.18 | .14 | .05 | .07 | .01 | .04 | -.18 | -- | | | | | | | | |
| 14. Neu | .15 | **-.20*** | -.02 | .16 | .12 | **-.21*** | **.47**** | .12 | -.14 | **.28**** | .03 | -.05 | **.21*** | -- | | | | | | | |
| 15. Neg | -.07 | .00 | -.08 | -.05 | **.26**** | -.02 | .02 | -.06 | -.15 | **.25**** | -.04 | .10 | .12 | .05 | -- | | | | | | |
| **16. ST** | **.22*** | -.18 | -.03 | -.07 | -.12 | -.09 | **.28**** | **.19*** | **.24*** | .03 | .04 | -.14 | **.37**** | **.30**** | .18 | -- | | | | | |
| 17. L | -.04 | .04 | .03 | .05 | .01 | -.08 | .14 | -.08 | **-.21*** | **.23*** | -.05 | -.09 | **.34**** | **.51**** | -.02 | .06 | -- | | | | |
| 18. V | .25 | **-.24*** | .10 | -.03 | -.06 | **-.20*** | **.47*** | .17 | -.07 | **.22*** | .03 | -.16 | **.42**** | **.70**** | .08 | .18 | **.24*** | -- | | | |
| 19. MR | -.03 | .03 | **.34**** | -.05 | -.06 | -.01 | .11 | .01 | .13 | -.10 | .03 | -.02 | .08 | .06 | .01 | -.03 | -.07 | .00 | -- | | |
| 20. R | -.04 | -.09 | -.06 | **.26**** | **.39**** | .02 | .02 | -.04 | -.17 | .13 | .00 | **.24*** | -.05 | **.21*** | **.47**** | -.11 | -.02 | -.05 | .02 | -- | |
| 21. VOT | **-.23*** | .12 | -.01 | .15 | **.38**** | -.18 | .03 | -.12 | -.07 | .00 | -.01 | .16 | .07 | **.36**** | .02 | .07 | -.03 | .07 | .06 | -.03 | -- |
| Mean | .52 | .44 | .01 | .00 | .04 | .08 | .29 | .33 | .07 | .13 | .05 | .08 | .04 | .16 | .01 | .06 | .04 | .09 | .01 | .03 | .03 |
| *SD* | .35 | .34 | .02 | .01 | .11 | .10 | .26 | .30 | .10 | .14 | .11 | .17 | .08 | .19 | .04 | .10 | .10 | .15 | .02 | .07 | .07 |

Note. Significant behaviors used for IC behavior analyses are shown in boldface. N=108. T=Thoughtful, NE=Not Effortful, C=Cautious, M=Miss, QOT=Quality Off-Task, LG=Looks General, LE=Looks to Experimenter, WD=Withdraw, H=Hesitation, F=Fidgeting, PR=Physical Restraint, BOT=Behavioral Off-Task, Pos=Positive Affect, Neu=Neutral Affect, Neg=Negative Affect, ST=Self-Talk, L=Labeling, V=Verbalization, MR=Mistake Recognition, R=Refusal, VOT=Verbal Off-Task.
*$p < .05$, **$p < .01$

