

**SELF CONTROL AND AGGRESSIVE BEHAVIOR DURING THE
TRANSITION TO ADOLESCENCE: FINDINGS IN A VENEZUELAN
SAMPLE**

by

Ariel Ida Appelbaum Williamson

A dissertation submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Psychology

Summer 2016

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TRANSITION TO ADOLESCENCE: FINDINGS IN A VENEZUELAN
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ACKNOWLEDGMENTS

Nancy G. Guerra, Ed.D., for her mentorship throughout this project as well as during my progress towards the doctoral degree. I greatly appreciate all of the opportunities that she has provided me with, and I am forever grateful to both her and Kirk R. Williams, Ph.D., for bringing me along on their California to Delaware adventure. I also would like to thank Dr. Williams for his guidance on statistical methods, and for reminding me to always keep things simple.

Brian P. Ackerman, Ph.D., and Ryan Beveridge, Ph.D., for serving as my committee members, and for their continued communication and support during this project and throughout my graduate student career.

Suzanne Duryea, Ph.D., of the Inter-American Development Bank and the *El Sistema* research team (Xiomara Alemán, Ph.D., Patrick McEwan, Ph.D., Rodrigo Muñoz, and Marco Stampini, Ph.D.) for the opportunity to collaborate on the impact evaluation of Venezuela's National System of Children's and Youth Orchestras. I also thank the Venezuelan Fundación Musical Simón Bolívar and the parents and children who participated in this study.

My professional colleagues and friends for their feedback, support, humor, and understanding, especially from Lauren McManus, Lauren Swift, Carly Yasinski, C. Beth Ready, Ph.D., Joanna Herres, Ph.D., and Noel Shadowen.

My parents, Tom and Jeanne Appelbaum, my brother, Sam Appelbaum, and my family-in-law, Diane, Jim, Brendan, and Conner Williamson, for their encouragement.

Above all, I grateful for my husband, Colin James Williamson, Ph.D., who has provided me with unconditional support, love, humor, encouragement, and guidance in navigating this project and my life since 2002.

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ABSTRACT

Self-control is a multifaceted and widely researched construct within child development that has important implications for the prevention of aggressive behavior problems. Although many U.S.-based studies of child self-control are available, few have utilized multi-method and multi-informant approaches to measure this construct during the transition to adolescence. The overall goal of this study was to inform the aggression prevention literature by replicating and extending U.S. findings on self-control in the areas of: the structure of, associations among, and stability of self-control indicators during the transition to adolescence; individual differences associated with self-control; and associations between self-control indicators and aggressive behavior in a Venezuelan youth sample ($N = 595$; 50.9% female; M age = 11.33 years). Study measures were examined at Time 1 and 12 months later, at Time 2. Results showed that observed self-control data formed three distinct child-reported, parent-reported, and performance-based latent factors, which were significantly intercorrelated. The factors were largely stable over time, with performance-based self-control showing the highest stability coefficient. Few individual differences were associated with variation in self-control at Time 1 and from Time 1 to Time 2, although there were some significant child age and gender differences. Finally, although the self-control and aggressive behavior factors were moderately associated at both time points, only the Time 1 parent-reported self-control

factor predicted Time 2 residualized change in parent-reported child aggressive behavior. Results are discussed in the context of measurement strategies to assess self-control, as well as implications for targeted aggression prevention programs during childhood and adolescence.

Chapter 1

INTRODUCTION

Control of cognitive, behavioral, and emotional responses is an adaptive and widely studied developmental skill that is predictive of broad psychosocial outcomes (Berger, 2011; Moffitt et al., 2011; Tangney, Baumeister, & Boone, 2004). In particular, studies have shown that lower self-control is robustly associated with concurrent and longitudinal aggressive and risk-taking behaviors (e.g., Moffitt et al., 2011; Pratt & Cullen, 2000; White et al., 1994). A corresponding literature has shown that self-control is an important target for preventive interventions, and that it can be improved through targeted programming (Greenberg, Kusche, Cook, & Quamma, 1995; Lochman & Wells, 2004; Piquero, Jennings, & Farrington, 2010).

Given the importance of self-control for childhood adjustment and the prevention of aggressive behavior, it is surprising that relatively few studies have examined stability and change in self-control during the transition from childhood to adolescence (Berger, 2011; Crosswhite & Kerpelman, 2012; Prencipe et al., 2010). A better understanding of these processes could guide the developmental timing of interventions that aim to prevent aggressive behavior by enhancing self-control. Research on self-control has also been limited by reliance on either socially contextualized report-based (child and parent) measures or more abstract, cognitive performance-based tasks. Each of these approaches has some inherent limitations, and

there are few studies that have examined the convergent validity of multi-informant and multi-method approaches that encompass both reported and performance indicators of self-control (Duckworth & Kern, 2011). Identifying appropriate self-control measurement strategies has the potential to inform studies evaluating the impact of related interventions among children. Finally, little research on this topic has been conducted with non-U.S. or European samples (Miller, Jennings, Alvarez-Rivera, & Lanza-Kaduce, 2009). There is a need to examine how self-control measures function outside of the United States and Europe, as this work could support the use of these measurement tools for program evaluation purposes in diverse samples and contexts.

The overall goal of this study was to inform aggression prevention programming by replicating and extending U.S.-based findings on associations between self-control and aggressive behavior in a non-U.S. sample, using a multi-informant and multi-method measurement strategy. First, I examined the latent structure of child-reported, parent-reported, and performance-based self-control indicators, as well as the stability of these indicators during the transition to adolescence (ages 10-14) over a 12-month period among a large sample of Venezuelan youth. I then examined individual differences in child-reported, parent-reported, and performance-based self-control, and assessed whether self-control indicators were differentially associated with aggressive behavior concurrently, over time, and according to individual differences.

Definition of Self-Control

Self-control is a multifaceted construct that has been defined in a variety of ways across disciplines and lacks a universal definition (Berger, 2011; Duckworth & Kern, 2011; Moffitt et al., 2011). For the purposes of this study, self-control is defined as the ability to change one's thoughts, feelings, or behaviors, either in accordance with societal norms or expectations, or to serve one's long-term goals and interests (Baumeister, Vohs, & Tice, 2007; Muraven & Baumeister, 2000; Duckworth & Kern, 2011). This definition reflects self-control across development, and aligns with recent conceptualizations of self-regulation (Berger, 2011), a term that is often used interchangeably with self-control (e.g., Bauser & Baumeister, 2011; Duckworth & Kern, 2011). Given the high degree of conceptual overlap between these terms, this study integrates literature that uses the term self-regulation to represent this construct.

Within this broad definition of self-control, there are a number of discrete and interrelated processes, each of which have been defined somewhat differently in distinct literatures, such as in early childhood work on temperament (Derryberry & Rothbart, 1997; Rothbart & Bates, 2006), sociological theories of crime (Gottfredson & Hirschi, 1990; Pratt & Cullen, 2000), and neuropsychological literature on cognitive functioning (Nigg, 2000; Miyake et al., 2000), among others. Relevant to the present study, inhibitory control and executive attention are two frequently cited processes within the broad construct of self-control across literatures. Inhibitory control (also called response inhibition) refers to the suppression of an automatic or dominant response and, in some cases, the activation of some other more desired or acceptable

response, in a given situation or context (Berger, 2011; Miyake et al., 2000). In children, inhibitory control may appear as rule-following behavior, like taking turns during a game or raising one's hand to speak in class rather than calling out. The complexity of inhibitory control varies according to different tasks or situations (Best & Miller, 2010; Eisenberg, Smith, & Spinrad, 2011). Whereas some tasks or behaviors may simply require the inhibition of a response, such as stopping one's self from pressing a particular button in a game or interrupting a parent who is on the telephone, others also involve the activation of an alternative response, to some extent. For example, stopping one's self from pressing one button in order to press another or waiting and saying, "excuse me," instead of interrupting a parent involve both the inhibition of one response and the activation of another.

Inhibiting inappropriate or unwanted responses also requires a degree of executive attention (Berger & Posner, 2000; Rueda, Posner, & Rothbart, 2005). Executive attention refers to control of attention processes that facilitate one's ability to select, monitor, integrate, and resolve conflicts between relevant internal or external stimuli (Berger, 2011; Rueda et al., 2005). For instance, as described further below, the Flanker (Eriksen & Eriksen, 1974) and Stroop (Stroop, 1935) performance tasks are thought to measure executive attention, in that these tasks challenge individuals to attend to certain stimuli while ignoring irrelevant stimuli, and to provide correct responses in the presence of conflicting stimuli (e.g., saying the word "blue" when the word red is written in blue ink; Berger, 2011). Attentional control is also facilitated by the attentional processes of orienting and alertness, which serve to direct attention to

one's environment and maintain vigilance, respectively (Rueda et al., 2005; Simonds et al., 2007).