Table 3.4 Inhibitory Control Behavior Correlations for Zoo Episode, Go Trials

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. T** | -- | | | | | | | | | | | | | | | | | | | | |
| 2. NE | **-.85**** | -- | | | | | | | | | | | | | | | | | | | |
| **3. C** | **.23*** | **-.44**** | -- | | | | | | | | | | | | | | | | | | |
| 4. M | -.13 | -.06 | -.13 | -- | | | | | | | | | | | | | | | | | |
| 5. QOT | **-.39**** | -.04 | .00 | -.10 | -- | | | | | | | | | | | | | | | | |
| 6. LG | **-.26**** | **.25**** | -.10 | **.22*** | .00 | -- | | | | | | | | | | | | | | | |
| 7. LE | -.16 | -.01 | -.06 | **.56**** | .02 | .08 | -- | | | | | | | | | | | | | | |
| 8. W | .03 | -.02 | .04 | .13 | -.09 | .07 | .16 | -- | | | | | | | | | | | | | |
| **9. H** | **.24*** | **-.31**** | **.58**** | -.01 | -.13 | -.08 | -.04 | .13 | -- | | | | | | | | | | | | |
| 10. F | -.17 | .24* | -.13 | .15 | -.15 | **.23*** | .11 | .17 | -.14 | -- | | | | | | | | | | | |
| 11. PR | .02 | -.04 | **.23*** | -.05 | -.07 | .09 | -.09 | .11 | .16 | .01 | -- | | | | | | | | | | |
| 12. BOT | **-.51**** | **.21*** | -.07 | -.09 | **.73**** | .06 | .02 | -.07 | -.18 | -.07 | -.02 | -- | | | | | | | | | |
| 13. Pos | -.03 | -.05 | -.05 | **.35**** | -.07 | .01 | **.28**** | **.48**** | -.01 | .02 | .02 | -.07 | -- | | | | | | | | |
| 14. Neu | -.10 | .07 | **-.24*** | **.37**** | -.03 | .04 | **.57**** | **.24*** | -.11 | .15 | .02 | -.07 | **.25**** | -- | | | | | | | |
| 15. Neg | **-.21*** | -.06 | **.24*** | -.05 | **.50**** | -.04 | **.25**** | .01 | -.06 | -.04 | -.02 | **.30*** | -.04 | -.06 | -- | | | | | | |
| 16. ST | .18 | -.13 | .01 | .02 | -.11 | -.06 | .12 | **.62*** | .01 | .08 | -.03 | -.08 | **.41**** | **.29**** | -.03 | -- | | | | | |
| 17. L | -.04 | -.05 | -.12 | **.40**** | -.08 | -.03 | **.51**** | .08 | -.06 | .03 | .07 | -.07 | **.37**** | **.68**** | -.04 | .05 | -- | | | | |
| 18. V | -.12 | .08 | -.17 | **.45**** | -.05 | .12 | **.39**** | **.24*** | -.02 | .12 | .10 | -.07 | **.40**** | **.58**** | -.03 | **.20*** | **.19** | -- | | | |
| 19. MR | .06 | .04 | -.11 | .01 | -.15 | .00 | **.22*** | -.01 | .00 | .13 | .03 | -.01 | -.13 | **.35**** | -.02 | .09 | .15 | -.05 | -- | | |
| 20. R | **-.25**** | -.02 | .12 | -.03 | **.56**** | -.06 | **.28**** | -.01 | -.12 | -.03 | -.09 | **.43*** | -.09 | .16 | **.79**** | -.03 | .07 | -.05 | -.03 | -- | |
| 21. VOT | -.16 | .16 | -.18 | .14 | .03 | .06 | .17 | **.30**** | -.08 | .12 | .02 | .14 | **.44**** | **.41**** | -.04 | .16 | .05 | **.37**** | .08 | -.11 | -- |
| Mean | .44 | .41 | .04 | .06 | .03 | .08 | .02 | .01 | .05 | .00 | .11 | .02 | .10 | .01 | .01 | .03 | .03 | .04 | .01 | .02 | .02 |
| *SD* | .30 | .30 | .07 | .07 | .04 | .07 | .07 | .02 | .06 | .01 | .20 | .04 | .10 | .05 | .03 | .07 | .05 | .05 | .02 | .06 | .04 |

*Note*. Significant behaviors used for IC behavior analyses are shown in boldface. *N*=110. T=Thoughtful, NE=Not Effortful, C=Cautious, M=Miss, QOT=Quality Off-Task, LG=Looks General, LE=Looks to Experimenter, WD=Withdraw, H=Hesitation, F=Fidgeting, PR=Physical Restraint, BOT=Behavioral Off-Task, Pos=Positive Affect, Neu=Neutral Affect, Neg=Negative Affect, ST=Self-Talk, L=Labeling, V=Verbalization, MR=Mistake Recognition, R=Refusal, VOT=Verbal Off-Task.
**p* < .05, ***p* < .01

Table 3.5 Inhibitory Control Behavior Correlations for Zoo Episode, NoGo Trials

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. T** | -- | | | | | | | | | | | | | | | | | | | | |
| 2. NE | **-.82**** | -- | | | | | | | | | | | | | | | | | | | |
| 3. C | -.09 | .07 | -- | | | | | | | | | | | | | | | | | | |
| 4. M | -.17 | -.08 | **.24*** | -- | | | | | | | | | | | | | | | | | |
| 5. QOT | **-.25**** | .02 | -.05 | -.04 | -- | | | | | | | | | | | | | | | | |
| 6. LG | .18 | **-.22*** | -.05 | -.09 | .02 | -- | | | | | | | | | | | | | | | |
| **7. LE** | **.37**** | **-.46**** | -.06 | **.21*** | **-.21*** | -.06 | -- | | | | | | | | | | | | | | |
| **8. WD** | **.56**** | **-.65**** | -.08 | -.14 | **-.24*** | **.21*** | **.39**** | -- | | | | | | | | | | | | | |
| 9. H | **.41**** | **-.38**** | -.05 | -.10 | -.14 | .12 | .15 | **.48**** | -- | | | | | | | | | | | | |
| 10. F | .16 | -.18 | -.09 | .09 | -.03 | **.26**** | .00 | **.26**** | -.09 | -- | | | | | | | | | | | |
| **11. PR** | **.19*** | **-.21*** | .01 | -.06 | -.14 | .09 | .18 | **.48**** | **.32**** | -.05 | -- | | | | | | | | | | |
| 12. BOT | **-.37**** | **.27**** | -.06 | -.05 | **.66**** | .04 | **-.23*** | **-.33**** | -.17 | .00 | -.18 | -- | | | | | | | | | |
| 13. Pos | .14 | -.15 | -.03 | -.05 | -.10 | **-.20*** | **.25*** | .08 | .07 | -.01 | .05 | -.15 | -- | | | | | | | | |
| 14. Neu | **-.23*** | -.13 | -.06 | -.09 | -.14 | **-.24*** | **.45**** | .14 | -.07 | .07 | .05 | -.13 | .13 | -- | | | | | | | |
| 15. Neg | .19 | -.02 | -.03 | -.04 | .10 | -.04 | .11 | .00 | -.04 | -.01 | -.05 | -.02 | **.31**** | .12 | -- | | | | | | |
| **16. ST** | **.24*** | **-.24*** | -.05 | -.08 | -.15 | -.16 | **.30**** | **.25**** | .18 | -.08 | .09 | -.19 | **.41**** | **.46**** | .06 | -- | | | | | |
| 17. L | -.03 | -.05 | -.04 | -.03 | -.05 | -.08 | .09 | .02 | -.10 | .03 | -.02 | -.09 | **.27**** | **.30**** | **.22*** | .04 | -- | | | | |
| 18. V | **.23*** | -.18 | .00 | -.07 | -.14 | **-.21*** | **.46**** | .09 | -.16 | .10 | .01 | -.19 | **.57**** | **.62**** | **.22*** | .15 | **.36** | -- | | | |
| 19. MR | .03 | -.02 | -.04 | -.03 | -.07 | -.08 | .17 | .10 | -.13 | .13 | .04 | -.07 | .12 | **.25**** | .01 | .03 | .14 | .15 | -- | | |
| 20. R | **.31*** | -.12 | -.04 | -.01 | **.19*** | -.03 | .14 | .01 | **.22*** | .03 | -.04 | .11 | .09 | **.20*** | **.44**** | .01 | -.02 | .05 | -.04 | -- | |
| 21. VOT | -.17 | **.19*** | -.04 | -.04 | .01 | -.12 | -.03 | **-.21*** | -.15 | -.01 | -.12 | .17 | .18 | **.28**** | .11 | .04 | -.07 | .17 | .13 | .02 | -- |
| Mean | .60 | .38 | .01 | .01 | .04 | .08 | .30 | .34 | .09 | .10 | .04 | .10 | .05 | .15 | .01 | .08 | .02 | .10 | .01 | .02 | .02 |
| *SD* | .41 | .32 | .08 | .10 | .12 | .10 | .26 | .29 | .12 | .13 | .11 | .20 | .12 | .17 | .03 | .14 | .08 | .15 | .02 | .06 | .05 |

*Note*. Significant behaviors used for IC behavior analyses are shown in boldface. *N*=110. T=Thoughtful, NE=Not Effortful, C=Cautious, M=Miss, QOT=Quality Off-Task, LG=Looks General, LE=Looks to Experimenter, WD=Withdraw, H=Hesitation, F=Fidgeting, PR=Physical Restraint, BOT=Behavioral Off-Task, Pos=Positive Affect, Neu=Neutral Affect, Neg=Negative Affect, ST=Self-Talk, L=Labeling, V=Verbalization, MR=Mistake Recognition, R=Refusal, VOT=Verbal Off-Task.
**p* < .05, ***p* < .01

Table 3.6 Correlations Between *Go-NoGo* Task and *Hippity Hop-Book Reading* Transition