Other frequently referenced processes within the self-control construct include planning and delay of gratification. Planning involves prioritizing or selecting among activities or behavior in order to reach a task or complete a goal (Berg & Byrd, 2002; Dagher, Owen, Boecker, & Brooks, 1999). Given that one must attend to various alternatives and inhibit immediate or impulsive responses in order to effectively plan and enact planned behaviors, planning is a more complex process that involves attention, inhibitory control, and other higher-order cognitive skills, such as working memory, abstract thinking, and set-shifting (Berg & Byrd, 2002; Huizinga, Dolan, & van der Molen, 2006). Delay of gratification is similarly a complex process that is thought to require both cognitive and attentional skills (Mischel et al., 2011), as well as inhibitory control and future planning capacities (Steinberg et al., 2009). Delay of gratification is defined as the ability to wait for or delay an immediate reward or other gratifying outcome in exchange for a more valued or preferred but delayed reward or outcome (Mischel et al., 2011; Mischel, Shoda, & Rodriguez, 1989). For example, a child might delay gratification when given the choice to earn \$400 now or \$700 in one month (Steinberg et al., 2009), or when given the choice to have one marshmallow treat now, or two of these treats after waiting for a period of time, as in Mischel's delay-of-gratification paradigm (Mischel, Ebbesen, & Zeiss, 1972; Mischel et al., 1989).

Measurement of Child Self-Control

Due to variation in the conceptualization and definition of self-control, it is often measured differently across disciplines, with measurement approaches largely falling into either report-based (e.g., self-, parent-, observer-completed) or performance-based categories (Duckworth & Kern, 2011). Report-based measures for children tend to reflect a broad definition of self-control and include a number of different processes within the same measure. For example, questions related to delay of gratification, response inhibition, planning, rule following, compliance, cooperation, task perseverance, attention, hyperactivity, and anger control might all be included in report-based questionnaires pertaining to children (Duckworth & Kern, 2011; Gresham & Elliot, 1990; Kendall & Wilcox, 1979; Moffitt et al., 2011). Such measures might ask whether the child thinks before acting, follows rules, pays attention, plays well with others, and can complete age-appropriate tasks, as in the Self-Control Rating Scale (Kendall & Wilcox, 1979) or the self-control subscale of the Social Skills Rating System (Gresham & Elliot, 1990).

Other report-based measures focus specifically on the closely related temperamental trait of effortful control, as in the effortful control subscale of the Children's Behavior Questionnaire (Rothbart, Ahadi, Hershey, & Fisher, 2001). Effortful control questions ask reporters about the child's inhibitory control, attention focusing, persistence, low intensity pleasure, and perceptual sensitivity domains (Rothbart & Bates, 2006). Still other measures focus exclusively on impulsivity (e.g., the Eysenck Impulsiveness Questionnaire; Eysenck, Easting, & Pearson, 1984) or are

organized according to the Gottfredson and Hirschi (1990) General Theory of Crime, which posits that poor self-control is the source of criminal behavior. These questionnaires similarly ask about many different self-control processes, including impulsivity, delay of gratification, and anger control, as well as sensation-seeking and self-centered personality traits (Grasmick, Tittle, Bursik, & Arneklev, 1993; Piquero, MacIntosh, & Hickman, 2000).

Report-based measures provide socially contextualized information about whether a child engages in self-controlled behaviors, and are relatively simple to administer to children, parents, and teachers. However, there are several limitations in using report-based measures. Common to all report-based measures are problems of shared or mono-method variance, response biases, and low to moderate intercorrelations and some inconsistencies between child, parent, and other observer (e.g., teacher) informants (De Los Reyes, Thomas, Goodman, & Kundey, 2013; Duckworth & Kern, 2011; Kazdin, 2003). Specific to self-control scales, scholars have noted that reporters, and especially children, must be relatively well-controlled in order to focus attention on the report-based task and provide valid responses about their own functioning, which impacts the validity of self-report measures in this area (Gottfredson & Hirschi, 1990; Piquero et al., 2000). Social desirability may also bias report-based measures of self-control in particular, as many of these measures often ask about socially appropriate behaviors (Bezdjian, Baker, Lozano, & Raine, 2009).

On the other hand, performance-based measures examine aspects of self-control through more discrete, typically decontextualized tasks, some of which are

thought to tap closely related executive functioning (EF) domains. EFs are complex cognitive processes involving inhibitory control, executive attention, working memory, and task shifting (Best & Miller, 2010; Miyake & Friedman, 2012). EFs are facilitated by activity in the prefrontal cortex, and involve processes like decision-making and other goal-oriented behaviors that serve to promote adaptive and well-regulated functioning (Best & Miller, 2010; Miyake et al., 2000). EF performance tasks can measure decontextualized self-control skills through abstract activities that require high levels of response inhibition and attentional control.

For example, in the Go/No-Go task, individuals are told to respond quickly to a “Go” stimulus (e.g., a letter or symbol on a computer screen), usually by clicking or pressing a computer key, and are told not to respond to a “No-Go” stimulus (Bezdjian et al., 2009). More frequent “Go” stimuli in this paradigm create a dominant response that must be inhibited on “No-Go” trials, making this task a measure of response inhibition (Berger, 2011; Schulz et al., 2006), although it can be scored to reflect attention functioning (Bezdjian et al., 2009). Another example is the widely used Stroop task (Stroop, 1935), in which the individual must name the font color of a written color word, which is at times congruent (“red” printed in the color red) and at other times incongruent (“red” printed in the color blue). This task requires both executive attention (attending to conflicting stimuli during incongruent tasks) as well as response inhibition (inhibiting an automatic response to say “red” when the word “red” is printed in blue; Berger, 2011).

Some performance-based tasks are more socially contextualized through the addition of emotional stimuli or through the use of paradigms that correspond with common social situations. For instance, the Go/No-Go task has been adapted to test emotional processing and regulation by including facial expressions of positive, neutral, and negative emotions as “Go” and “No-Go” stimuli (Casey & Caudle, 2013; Schulz et al., 2006). Delay of gratification paradigms that ask children to choose between smaller rewards immediately (e.g., treats; prizes; money) or wait for a larger reward later sometimes mimic child socialization processes, such as saving up money or planning for a long-term goal (Mischel et al., 1972; Moffitt et al., 2011; Steinberg et al., 2009). In the EF literature, performance tasks like these that involve emotionally or motivationally salient stimuli and decision-making processes have been termed “hot” EF tasks, and are distinguished from “cool” or more abstract and decontextualized tasks like the standard Go/No-Go paradigm described above (Prencipe et al., 2010). These tasks are somewhat more socially contextualized or socially relevant than other performance measures, but similarly rely on observing children’s discrete behaviors and recording performance-based indices of self-control like reaction or delay times, response inhibition, and attentional control.

Performance-based measures offer advantages over report-based strategies in that these tasks provide observable indices of self-control that are not prone to social desirability biases or informant inconsistencies. These tasks provide an operationalization of self-controlled behaviors, and can be used to measure discrete aspects of self-regulation depending on the scoring system. For example, commission

(“No-Go”) errors on the Go-No/Go task can be used to index impulsivity/hyperactivity, and omission (“Go”) errors can be used to index inattention (Bezdjian et al., 2009). However, these tasks have some limitations when used to measure self-control. Although performance measures can be scored to reflect discrete self-control skills, these tasks typically involve many different self-regulation skills and related EFs, especially as tasks increase in their complexity. Miyake et al. (2000) have described “unity and diversity” in EFs, such that EFs like inhibitory control and working memory constitute discrete entities, but are also highly interrelated. As noted above, simple tasks like the Go/No-Go may involve both response inhibition and attention. More complex tasks like the Tower of Hanoi or the Tower of London, which involve planning and problem-solving skills, may measure these processes as well as working memory and processing speed skills (Berg & Byrd, 2002; Karen, Segalowitz Baker, & Ferlisi, 2001; Miller & Best, 2010). Performance measures may also be associated with general intelligence (e.g., Steinberg et al., 2009; White et al., 1994). Additionally, despite some more socially contextualized (“hot”) paradigms noted above, these measures are largely decontextualized and may not always converge with children’s behaviors in social contexts.