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. ICB Comp | -- | | | | | | | | | | | | | | | | | | | |
| 2. Mean RT Incorrect | **-.42**** | -- | | | | | | | | | | | | | | | | | | |
| 3. Mean RT Correct | **.40**** | .18 | -- | | | | | | | | | | | | | | | | | |
| 4. Mean RT Comm Er | -.08 | **.64**** | **.41**** | -- | | | | | | | | | | | | | | | | |
| 5. % Comm Error | **-.87**** | **.52**** | **-.36**** | .15 | -- | | | | | | | | | | | | | | | |
| 6. BR Child On-Task | .04 | .11 | .10 | .03 | -.10 | -- | | | | | | | | | | | | | | |
| 7. BR Child Split | -.03 | -.14 | -.08 | -.07 | -.02 | **-.44**** | -- | | | | | | | | | | | | | |
| 8. BR Child Off-Task | -.12 | -.02 | -.04 | -.08 | .12 | **-.28**** | .13 | -- | | | | | | | | | | | | |
| 9. BR Child Verbal | -.10 | -.04 | -.04 | -.10 | .00 | **.28**** | **.46**** | **.58**** | -- | | | | | | | | | | | |
| 10. BR Child Unobs | -.08 | -.03 | -.02 | -.09 | -.02 | **.33**** | **.47**** | **.54**** | **.99**** | -- | | | | | | | | | | |
| 11. Attn Grabbing | -.06 | **.21*** | .06 | .05 | .14 | .15 | .05 | **-.28**** | -.03 | .02 | -- | | | | | | | | | |
| 12. Negotiation | -.03 | .08 | .01 | .14 | .04 | **-.33**** | .10 | **.33**** | **.34**** | -.08 | -.10 | -- | | | | | | | | |
| 13. Redirection | **-.24*** | .02 | -.01 | -.02 | **.30**** | **-.41**** | -.05 | **.62**** | **.51**** | .03 | -.17 | .17 | -- | | | | | | | |
| 14. On Task | **.20*** | -.07 | .09 | .01 | **-.25*** | **.48**** | .17 | **-.87**** | **-.52**** | .04 | .03 | **-.43**** | **-.60**** | -- | | | | | | |
| 15. Off Task | -.10 | .01 | -.10 | -.02 | .10 | **-.38**** | **-.21*** | **.80**** | **.28**** | -.05 | **-.32**** | **.25**** | **.28**** | **-.84**** | -- | | | | | |
| 16. Command | -.14 | .00 | -.10 | -.04 | .18 | -.14 | -.06 | **.23*** | **.48**** | -.04 | -.04 | **.32**** | **.42**** | **-.33**** | -.02 | -- | | | | |
| 17. Prohibitive | -.18 | -.05 | -.15 | -.10 | .15 | **-.23*** | -.09 | **.41**** | **.51**** | -.04 | -.06 | **.38**** | **.31**** | **-.50**** | **.24*** | **.50**** | -- | | | |
| 18. Positive Redirection | **-.26*** | .09 | .01 | .02 | **.29**** | **-.37**** | -.05 | **.56**** | **.37**** | .01 | -.14 | .12 | **.89**** | **-.53**** | **.25**** | **.35**** | **.24*** | -- | | |
| 19. Neutral Redirection | -.12 | -.05 | -.09 | -.10 | **.19*** | -.16 | -.13 | **.36**** | **.29**** | **.20*** | -.19 | .11 | **.50**** | **-.38**** | **.26**** | .12 | .16 | **.21*** | -- | |
| 20. Negative Redirection | -.13 | -.09 | .01 | -.04 | .13 | -.13 | -.06 | **.21*** | **.49**** | -.03 | -.08 | .02 | **.56**** | **-.21*** | -.03 | **.43**** | **.30**** | **.37**** | **.19*** | -- |
| 21. Positive On-Task | .19 | -.09 | .09 | -.02 | **-.28**** | **.39**** | **.22*** | **-.80**** | **-.45**** | .02 | **.25**** | **-.34**** | **-.56**** | **.81**** | **-.72**** | **-.29**** | **-.45**** | **-.50**** | **-.46**** | **-.20*** |
| 22. Neutral On-Task | -.04 | .01 | .05 | .08 | .05 | .16 | -.11 | -.09 | -.08 | -.01 | **-.38**** | -.13 | -.08 | **.28**** | -.13 | -.12 | -.10 | **-.19*** | .17 | -.01 |
| 23. Negative On-Task | .13 | -.10 | -.13 | -.12 | -.07 | .03 | -.06 | .03 | .03 | -.03 | -.17 | -.11 | -.07 | .16 | -.07 | -.04 | -.02 | -.08 | -.03 | .01 |
| 24. Positive Commands | -.08 | -.07 | -.05 | -.10 | .12 | -.18 | .02 | **.20*** | **.42**** | -.05 | -.03 | .15 | **.43**** | **-.30**** | -.02 | **.88**** | **.38**** | **.39**** | .10 | **.34**** |
| 25. Neutral Commands | -.14 | .18 | -.06 | .08 | .16 | .10 | -.12 | -.01 | .05 | -.02 | .09 | .15 | .04 | -.08 | -.03 | **.33**** | .01 | .04 | .05 | -.05 |
| 26. Negative Commands | -.15 | .02 | -.11 | .01 | .15 | -.09 | -.10 | **.21*** | **.47**** | -.02 | -.06 | **.41**** | **.27**** | **-.28**** | .00 | **.78**** | **.62**** | .18 | .08 | **.47**** |
| 27. Positive Prohibitive | -.16 | .03 | -.16 | -.02 | .15 | -.15 | -.10 | **.31**** | **.25**** | -.03 | -.07 | **.38**** | .05 | **-.37**** | **.26**** | **.34**** | **.71**** | .13 | -.07 | .10 |
| 28. Neutral Prohibitive | -.04 | .04 | -.04 | -.03 | .09 | -.10 | -.04 | **.19*** | .16 | -.01 | -.15 | .12 | **.19*** | **-.23*** | **.21*** | .00 | .12 | .07 | **.46**** | -.04 |
| 29. Negative Prohibitive | **-.21*** | .01 | -.15 | -.04 | .15 | -.13 | -.10 | **.26**** | **.61**** | -.03 | -.06 | **.25**** | **.26**** | **-.34**** | .14 | **.56**** | **.84**** | **.19*** | .09 | **.34**** |
| 30. Positive Reasoning | .12 | -.08 | .00 | -.11 | -.07 | -.06 | .01 | .07 | -.01 | -.03 | -.04 | .04 | .02 | -.07 | .00 | .13 | .17 | .04 | -.07 | .01 |
| 31. Neutral Reasoning | -.08 | -.08 | -.12 | -.08 | .06 | .03 | -.08 | .04 | .09 | -.02 | -.10 | .05 | .13 | -.08 | .02 | **.23*** | .01 | .10 | .12 | .06 |
| 32. Negative Reasoning | -.12 | -.02 | -.04 | -.04 | .11 | -.10 | .02 | .12 | .15 | -.01 | -.09 | .09 | .06 | -.14 | .14 | .04 | .08 | .05 | .08 | -.03 |
| 33. Positive Negotiation | -.06 | .13 | -.01 | .16 | .03 | **-.26**** | .06 | **.29**** | **.28**** | -.07 | -.05 | **.90**** | .00 | **-.40**** | **.28**** | **.25**** | **.41**** | .03 | -.06 | -.06 |
| 34. Neutral Negotiation | .08 | -.04 | .02 | -.02 | .00 | -.18 | .13 | .10 | .05 | -.04 | -.15 | **.40**** | .17 | -.09 | .04 | -.07 | -.04 | .08 | **.27**** | -.08 |
| 35. Negative Negotiation | -.08 | .01 | -.02 | -.01 | .09 | .03 | -.11 | .07 | .15 | -.02 | -.07 | .07 | **.41**** | -.13 | -.07 | **.46**** | .10 | **.51**** | .15 | **.34**** |
| 36. Positive Off-Task | -.07 | .03 | -.07 | -.01 | .06 | **-.32**** | -.19 | **.70**** | .17 | -.04 | **-.25**** | .18 | **.21*** | **-.72**** | **.89**** | -.08 | **.19*** | **.30**** | .08 | -.06 |
| 37. Neutral Off-Task | -.11 | .01 | -.08 | -.05 | .15 | **-.25**** | -.18 | **.57**** | **.27**** | -.05 | **-.26**** | .16 | **.28**** | **-.61**** | **.71**** | -.03 | .16 | .15 | **.57**** | .00 |
| 38. Negative Off-Task | -.10 | .00 | -.15 | -.03 | .11 | -.12 | -.13 | **.30**** | **.34**** | -.02 | -.14 | **.35**** | .13 | **-.31**** | **.19*** | **.50**** | **.51**** | .07 | .08 | **.21*** |
| 39. Negative Behav Sum | -.12 | -.06 | -.18 | -.08 | .13 | -.12 | -.15 | **.30**** | **.55**** | -.04 | -.19 | **.26**** | **.35**** | **-.27**** | .06 | **.67**** | **.62**** | **.25**** | .13 | **.57**** |
| 40. Positive Behav Sum | .11 | -.07 | .07 | -.02 | **-.24*** | .11 | .16 | **-.32**** | **-.29**** | -.02 | .10 | -.12 | **-.30**** | **.29**** | **-.20*** | **-.20*** | **-.26**** | -.10 | **-.54**** | -.18 |
| 41. Neutral Behav Sum | -.10 | .01 | -.01 | .02 | .14 | -.03 | -.18 | **.25**** | .11 | -.01 | **-.45**** | .02 | .15 | -.12 | **.26**** | -.08 | .01 | -.04 | **.55**** | .01 |