Indeed, in a recent meta-analysis of interrelations among report-based and performance-based measures of self-control, Duckworth and Kern (2011) found that across 282 samples ranging in age from 0 to 70+ years, there were generally small to moderate correlations ($r = .27$, 95% CI [.24, .30]), on average) across different self-control measurement strategies. The average correlation between delay of gratification

versus response inhibition or attention-focused performance-based measures was small ($r = .11$, 95% CI [.08, .15]), suggesting that these measures tap different aspects of behavioral self-control (Duckworth & Kern, 2011). Performance-based measures were also weakly associated with self-reported or other-reported self-control, with correlations ranging from $r = .10$ to $r = .21$, although consistent with other literature, correlations among report-based measures were moderate ($r = .48$, 95% CI [.46, .50]) (Duckworth & Kern, 2011). Duckworth and Kern (2011) concluded that convergent validity across self-control measures is adequate, but that more studies using multiple measurement strategies are needed.

Although meta-analytic findings provide some information on interrelations among different self-control measurement strategies, few studies of *childhood* self-control have utilized multiple report- and performance-based measurement strategies. Of those that do, many have either focused on early childhood (e.g., Kochanska, Murray, & Harlan, 2000), or have collapsed these measures into a single self-regulation index (e.g., Duckworth, Tsukayama, & Geier, 2010). Consequently, little is known about interrelationships between multi-informant and multi-method report- and performance-based tasks during childhood and adolescence, and whether these measures are differentially associated with other salient and related behavior outcomes, such as aggressive behavior. Additionally, the measures included in the Duckworth and Kern (2011) meta-analysis were all drawn from observed data, and as such, contained substantial measurement error, leaving questions about how these measures function in a latent variable modeling context. These questions have

important implications for the construct validity of self-regulation and the integration of developmental findings about self-regulation from different theoretical frameworks and literatures.

Stability and Change in Self-Control During Middle Childhood and Early Adolescence

Based on longitudinal findings, self-control shows moderate stability during childhood and adolescence. Murphy et al. (1999) found intercorrelations of .41 to .67 between baseline and a 4-year follow-up of parent-reported self-control. Raffaelli et al. (2005) also found moderate stability for broad self-control in their longitudinal sample, with coefficients of $r = .49$ for early to middle childhood, and $r = .50$ for middle childhood to early adolescence. In a large sample of youth followed over 8 years and assessed at ages 7, 9, 11, 13, and 15, Hay and Forrest (2006) found moderate stability for self-control, but also found that self-control was more stable in the short-term compared to the long-term. Self-control at age 7 was correlated with age 9 self control at $r = .67$ but correlations between age 7 and subsequent ages dropped over time to reach $r = .43$ for the correlation between ages 7 and 15.

Other longitudinal studies have similarly found some stability in self-control skills over longer periods of time. For instance, Moffitt et al. (2011) found a significant correlation of $r = .30$ between childhood and young adult measures of self-control in their longitudinal Dunedin sample. They also showed that low childhood self-control was predictive of poor financial planning skills at age 32, among other outcomes. In a sample followed over 40 years, Mischel and colleagues (Mischel et al.,

2011; Mischel et al., 1989; Shoda, Mischel, & Peake, 1990) found that individuals who showed high delay of gratification skills at age 4 also showed related competencies in adolescence, such as increased frustration tolerance, attention, and academic achievement. High age 4 delay of gratification was also predictive of self-control skills throughout adulthood, including greater inhibitory control on a social-emotional version of the Go/No-Go task administered when the sample was in their sixties (Casey et al., 2011).

Despite showing moderate rank-order stability over time, self-control skills do appear to improve from early childhood through adolescence, moving gradually from externally guided processes to more internally regulated functioning (Berger, 2011; Kopp, 1982). Much research has focused on the early childhood period in particular, when there are more rapid gains in discrete self-control skills and related EFs (i.e., working memory, inhibition, and set-shifting) (Best & Miller, 2010; Garon, Bryson, & Smith, 2008; Sokol & Müller, 2007). Studies have shown that between the ages of 2 and 5, there are improvements in response inhibition, delay of gratification, and attentional control processes, as well as related gains in behavioral compliance and social-emotional functioning (Berger, 2011; Garon et al., 2008; Kochanska, Coy, & Murray, 2001). These improvements are likely facilitated by both external socialization processes and cognitive development in the frontal lobes (Berger, 2011; Kopp, 1982; Rueda et al., 2005). As Berger (2011) summarizes, there is a marked shift during this period in the ability to negotiate conflicting stimuli or rules, to activate appropriate behavioral responses, and to understand consequences, leading to

internalization of social rules and norms and increased control of emotions and behavior.

Compared to studies of early childhood, much less research has focused on how self-control and related EFs might change over the course of middle childhood and adolescence (Best & Miller, 2010; Raffaelli, Crockett, & Shen, 2005).

Importantly, there are salient neurodevelopmental and social-emotional changes during the transition from middle childhood to adolescence that have bearing on the capacity for self-controlled functioning. For instance, neuroimaging studies have shown that during these periods and into young adulthood, there is continued maturation of the prefrontal cortex, which is associated with EFs and closely related self-control capacities (Casey, Jones, & Hare, 2008; Miller & Best, 2010; Steinberg, 2010). As such, more complex and nuanced working memory, planning, and decision-making skills emerge during middle childhood and adolescence, although these skills are also influenced by a changing social context (Steinberg, Vandell, & Bornstein, 2011).

There are increased academic, social, and behavioral demands during the transition from middle childhood to adolescence, as well as a growing susceptibility to peer influence and sense of self-awareness (Steinberg et al., 2011). Adolescents in particular undergo changes in connectivity between prefrontal and other brain regions, and increases in dopaminergic activity, making them more sensitive to rewards and prone to sensation-seeking behaviors (Casey et al., 2008; Steinberg, 2010). This combination of a less mature prefrontal cortex and increased reward sensitivity, along

with a changing pubertal status and greater susceptibility to peer influence, is thought to underlie the increased impulsivity and risk-taking behaviors exhibited by adolescents (Casey & Caudle, 2013; Steinberg, 2010). Indeed, Miller and Best (2010) have noted that there tends to be a regression in inhibitory control during adolescence, but that decreases in this skill are mostly found in studies that examine adolescent inhibitory processes in relation to emotionally-laden stimuli (e.g., the Go/No-Go emotional processing paradigm). Consistent with this idea, there is some evidence for increased growth in other “hot” EF tasks that have motivational significance (emotional paradigms, monetary consequences, etc.) during the transition to adolescence compared to during middle childhood (Prencipe et al., 2010).

Longitudinal work has shown that broad self-control generally improves during middle childhood, with less change during early adolescence, although findings on discrete skills and age-specific change are inconsistent due to differences in theoretical frameworks and measurement approaches (Best & Miller, 2010; Raffaelli et al., 2005). Murphy, Eisenberg, Fabes, Shepard, and Guthrie (1999) examined change in aspects of self-control among a sample of 94 children in a 6-year longitudinal study that began when participants were ages 4 to 6 years. Murphy et al. (1999) found that attention shifting and response inhibition skills improved from early childhood (ages 4 to 6) to preadolescence (ages 10 to 12), but that there were no changes in attention-focusing or behavioral regulation skills over time. Raffaelli et al. (2005) studied affective, behavioral, and attentional self-control in children using a composite mother-reported measure over three time points from early childhood to

early adolescence (4-5 years, 8-9 years, and 12-13 years). Unlike Murphy et al., they found that broad self-control improved from early to middle childhood, but not from middle childhood to early adolescence. However, consistent with Raffaelli et al.'s findings on broad self-control improvements in middle childhood, Vazsonyi and Huang (2010) reported that maternal ratings of self-control increased over the ages of 4.5 years, 8.5 years, and 10.5 years among a sample of 1,155 children.

Cross-sectional studies similarly show some improvements in self-control during middle childhood. In the area of response inhibition and executive attention, Brocki and Bohlin (2004) examined EFs in 92 children ages 6 to 13 and found that disinhibition on the Go/No-Go and a Stroop-like task improved with each year of age for children ages 7 to 11. There was less change for the 12 to 13 year old age group (Brocki & Bohlin, 2004). Similarly, Levin and colleagues (1991) found that response inhibition on the Go/No-Go improved the most during middle childhood (ages 7 to 8 and ages 9 to 12) compared to adolescence (ages 13 to 15). Although these studies showed few improvements in response inhibition and attention functioning for early adolescents compared to younger children, other studies have shown changes in impulsivity, planning, and delay of gratification during the transition to adolescence.