*(continued)*

Table 3.6 Correlations Between *Go-NoGo* Task and *Hippity Hop-Book Reading* Transition (continued)

| | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. ICB Comp | | | | | | | | | | | | | | | | | | | | | |
| 2. Mean RT Incorrect | | | | | | | | | | | | | | | | | | | | | |
| 3. Mean RT Correct | | | | | | | | | | | | | | | | | | | | | |
| 4. Mean RT Comm Er | | | | | | | | | | | | | | | | | | | | | |
| 5. % Comm Error | | | | | | | | | | | | | | | | | | | | | |
| 6. BR Child On-Task | | | | | | | | | | | | | | | | | | | | | |
| 7. BR Child Split | | | | | | | | | | | | | | | | | | | | | |
| 8. BR Child Off-Task | | | | | | | | | | | | | | | | | | | | | |
| 9. BR Child Verbal | | | | | | | | | | | | | | | | | | | | | |
| 10. BR Child Unobs | | | | | | | | | | | | | | | | | | | | | |
| 11. Attn Grabbing | | | | | | | | | | | | | | | | | | | | | |
| 12. Negotiation | | | | | | | | | | | | | | | | | | | | | |
| 13. Redirection | | | | | | | | | | | | | | | | | | | | | |
| 14. On Task | | | | | | | | | | | | | | | | | | | | | |
| 15. Off Task | | | | | | | | | | | | | | | | | | | | | |
| 16. Command | | | | | | | | | | | | | | | | | | | | | |
| 17. Prohibitive | | | | | | | | | | | | | | | | | | | | | |
| 18. Positive Redirection | | | | | | | | | | | | | | | | | | | | | |
| 19. Neutral Redirection | | | | | | | | | | | | | | | | | | | | | |
| 20. Negative Redirection | | | | | | | | | | | | | | | | | | | | | |
| 21. Positive On-Task | -- | | | | | | | | | | | | | | | | | | | | |
| 22. Neutral On-Task | **-.23*** | -- | | | | | | | | | | | | | | | | | | | |
| 23. Negative On-Task | -.16 | **.43**** | -- | | | | | | | | | | | | | | | | | | |
| 24. Positive Commands | **-.24*** | -.11 | -.07 | -- | | | | | | | | | | | | | | | | | |
| 25. Neutral Commands | -.08 | -.01 | .14 | **.21*** | -- | | | | | | | | | | | | | | | | |
| 26. Negative Commands | **-.23*** | -.08 | -.02 | **.44**** | .05 | -- | | | | | | | | | | | | | | | |
| 27. Positive Prohibitive | **-.34**** | -.14 | -.04 | **.19*** | .11 | **.43**** | -- | | | | | | | | | | | | | | |
| 28. Neutral Prohibitive | **-.26**** | .10 | -.05 | .03 | -.02 | -.02 | -.04 | -- | | | | | | | | | | | | | |
| 29. Negative Prohibitive | **-.32**** | -.07 | .03 | **.39**** | -.05 | **.67**** | **.40**** | -.04 | -- | | | | | | | | | | | | |
| 30. Positive Reasoning | .00 | -.09 | -.09 | **.27**** | -.05 | -.04 | **.20*** | -.04 | .03 | -- | | | | | | | | | | | |
| 31. Neutral Reasoning | -.07 | .02 | -.06 | **.21*** | **.27**** | .06 | -.05 | **.41**** | -.05 | -.05 | -- | | | | | | | | | | |
| 32. Negative Reasoning | -.17 | .09 | -.03 | .09 | -.02 | -.02 | -.03 | **.70**** | -.03 | -.03 | **.59**** | -- | | | | | | | | | |
| 33. Positive Negotiation | **-.28**** | -.17 | -.08 | .07 | .11 | **.40**** | **.49**** | .03 | **.28**** | .10 | -.06 | .02 | -- | | | | | | | | |
| 34. Neutral Negotiation | **-.19*** | .11 | -.11 | -.09 | -.07 | -.06 | -.12 | **.26**** | -.07 | -.11 | .07 | .18 | .05 | -- | | | | | | | |
| 35. Negative Negotiation | -.18 | -.15 | -.05 | **.46**** | **.24*** | **.23*** | .16 | -.03 | .10 | .11 | **.25**** | -.02 | .01 | -.09 | -- | | | | | | |
| 36. Positive Off-Task | **-.62**** | **-.20*** | -.11 | -.04 | -.05 | -.08 | **.32**** | -.02 | .07 | .01 | -.09 | -.04 | **.25**** | -.04 | .07 | -- | | | | | |
| 37. Neutral Off-Task | **-.61**** | .03 | -.02 | -.03 | .00 | -.03 | .02 | **.58**** | .07 | -.05 | **.22*** | **.43**** | .11 | **.19*** | -.04 | **.39**** | -- | | | | |
| 38. Negative Off-Task | **-.30**** | -.01 | .10 | **.21*** | .10 | **.70**** | **.47**** | -.03 | **.47**** | .06 | .02 | -.02 | **.38**** | -.05 | .01 | .01 | **.19*** | -- | | | |
| 39. Negative Behav Sum | **-.39**** | .12 | **.45**** | **.41**** | .12 | **.80**** | **.40**** | -.03 | **.68**** | -.01 | .07 | .00 | **.26**** | -.12 | **.30**** | -.06 | .08 | **.73**** | -- | | |
| 40. Positive Behav Sum | **.69**** | **-.60**** | **-.37**** | -.11 | -.09 | **-.20*** | -.02 | **-.35**** | **-.23*** | .14 | -.14 | **-.25**** | .01 | **-.29**** | .02 | .06 | **-.50**** | **-.28**** | **-.41**** | -- | |
| 41. Neutral Behav Sum | **-.54**** | **.82**** | **.31**** | -.08 | .03 | -.07 | -.11 | **.45**** | -.02 | -.11 | .18 | **.32**** | -.08 | **.28**** | -.11 | .02 | **.58**** | .09 | .14 | **-.80**** | -- |

*(continued)*

*Note*. Inhibitory control performance is summarized in items 2-5. Child behaviors during *Book Reading* are summarized in items 6-10. Maternal behaviors during *Book Reading* are summarized in items 11-17. Maternal behaviors are separated by the affect displayed by the mother in items 18-38. The summary of overall affect across maternal behaviors is summarized in items 39-41. ICB Comp=Inhibitory Control Behavior Composite, Comm Err=Commission Error, BR=*Book Reading*, Split=Split Attention, Verbal= Verbal Refusal, Unobs=Unobservable, Attn Grabbing=Attention Grabbing, Prohibitive=Prohibitive Statement, Negative Behav Sum=Negative Behaviors Sum, Positive Behav Sum=Positive Behaviors Sum, Neutral Behav Sum=Neutral Behaviors Sum.
*$p < .05$, **$p < .01$

# Chapter 4

## Discussion

This thesis investigated the behaviors preschool-aged children displayed while completing an inhibitory control task, and the relation these behaviors had with inhibitory control performance, a self-regulation task, and potential moderators (maternal behaviors and affect, and temperament). The results showed some support for a link between inhibitory control behaviors and performance as well as the influence of maternal behaviors; however, no evidence was found to support a link to other self-regulation tasks and temperament profiles.

Aligning with the first hypothesis, the inhibitory control behaviors of thoughtful responses, looks to experimenter, hesitation, physical restraint, and self-talk appeared to assist children in the inhibitory control task. Previous research has focused solely on the reaction times and number of errors when studying inhibitory control performance, yet this thesis showed there are observable behavioral indicators of performance as well (Rueda, Posner, & Rothbart, 2005). Children who displayed more of these inhibitory control behaviors tended to have longer reaction times during correct responses, possibly contributing to the individual differences in reaction times and development of inhibitory control. Children with more inhibitory control behaviors also had fewer commission errors, and longer reaction times during correct trials. Similar to Rothbart and Rueda (2005), children between 30 to 39 months are developing the ability to detect errors, which caused slowed responses after an error and an increase in the ability to inhibit. In addition, by age 4, children were able to show an understanding of task instructions, yet their reaction times were significantly longer than older children and adults (Rothbart & Rueda, 2005). With this study's sample between these ages, these behaviors may also be measuring the development

of the internalization of inhibition or regulation. These inhibitory control behaviors may also account for the increased reaction times as children develop self-regulation. Therefore, inhibitory control behavior is associated with individual differences as another indicator of inhibitory control performance.

Contrary to our hypothesis, child inhibitory control behaviors and performance were not associated with child *Book Reading* behaviors. This evidence showed that these inhibitory control behaviors are likely specific to the inhibitory control task, and possibly not trait-like. Past research has indicated the processes surrounding inhibitory control are rapidly developing to integrate several domains during the preschool age (Cole et al., 2011). Therefore, the ability for children to generalize these behaviors to different situations may not have developed yet (Cole et al., 2011). The inhibitory control task behaviors and performance did not relate to the self-regulation transition.

Existing research showed that temperament had an influence on self-regulation tasks such as *Book Reading* in Dollar (2011b). Past research also showed strong connections between temperament and self-regulation (Rothbart & Rueda, 2005). In the current thesis, temperament was not associated with inhibitory control behaviors, which was in contrast to previous findings and our hypothesis. Therefore, the inhibitory control behaviors may only be related to the *Go-NoGo* task or there may be differences in how the inhibitory control behaviors are used by children of different temperaments. However, the current study did not reveal these potential temperament differences.

Although inhibitory control behaviors and performance did not influence the child's behavior during *Book Reading*, there was a link to maternal behaviors. An increase in inhibitory control behaviors was associated with the mother having to work less to have the child engaged during the *Book Reading* task. This relation also indicated that inhibitory control behaviors assisted the development of self-regulation as previously stated. Inhibitory control behaviors were

also negatively associated with redirection and negative prohibitive statements, showing mothers had to use less of these behaviors for children to transition between tasks. Mothers who showed more of the maternal behaviors were likely attempting to teach skills associated with self-regulation. These findings are similar to Spinrad and colleagues (2011) that found children who complied better to their mothers had later improved effortful control. Also, parents of children with higher self-regulation and obedience may allow their children to engage in more independent tasks that exercise self-regulation development (Spinrad et al., 2011). These maternal behaviors may also be more dominant in the transition setting, since the child behaviors showed no associations to the inhibitory control measures. Maternal behaviors were related to IC behaviors and performance.