For instance, Steinberg et al. (2008, 2009) have found decreases in impulsivity between the ages of 10 and 15 using planning and impulsivity measures, as well as increases in delay of gratification between the ages of 10 and 16. Prencipe et al. (2010) also found among 8 to 15 year old children that growth in response inhibition and attention tasks (i.e., "cool" EF tasks) occurred only during middle childhood, but that

performance on a Delay Discounting task (a “hot” EF task) showed continued improvement during the transition to adolescence. Taken together, these cross-sectional and longitudinal studies show that there is some growth in self-control skills from middle childhood through adolescence, but that skill development varies according to the complexity and measurement strategy of the skill in question.

Individual Differences in Child Self-Control

With regard to individual differences in self-control, a large body of research suggests that both genetic and environmental factors contribute to the development of self-controlled behavior (Berger, 2011). Findings from twin studies have shown that approximately 50% of the variability in self-control can be attributed to genetic factors (Beaver, DeLisi, Vaughn, Wright, & Boutwell, 2008; Beaver, Wright, DeLisi, & Vaughn, 2008). Variation in self-control skills like attention and inhibitory control have been linked to several genes in the dopamine and serotonin systems, including the dopamine D4 receptor (*DRD4*), the catechol-O-methyltransferase gene (*COMT*), and the serotonin transporter gene (*5-HTT*), among others (Beaver, Ratchford, & Ferguson, 2009; Berger, 2011). Studies have also identified environmental influences that can foster or undermine the development of self-control, such as parent-child interactions and the family environment (Berger, 2011). Whereas increased parent-child synchrony (affect coordination) in the first year of life and warm, responsive parenting during childhood have been associated with the development of better self-control, unsupportive parent behaviors and chaotic home environments have been correlated with diminished self-control skills (Colman, Hardy, Albert, Raffaelli, &

Crockett, 2006; Dumas et al., 2005; Eisenberg et al., 2011; Feldman, Greenbaum, & Yirmiya, 1999).

Recent work has examined the interactive effects of these genetic and social influences on self-control. For instance, Belsky and Beaver (2011) found in a cross-sectional study that adolescent males with more serotonergic and dopaminergic plasticity alleles (reactive genetic polymorphisms) showed both increased self-control given supportive parenting and decreased self-control given unsupportive parenting. Beaver et al. (2009) have also demonstrated that the effects of a functional polymorphism in the serotonin transporter gene (*5-HTTLPR*) on low self-control in adolescence and adulthood is contingent upon concurrent exposure to delinquent peers, such that those with the low-expressing *5-HTTLPR* alleles showed diminished self-control only when they also reported deviant peer exposure. These studies demonstrate how both genes and environment play a role in influencing child self-regulation abilities.

Most available studies on child self-control also examine gender differences. Research has consistently shown males to be lower in broad self-control compared to females, across age groups and parent-rated, child-rated, or socially contextualized performance-based measures (Berger, 2011; Kochanska et al., 2000; Moffitt et al., 2011; Murphy et al., 1999; Pender-Tessler et al., 2013; Raffaelli et al., 2005). Scholars have hypothesized that genetic effects (differential associations between serotonin and self-control; Pender-Tessler et al., 2013) and socialization processes (gender-based norms for appropriate behaviors; Murphy et al., 1999) play a role in these apparent

gender differences. Gender differences are less consistent when self-control skills are measured through abstract performance-based tasks, however. For instance, Brocki and Bohlin (2004) found no gender differences on decontextualized performance-based tasks of response inhibition and executive attention skills in their study of EFs. Dias and Seabra (2012) also found no gender differences with regard to planning skills when they examined Tower of London task performance in a sample of Brazilian youth.

Less work has focused on individual differences in self-control by culture or by the broader social context. Much of the research on self-control has utilized predominately non-Latino White samples based in either the United States or in similar cultural contexts (i.e., New Zealand; Moffitt et al., 2011; Europe and Canada; Miller et al., 2009). There is some work that has examined delay of gratification and emotional self-control in lower socioeconomic status (SES) or ethnic minority populations within the United States (see Raver, 2004, for a review). More recently, some studies have examined how dynamic contextual factors such as SES and exposure to stressful or traumatic events, which are common in low-SES environments, can impact self-control and related skills over early to middle childhood. In line with the studies described above showing genetic and environmental interactions related to the development of self-control, Blair (2010) reviewed the biological mechanisms that may place low-SES children who are genetically sensitive to environmental context at-risk for poor self-regulation and executive control. Similarly, Raver, McCoy, and Lowenstein (2013) found among a

sample of low-SES youth that environmental stress exposure in school, family, and community domains during early childhood were predictive of continued executive control difficulties during middle childhood.

Developmental studies of self-control that have been conducted outside of the United States or similar European contexts are quite rare. One study by Keller and colleagues (2004) examined associations between parenting at age 3 months and the development of self-control at ages 18-20 months in a sample of Cameroon farming families, urban middle-class Greek families, and middle-class Costa Rican families. Developmental timing of self-control differed depending on the proximal and distal parenting styles of each culture (Keller et al., 2004). A cross-sectional study comparing children ages 11 to 15 from Kenya, Thailand, and the United States found higher levels of externalizing concerns among U.S. children (Weisz, Sigman, Weiss, & Mosk, 1993). The authors hypothesized that Thai and Kenyan cultures may place a higher value on behavioral compliance and, as such, discourage undercontrolled behaviors (poor self-control).

In a cross-sectional study focused on EFs, Dias and Seabra (2012) examined performance on the Tower of London planning task and working memory tasks among 124 early adolescents (ages 11-14) in Brazil, but they did not examine broad self-control in a developmental framework. Dos Santos Assef and colleagues (2007) have also studied associations between selective attention on the Stroop task and attention deficit disorder in a sample of 62 Brazilian children ages 8 to 12, but they did not examine developmental differences in task performance or broad self-control by age

or gender. There is a paucity of developmental studies on broad self-control in middle childhood and adolescence in non-U.S. or European contexts. To the extent that self-control is developed through different cultural socialization processes and values, it is important to examine self-control in other cultural contexts (Miller et al., 2009; Trommsdorff & Cole, 2011).

Self-Control and Aggressive Behavior

Variation in self-control has been linked to diverse psychosocial outcomes during childhood and into adulthood, including social competencies, academic achievement, weight and health-related behavior, psychopathology and substance use, and even adult income (Duckworth et al., 2010; Mischel et al., 2011; Moffitt et al., 2011; Shoda et al., 1990; Tangney et al., 2004). In particular, many studies have demonstrated robust associations between poor self-control and aggressive behavior or externalizing outcomes (Benda, 2005; Gottfredson & Hirschi, 1990; Moffitt et al., 2011; Pratt & Cullen, 2000; Vazsonyi & Huang, 2010; White et al., 1994). Research across developmental periods has supported the notion that individuals who are unable to inhibit prepotent responses, focus attention, delay gratification, follow rules, control anger, and engage in effective planning are also more likely to show increased aggression and rule-breaking behavior, including involvement in juvenile delinquency and later adult offending (Moffitt et al., 2011; Pratt & Cullen, 2000; White et al., 1994).

Much of the research on associations between poor self-control and aggressive behavior has been conducted in the context of Gottfredson and Hirschi's General

Theory of Crime (1990), which holds that poor self-control distinguishes criminal offenders from non-offenders. In a meta-analysis of 21 studies examining this theory, Pratt and Cullen (2000) found that low self-control was a strong correlate of criminal behavior, with no differences across samples by gender or age (adult versus juvenile). Longitudinal studies have also provided support for linkages between self-control and aggressive behavior problems from childhood through adulthood. For instance, Moffitt et al. (2011) measured undercontrol (impulsivity and hyperactivity) in 1,000 children at ages 3, 5, 7, 9, and 11, and found that those with poor self-control during childhood were significantly more likely to have been convicted of a criminal offense by age 32, even when the authors controlled for socioeconomic status and intelligence.

Short-term longitudinal, cross-sectional, and experimental studies during middle childhood and adolescence have also shown interrelations between self-control and aggressive behavior. For example, Vazsonyi and Huang (2010) examined broad indicators of self-control and deviant (aggressive and rule-breaking) behaviors in children between the ages of 4.5, 8.5, and 10.5 years and found that self-control at the end of preschool explained 44.8% of the subsequent variation in deviant behavior from ages 4.5 to 10.5. In a cross-sectional study, White et al. (1994) found that both report-based and performance-based measures of impulsivity and delay of gratification were associated with greater involvement in juvenile delinquency in a sample of 400 adolescent boys ages 12 to 13 years. In the same sample, Krueger et al. (1996) also showed that boys who were unable to delay gratification had higher rates of mother- and teacher-reported aggression and delinquency. Experimental intervention studies

have additionally provided evidence on relations between self-regulation and aggressive behavior. A recent meta-analysis of 34 self-control interventions for youth under age 10 demonstrated that interventions that were found to improve self-regulation skills were also effective in reducing aggression and delinquent behaviors, with positive effects across child gender and various study measurement strategies (Piquero et al., 2010).

In general, males tend to score higher on reports of aggressive behavior compared to females (Steinberg et al., 2011). However, studies of self-control and aggressive behavior outcomes typically do not show gender differences in the interrelations between self-control and aggressive behavior. For example, of the studies cited above using male and female samples, none have shown gender differences in the longitudinal relations between self-control and aggressive or criminal behavior (e.g., Moffitt et al., 2011; Pratt & Cullen, 2000; Vazsonyi & Huang, 2010) or in the intervention work on this topic (Piquero et al., 2010). Other studies examining linkages between poor self-control and risk-taking behaviors closely related to aggression and rule-breaking, such as problematic adolescent or early adulthood substance use, have also shown consistent associations across males and females (e.g., Piehler, Véronneau, & Dishion, 2012; Romer, Duckworth, Sznitman, & Park, 2010; Wills & Stoolmiller, 2002).

Similar to developmental work on child self-control, very few studies examining self-control and aggressive behavior have been conducted with non-U.S. or European samples. Vazsonyi, Wittekind, Belliston, and Van Loh (2004) tested the

relations between self-control and aggression among a sample of 335 adolescents in Japan, and found that low levels of self-regulation (impulsivity, poor task perseverance, low anger control) were associated with greater levels of aggressive and rule-breaking behaviors across males and females. In another study of Puerto Rican adolescents, Miller and colleagues (2009) also found that low self-control was associated with concurrent deviant behaviors, independent of demographic differences and familial indicators like maternal attachment. Although associations between self-control and aggressive behavior have been well-established in U.S. and European samples, with some replication studies in other cultural contexts, more developmentally-oriented work that examines associations between these constructs in middle childhood and early adolescence is necessary.

The Current Study

In summary, the extant literature indicates that few studies have used multiple report- and performance-based measures to assess the construct and stability of self-control during the transition to adolescence. Additionally, more work is needed to identify individual differences associated with stability and change in self-control during this period. Finally, few studies on self-control and its association with aggressive behavior have been conducted outside of the United States and Europe. A close examination of multi-informant and multi-method strategies to assess self-control, as well as its association with aggressive behavior, can inform implementation and evaluation strategies for interventions that aim to prevent child and adolescent aggressive behavior by improving self-control. The overall goal of this study was to

inform the aggression prevention literature by replicating and extending findings on self-control in the United States in the areas of (a) the structure and stability of self-control indicators during early adolescence, (b) individual differences associated with self-control, and (c) associations between self-control indicators and aggressive behavior in a Venezuelan youth sample. Specific study aims and hypotheses were as follows.

Aim 1: Structure of Self-Control Indicators Over Time

The first aim of this study was to examine the latent structure of the child-reported, parent-reported, and performance-based self-control items over time (at Time 1 and Time 2). In line with previous research (Duckworth & Kern, 2011), I hypothesized that child-reported, parent-reported, and performance-based self-control indicators would comprise three distinct factors, organized by reporter and/or measurement type, rather than loading onto one overarching self-control factor.

Aim 2: Stability and Associations Among Self-Control Indicators Over Time

The second study aim was to examine associations among self-control indicators concurrently (Time 1-Time 1) and across time (Time 1- Time 2), as well as the stability of these indicators from Time 1 to Time 2. Based on research conducted in the United States (Duckworth & Kern, 2011), I hypothesized that child-reported, parent-reported, and performance-based self-control indicators would be moderately positively intercorrelated at each time point, with larger correlations among report-based factors, due to shared method (questionnaire-based) variance. Given that self-control is generally thought to become more stable by late childhood, I hypothesized

that child- and parent-reported indicators of self-control would be largely stable over early adolescence (from Time 1 to Time 2). However, I hypothesized that there would be less stability for the performance-based factor from Time 1 to Time 2, as task-based performance could represent a momentary behavioral assessment of child functioning.

Aim 3: Individual Differences Associated with Self-Control

The third study aim was to examine individual and environmental factors that could be associated with self-control indicators at Time 1, and change in self-control indicators from Time 1 to Time 2. Based on the research literature and available data, individual difference variables included child gender, child age, parental education, intelligence, socioeconomic status (SES), and child exposure to environmental stress. Analyses of individual differences are exploratory, given mixed findings on the impact of individual differences on report-based and performance-based self-control.

Aim 4: Self-Control and Aggressive Behavior Over Time

The fourth and final aim of this study was to examine whether self-control indicators at Time 1 were predictive of aggressive behavior at Time 2, controlling for initial levels of aggressive behavior at Time 1. The purpose of this aim was to examine differential associations between report-based and performance-based indicators of self-control and aggressive behavior. Additionally, this aim was meant to replicate and extend previous U.S.-based findings to a Venezuelan context. I hypothesized that greater child self-control at Time 1 would predict lower levels of aggressive behavior at Time 2, but that report-based self-control indicators would be more predictive of aggressive behavior than performance-based indicators, in line with previous work on

this topic. I also conducted exploratory analyses that included observed individual differences as predictors in models that used child-reported, parent-reported, and performance-based indicators of self-control to predict child- and parent-reported aggressive behavior at Time 2. Finally, I tested alternative models, in which Time 1 aggressive behavior factors predicted Time 2 self-control factors, controlling for Time 1 self-control, given that associations between self-control and aggression over time may be bidirectional.

Chapter 2

METHOD

Overview

Study participants were drawn from the wait-list control sample of a larger randomized controlled trial of the National System of Youth and Children's Orchestras of Venezuela, known as *el Sistema*. The larger study examined the impact of orchestra participation on child cognitive, social-emotional, and behavioral skills from pretest (Time 1) to 12-month posttest (Time 2). The study focused on Venezuelan youth ages 6 to 14, as these are the typical age groups for entering *el Sistema*. The evaluation was conducted through a collaborative effort between the Venezuelan Simón Bolívar Music Foundation, the Inter-American Development Bank (IDB), and a university-based study team at the University of Delaware. Basic recruitment procedures and the current sample are briefly described below, with full details reported by Alemán et al. (2013, 2014).

Children from 24 *núcleos*, or orchestra centers, located in the states of Aragua, Bolívar, Lara, Miranda, and the capital district, Caracas, were recruited to participate in the *el Sistema* impact evaluation. Orchestra centers were selected for participation in the study if they had (1) a start date of September 2012 for the new orchestra cohort, (2) the capacity to accept new orchestra participants, and (3) a high likelihood that participant demand would exceed available orchestra spots. Access to *el Sistema*

is typically free and on a first-come, first-served basis. In the impact evaluation, trained personnel at orchestra centers adopted a standardized admission procedure and a common, computerized orchestra application form. Orchestra applications were collected during a 9-week period between May and July 2012. The application form included socio-demographic information and parental consent to participate in the impact evaluation. Inclusion criteria were that children had not previously participated in *el Sistema*, and would be within the 6 to 14 year age range by September 1, 2012 (orchestra start date). Denial of parental consent did not prevent orchestra participation or subsequent randomization to study condition. Parents were informed of this information, and consent was collected in compliance with the Institutional Review Board.

All orchestra applicants, regardless of consent status, were then randomly assigned to participate in *el Sistema* for the 2012-2013 year (intervention condition) or to participate the following year (wait-list control condition). Randomization was conducted using a computerized program that approximately evenly assigned all participants to either the intervention or wait-list control conditions. The unit of random assignment was the child's parent, to ensure that orchestra applicants within the same household would receive consistent orchestra admission status. Following randomization, the IDB then contacted the subsample of participants who had consented to participate in the impact evaluation.

Participants

Participants for this study were 595 wait-list control children and their parent respondents from the larger intervention evaluation. Child participants were between the ages of 10 and 14 (M age 11.33 years, $SD = 1.25$ years). This subsample of the larger wait-list control group was selected for the current study in order to specifically examine adolescent functioning. Child participants were Venezuelan descent, with approximately half being female (50.9%). Twenty-six percent of child participants were siblings. All parent respondents were of Venezuelan descent, with an average age of 39.43 years ($SD = 7.49$ years). Parent respondents were mostly female (98.0%) and were mothers (95.4%) of the child participants, with the remainder of parent respondents being fathers (1.6%), grandparents (1.9%), or other relatives above the age of 18 (siblings, aunts, or uncles; 1.1%). A total of 95.3% of participant households had a mother living in the home, and 73.9% of households had a father living in the home.