An interaction between inhibitory control behaviors and maternal behaviors was not found in predicting child *Book Reading* behaviors. This was likely due to the inhibitory control behaviors not being related to child *Book Reading* behaviors. In addition, this may be associated with maternal behaviors overpowering the child's regulation, or the lack of generalization the children have developed for self-regulation strategies.

## Future Directions and Limitations

This thesis showed a likely promise that not only can self-regulation be measured in children, but also how children self-regulate can be measured. Future studies coding behaviors across self-regulation tasks may give better insight to the strategies children develop for self-regulation. Further, these studies may show the development of the internalization of self-regulation as children increase inhibition and control of their behaviors. If these findings are replicated across multiple inhibitory control and effortful control tasks, the findings could help clinicians identify intervention methods such as those to identify and remediate self-regulation

deficits (Blair et al., 2005). Prior research supports that effortful control is linked to internalizing and externalizing problems (Allan & Lonigan, 2011), and this further research could help identify precursors to these possible problems and enhance children's development of effective self-regulation. Identification of these behaviors can also help with teacher interventions, where Bierman (2011) found that in early elementary years, teachers have greater impact on peer liking, aggression, and peer relations, which are also correlated with self-regulation. Examples of the evidence-based interventions include PATHS (Promoting Alternative Thinking Strategies; Greenberg, Kusche, Cook, & Quamma, 1995) and the Head Start REDI program (Bierman Nix, Greenberg, Blair, & Domitrovich, 2008).

Although this thesis touches on a new approach to measuring individual differences in inhibitory control, there are some limitations to the study. First, these behaviors that were only the ones observed by coders, and do not account for possible internalized strategies the children may have used (e.g., thoughts). This relies on the difficulty in knowing that if children who had few observable inhibitory behaviors are low in inhibitory conrtrol or not, because child could possibly enhance their performance by engaging in unobservable strategies. Second, temperament profiles associated with avoidance or approach to novelty were the only temperament measures used to analyze for a moderator. Including more assessments such as mother report and teacher report, may give insight to other the aspects of temperament, such as anger or impulsivity, that associate with these behaviors. Finally, the model lacked comparisons of maternal behaviors across different tasks. As mentioned previously, the maternal behaviors may have overpowered the child's ability to self-regulate, so incorporating a task that could better measure this component would likely be beneficial.

## Conclusion

This thesis provided insight into how preschool-aged children regulate themselves during an inhibitory control task and its relation to self-regulation. Further research studying behaviors across types of self-regulation tasks as well as tracking the behavior longitudinally will help identify possible ways for interventions. Self-regulation is essential for the development of social and scholastic readiness. This thesis provides evidence for a new approach in investigating behaviors used for self-regulation.

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**Research Experience**

Research Assistant, The Pennsylvania State University, University Park, PA
- Worked 10 hours per week for 3 academic credits

*Emotion Development Lab,* "TIKES" Project, 2011-Present
Dr. Kristin Buss, Department of Psychology
- Studied children's emotion regulation from toddler to Kindergarten years
- Administered interviews, assisted with data collection visits; reliability coding across several coding schemes, and data entry

*Infant and Child Temperament Lab,* "HAPPY" Project, 2009-2011
Dr. Cynthia Stifter, Department of Human Development and Family Studies

- Coded Preschool children's activity to analyze the effects of parent-child interactions
- Experience with several coding schemes for reliability coding and data entry

**Work Experience**

*Lead Teaching Assistant,* University Park, PA, Fall 2011-Fall 2013
- Taught biweekly two-hour lab periods about mammalian anatomy (Biol 129) and held office hours each week
- Experience with teaching, dissections, proctoring exams, grading, and teaching assistant meetings
- Interview Committee member: Interviewed and selected students for teaching openings

*JSerra High Tennis Camps, Assistant Coach*, San Juan Capistrano, CA, 2010-2012
- Coached the Freshmen-Sophomore, Junior Varsity, and Varsity summer camps

*JSerra Kids Tennis Camps, Tennis Coach,* San Juan Capistrano, CA, 2009-2011
- Coached children ages 3-12 the fundamentals of tennis in summer clinics and camps

*Science Externship at City of Hope Hospital, Student Shadow*, Duarte, CA, June 2010
- Followed a neurosurgeon through clinics, patient rounds, research labs, and surgeries

**Activities**

Penn State's Free Wheelchair Mission, Founder and President
Free Wheelchair Mission, Ambassador
Penn State's Ballroom Dance Competition Team, Competing Dancer
LifeLink PSU, Mentor
Schreyer Honors College Literary Committee, Secretary and Webmaster
Schreyer Honors College Orientation (SHOTIME), Mentor
Penn State Club Tennis, Member and Athlete
United States Tennis Association, Member and Competing Athlete
Penn State Varsity Tennis, Freshman Athlete
Eberly College of Science Student Council, Secretary