Several indicators in the larger impact evaluation were used obtain an estimate of family background and socioeconomic status, including parental college attendance, ownership of a cable television and/or a computer, and home Internet access. In this sample, 54.9% of mothers and 44.9% of fathers had attended some years of university level education, compared to 18% in the general Venezuelan population, based on recent survey estimates obtained on a representative child sample (Alemán et al., 2013). Additionally, 79.6% owned a cable television, 85.4% owned a computer, and 74.7% had home Internet access, compared to 44%, 28%, and 20% estimates for these

items, respectively, in the general population (Alemán et al., 2013). The larger *el Sistema* study team generated a composite socioeconomic status (SES) variable to reflect higher versus lower SES based on ownership of cable television and/or computer and home Internet access. Within the current study's wait-list control sample, 58.5% were identified as being of higher SES. SES and other socio-demographic estimates in the wait-list control sample did not differ significantly from those in the orchestra (intervention) condition. Both the wait-list and intervention conditions appear to have a slightly higher SES, based on these indicators, than the general Venezuelan population (Alemán et al., 2013).

Assessment

Assessment occurred at Time 1 (September-October 2012) and 12 months later, at Time 2 (September-October 2013). At each assessment time point, trained Venezuelan assessors who were blinded to the larger impact evaluation condition assignment administered a battery of computerized measures to children and their parent respondents. Assessments occurred in the families' homes. The child assessment was approximately 2 hours, and contained self-report questionnaire items as well as performance tasks, administered at both time points and in the same order for every participant. The child assessment included a brief color blindness task to ensure that children could see the colors presented to them in the assessment. The parent respondent assessment was approximately 1 hour and contained parent-report questionnaire items of child functioning as well as demographic items. Child and parent assessments in the same household occurred on the same day. Child and parent

assessments were administered in individual-interview format, with Venezuelan assessors reading all questionnaire items and performance task instructions aloud to participants.

All measures were administered in Spanish. Standard back-translation methods were used when study measures were not initially available in Spanish. The IDB and the university-based study team piloted all measures on a small, representative Venezuelan youth sample prior to use in the larger impact evaluation (Alemán et al., 2013). This study includes a selected set of measures from the larger impact evaluation that are relevant to this study's aims and hypotheses. Please refer to Alemán et al. (2013, 2014) for a complete description of measures used in the larger impact evaluation.

Child-Reported Self-Control

To measure child-reported self-control, children responded to items drawn from the Child Self-Control Rating Scale (CSCRS; Rohrbeck et al., 1991) and from the Hyperactivity/Inattention subscale of the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997; Goodman, Meltzer, & Bailey, 1998). Items were selected, adapted, and piloted with Venezuelan children in the same age range by the larger *el Sistema* study research team. The CSCRS was developed as a parallel form to the parent-rated Self-Control Rating Scale (SCRS; Kendall & Wilcox, 1979), and includes items related to broad self-controlled functioning, including inhibitory control and task perseverance. A validation study of the full CSCRS showed good internal consistency ($\alpha = .90$) and test-retest reliability ($r = .84$; Rohrbeck et al., 1991). A psychometric

report for the *el Sistema* study has shown that this measure had adequate reliability ($\alpha = .72$) and a unidimensional factor structure in the full sample of 2,563 Venezuelan youth ages 6 to 14 at Time 1 (Williamson, 2013). Convergent validity was also supported via correlations in the expected directions with prosocial and antisocial behavior (Williamson, 2013). For the SDQ Hyperactivity/Inattention subscale, a large validation study showed it to have adequate internal consistency ($\alpha = .67$) and test-retest reliability ($r = .60$), and moderate correlations with parent- and teacher-reported Hyperactivity/Inattention ($r = .41$ and $r = .32$, respectively; Goodman, 2001). This study also suggested good convergent validity via positive correlations between this subscale and SDQ conduct problems and with a diagnostic measure of attention problems (Goodman, 2001).

Based on confirmatory factor analysis, described further below, 5 items from the CSCRS and 2 items from the SDQ comprised the latent child-reported self-control factor. All items were rated on a 4-point Likert scale ranging from 1 (*never*) to 4 (*always*), and scored so that higher scores indicated higher levels of self-control. A sample CSCRS item is “In games, you follow the rules and wait your turn.” A sample SDQ item is “You think before you do things.” Internal consistency for these 7 items was $\alpha = .74$ at Time 1 and $\alpha = .72$ at Time 2.

Parent-Reported Child Self-Control

Parent-reported child self-control was measured using items parallel to the child-report, drawn from the Kendall and Wilcox Self-Control Rating Scale (SCRS; Kendall & Wilcox, 1979) and the SDQ Hyperactivity/Inattention subscale (Goodman,

1997; Goodman et al., 1998). Consistent with the child-report version of this measure (Rohrbeck et al., 1991), the SCRS is thought to reflect broad self-control abilities (Kendall & Wilcox, 1979). Kendall and Wilcox (1979) have shown that the SCRS has a unidimensional factor structure, as well as good internal consistency ($\alpha = .98$) and test-retest reliability ($r = .84$). Convergent validity has been supported through correlations with observer-rated self-control (Kendall & Wilcox, 1972; Kendall et al., 1981). The SCRS is additionally widely used in intervention studies that assess for changes in self-control (Piquero et al., 2010). Psychometric analyses on the full Venezuelan youth sample from the larger study have shown good internal consistency ($\alpha = .87$) and a unidimensional factor structure for this measure as well (Williamson, 2013). For the parent-reported SDQ items, the validation study noted above showed the full parent-reported Hyperactivity/Inattention subscale to have adequate internal consistency ($\alpha = .77$) and test-retest reliability, ($r = .72$), and a moderate correlation with the child-reported Hyperactivity/Inattention subscale ($r = .41$; Goodman, 2001). Similar to the child-reported subscale, the parent-reported subscale has shown convergent validity with SDQ conduct problems and a measure of attention deficit concerns (Goodman, 2001).

Based on confirmatory factor analysis, 7 items from the SCRS and 2 items from the SDQ comprised the parent-reported child self-control factor. Consistent with child reporting, all items were rated on a 4-point Likert scale ranging from 1 (*never*) to 4 (*always*), and scored so that higher scores indicated higher levels of self-control. A sample SCRS item is “Is the child able to complete tasks that he/she starts?” A sample

SDQ item is “He/she thinks before he or she does something.” Internal consistency for these 9 items was $\alpha = .78$ at Time 1 and $\alpha = .76$ at Time 2.

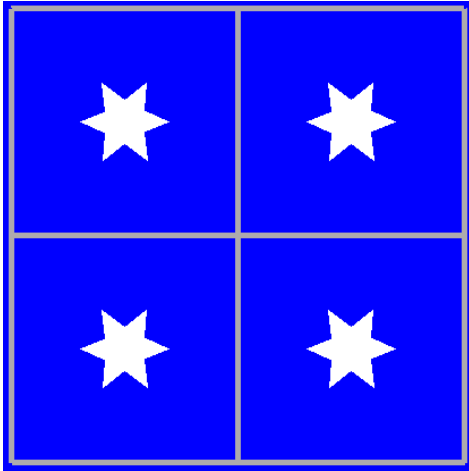
Performance-Based Measures of Child Self-Control

This study included two child-completed performance tasks thought to measure self-control.

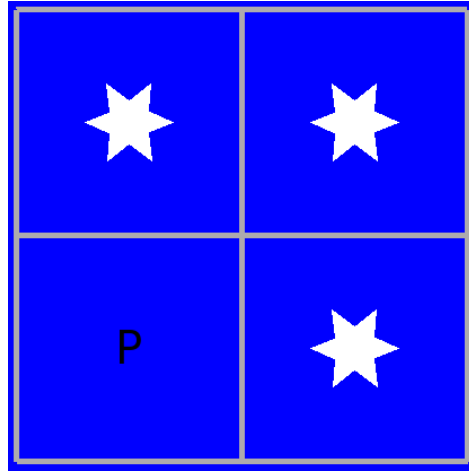
Children completed the Go/No-Go (GNG) paradigm, as described by Bezdjian et al. (2009), to measure inhibitory control. The GNG task has been used extensively with children to measure this construct (Berger, 2011). In this task, children were initially presented with a 2 x 2 matrix with four stars, one in each box of the matrix (Figure 1a). The task was presented in two blocks. In the first block, children were directed to respond to the “Go” stimulus, which was when the letter “P” appeared in any of the cells (Figure 1b), by pressing the space bar, and were told not to respond when the “No-Go” stimulus appeared, which was when the letter “R” appeared in any of the cells (Figure 1c). In the second block, the stimuli were reversed, so that the “Go” stimulus was the letter “R” and the “No-Go” stimulus was the letter “P.” In both blocks, the letter stimulus was presented in one of the squares for 500 milliseconds, with an inter-stimulus interval of 1,500 milliseconds. The ratio of “Go” to “No-Go” stimuli was 80:20 in each block. There were 40 trials per block, or 80 trials total. Children were provided with 10 practice trials (not scored) prior to beginning each block.

Several types of scores are available from the GNG task, including hit rate (“Go” stimuli correct), false alarm or commission rate (“No-Go” errors), omission rate

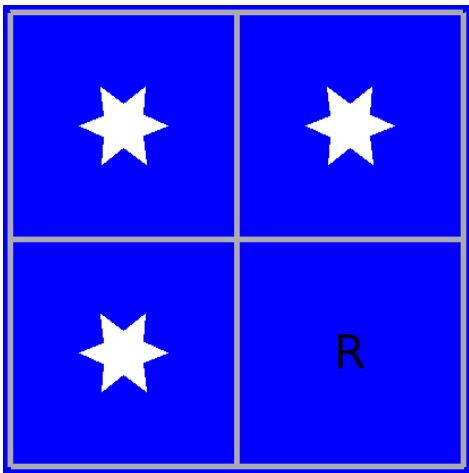
("Go" errors), and correct rejections of the "No-Go" stimuli (Bezdjian et al., 2009). As the hit rate could represent a child hitting every stimuli presented, this index may be inflated and cannot be used to accurately measure inhibitory control. The accuracy index D-prime (d') accounts for this response bias by calculating the difference between the z-scored hit rate and the z-scored false alarm (commission) rate (Nosek & Banaj, 2001). In this study, higher levels of the accuracy index D-prime were used to indicate greater self-control, or inhibitory control (Nosek & Banaj, 2001). D-prime was calculated for each of the two GNG blocks and averaged to generate the score used in study analyses (Nose & Banaj, 2001).



(a)



(b)



(c)

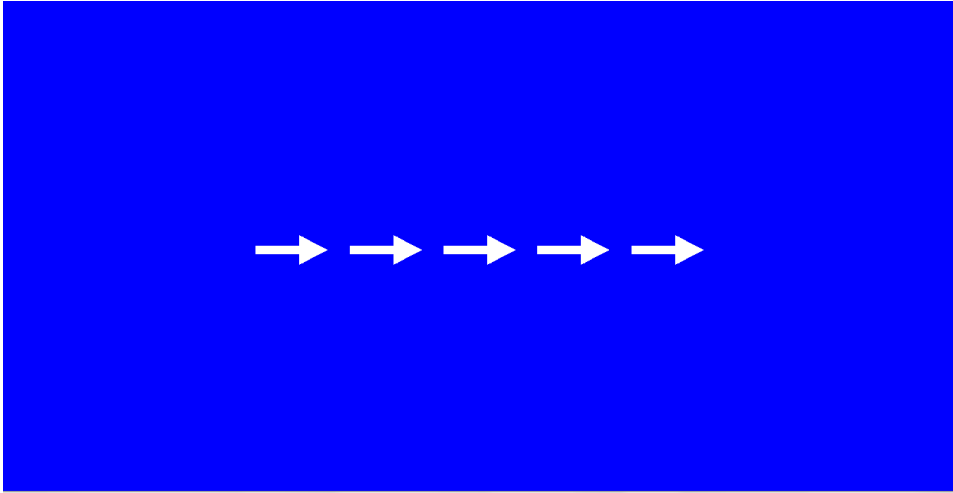
Figures 1a, 1b, and 1c

Screenshots of Go/No-Go Stimuli. (a) Array of Neutral Screen, (b) P Stimulus,

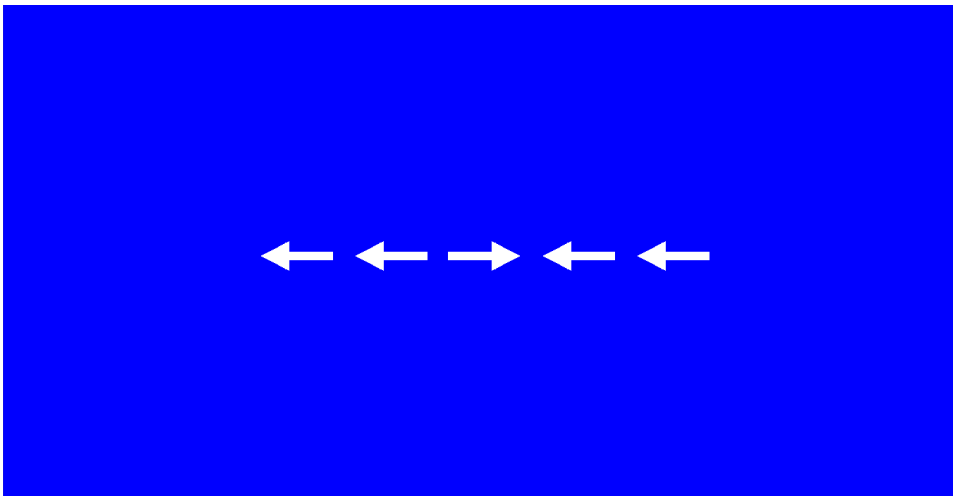
(c) R Stimulus

Source: Alemán et al., 2013.

Children also completed the arrow version of the Flanker Task as a second performance measure of self-control (Eriksen & Eriksen, 1974). The arrow version of the Flanker task has been used with children in the proposed study age range and is a widely used measure of attention and self-controlled functioning (Berger, 2011; Stins, Polderman, Boomsma, & de Geus, 2007). In this task, children were first presented with a blue screen for 500 milliseconds. The screen was then followed by a row of arrows for 800 milliseconds, with the middle arrow being the “target.” Children were directed to follow the target arrow and ignore the other arrows, which represent distractors or “flankers.” If the target arrow was pointed to the right, children were directed to press the right arrow computer key, and if the target arrow was pointed to the left, children were directed to press the left arrow computer key. The flanking arrows were either pointed in the same direction as the target arrow (congruent trials, Figure 2a), or in the opposite direction of the target arrow (incongruent trials; Figure 2b). There were 60 trials total, with 30 congruent trials and 30 incongruent trials, presented in a random order. Children completed 12 practice trials (not scored) prior to beginning the task. The total number of correct trials was used in this study to indicate higher levels of self-control and attention functioning (Stins et al., 2007).



(a)



(b)

Figures 2a and 2b

Screenshots of Flanker Stimuli. (a) Congruent Trials (b) Incongruent Trials.

Source: Alemán et al. (2013).

Individual Differences

Individual differences used as potential moderators of child self-control and aggressive behavior were drawn from Time 1 assessments. Individual differences included child age, child gender, maternal and paternal educational attainment, socioeconomic status (SES), child intelligence, and violence exposure. Maternal and paternal educational attainment were dichotomously coded such that university level education or beyond = 1. These scores were then added together to create a composite of parental education. SES was based on the composite variable described above.

Child nonverbal intelligence at Time 1 was assessed using an adapted version of the Raven's Colored Progressive Matrices (CPM; Raven, 1956; Raven, Raven, & Court, 1998). It has been suggested that the CPM and other Raven's Matrices (Advanced and Standard versions) measure slightly different but overlapping cognitive ability constructs, including Spearman's *g*, or general cognitive ability (e.g., Makintosh, 1996; Savage-McGlynn, 2012), fluid intelligence or nonverbal/abstract reasoning abilities (e.g., Kamphaus, 2005; Lynn & Irwing, 2004; Raven, 2000), and visual-spatial skills (Schweizer, Goldhammer, Rauch, & Moosbrugger, 2007). In the current study, it was used as a broad estimate of nonverbal child intelligence, similar to other recent developmental studies with adolescents (e.g., Steinberg et al., 2008, 2009). Psychometric analyses on the full youth sample included in the larger *el Sistema* impact evaluation showed good convergent validity for the task via positive correlations with task measures of processing speed, working memory, and other executive functions (Williamson, 2013).

In the *el Sistema* study version of the CPM, children were asked to solve 17 different colored matrices that increased in difficulty as the test progressed (Figure 3; Alemán et al., 2013). Each matrix was missing one “piece,” and children were asked to complete the matrix by choosing one “piece” among six possible options for each matrix. This task was untimed. As normative data for conversion of raw scores to standardized intelligence scores ($M = 100$, $SD = 15$) are not available for Venezuelan youth, total raw scores (number of matrices correct out of 17) were used to estimate nonverbal intelligence.

To assess child stress exposure, children responded to an 8-item dichotomous (yes/no) scale that was adapted from the UCLA Post-Traumatic Stress Disorder Reaction Index (UCLA PTSD RI; Pynoos, Rodriguez, Steinberg, Stuber, & Frederick, 1998). The 8 items assessed whether children had experienced different traumatic, stressful, or violent events, such as a natural disaster, or hearing about the violent death of a loved one. In an *el Sistema* psychometric report, these items were found to have acceptable internal consistency (Kuder-Richardson coefficient for dichotomous data of .61) and a unidimensional underlying structure (Williamson, 2013). These 8-items were summed to generate a total stress exposure index.

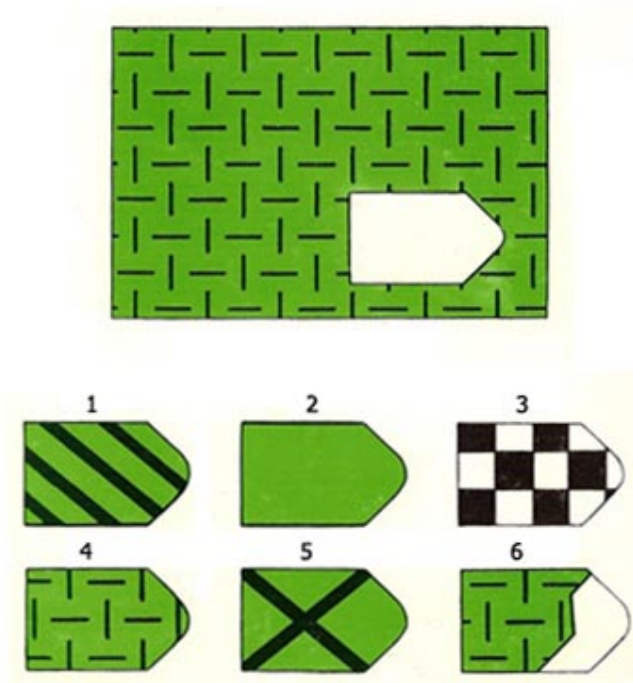


Figure 3

Screenshot of the Raven's Progressive Colored Matrices

Source: Alemán et al. (2013).

Child-Reported Aggressive Behavior

Children responded to 4 items measuring physically and verbally aggressive behaviors adapted from the Problem Behavior Frequency Scale (Farrell, Kung, White, & Valois, 2000). Items were selected, adapted, and piloted with Venezuelan children in the same age range by the larger *el Sistema* study research team. Children responded to items on a 4-point Likert scale ranging from 1 (*never*) to 4 (*always*). A sample item is “When you get angry with others, you hit or push.” The full Problem Behavior Frequency Scale has shown good internal consistency ($\alpha = .82-.85$) and convergent validity in a large, diverse sample of early adolescents (Farrell et al., 2000). Additionally, a psychometric report for the larger *el Sistema* study has shown that this measure had adequate reliability ($\alpha = .70$) and was inversely related to a measure of prosocial behavior in the full sample of 2,563 Venezuelan children ages 6 to 14 at Time 1 (Williamson, 2013).

Children also responded to items from the physical aggression propensity version of the What Would Make You Fight measure (WWMYF; Chan & Henry, 2009; Chan et al., n.d.; Appendix D). Children responded to items on a 4-point Likert scale ranging from 1 (*never*) to 4 (*for sure*). A sample item is “Would you hit, slap, or shove someone if the person yelled at you or called you names?” Different versions of the WWMYF scale have been used in previous research with youth samples. The physical aggression propensity version used in this study has been found to have good internal consistency in a diverse adolescent sample ($\alpha = .82$; Williamson, Guerra, & Dierkhising, 2013) and in a Jamaican youth sample ($\alpha = .73-.75$; Meeks-Gardner,

Williams, Guerra, & Walker, 2010). In a psychometric report for the larger *el Sistema* study, this version of WWMYF was found to have good internal consistency ($\alpha = .87$) and a unidimensional factor structure (Williamson, 2013). It was also inversely associated with a measure of prosocial behavior (Williamson, 2013).

Guided by confirmatory factor analysis, the final contained 4 child-report aggressive behavior items and 9 aggression propensity items. All items were scored so that higher values indicate greater aggressive behavior or aggression propensity. Internal consistency for the 4 aggressive behavior items was $\alpha = .68$ at Time 1 and $\alpha = .79$ at Time 2. Internal consistency for the 9 WWMYF items was $\alpha = .81$ at Time 1 and $\alpha = .82$ at Time 2.

Parent-Reported Child Aggressive Behavior

Parents responded to 4 items measuring child physical and verbal aggressive behavior from the Social and Antisocial Behavior Scale (European Monitoring Center for Drugs and Drug Addiction, n.d.). Items were rated on a 4-point Likert scale ranging from 1 (*never*) to 4 (*always*), and scored so that higher scores indicated increased aggressive behavior. A sample item is “He/she fights with other children.” Limited psychometric information is available for this scale, but in a psychometric report for the larger impact evaluation, these items were found to have acceptable internal consistency ($\alpha = .68$), with the scale being modestly negatively associated with parent-reported child interpersonal strengths/social behavior ($r = -.38$) and positively associated with child-reported aggressive behavior ($r = .20$; Williamson,

2013). In the current sample, internal consistency was $\alpha = .72$ at Time 1 and $\alpha = .74$ at Time 2.

Data Analytic Approach

Preliminary analyses included an examination of child-reported and parent-reported item means, as well as averages for child performance task outcomes and individual difference variables, using Stata version 12 (StataCorp, 2011). Missing data analyses were also conducted using logistic regression in Stata to examine patterns of missingness prior to conducting primary study hypothesis testing.

Primary analyses included confirmatory factor analysis (CFA) in Mplus version 12 (Muthén & Muthén, 1998-2011) to test the latent structure of child-reported, parent-reported, and performance-based tasks related to self-control and aggressive behavior, and to identify any poorly loading observed items or tasks in these models. Primary study aims related to the potential impact of individual differences on self-control measures, as well as associations between self-control and aggressive behavior over time, were then examined using SEM in Mplus.

Chapter 3

RESULTS

Preliminary Analyses

Descriptive Statistics

Means, standard deviations, range, skew, and kurtosis for observed study variables at Time 1 are presented in Table 1. For child- and parent-reported scale items, the average item mean for each outcome is shown. The composite score for parental university level education is shown as both a mean score and as frequencies. The sample was approximately evenly divided with regard to parental university level education, with 34.3% having no parental university education, 31.7% reporting university education for one parent, and 34.0% reporting university education for both parents. For the stress exposure index, on average children reported exposure to 1.34 events, out of a possible range of 0 to 8 events. Frequencies for these data are as follows: 34.2% for zero events; 27.3% for one event; 21.1% for two events; 10.4% for three events; 4.2% for four events; 1.5% for five events; 0.4% for six events; 0.2% for seven events; and 0.7% for 8 events.

The majority of the observed study outcome variables showed significant skew and kurtosis (Table 1), with the sample reporting higher levels of self-control and lower levels of aggressive behavior across parent and child informants. Additionally, performance data for self-control outcomes (Flanker and Go/No-Go) and individual

differences data also showed significant skew and kurtosis (i.e., values falling outside of -1 and +1; Table 1).

As shown in Table 2, Time 1 bivariate correlations among study outcomes and individual differences were generally small. Parent and child reports of child self-control were positively intercorrelated at $r = .38$ ($p < .01$), and parent-reported child aggressive behavior was positively correlated at $r = .23$ ($p < .01$) with both child-reported aggressive behavior and child-reported aggression propensity. These modest cross-informant intercorrelations are consistent with literature showing low to moderate correlations across parent and child reporters (e.g., Achenbach, McConaughy, & Howell, 1987; De Los Reyes et al., 2013; Duckworth & Kern, 2011). The Flanker and Go/No-Go indices of self-control were modestly correlated with parent and child reports of child self-control ($r = .12-.24$, $p < .01$), which also aligns with the broader literature on this topic (Duckworth & Kern, 2011). Correlations among latent factors created from these observed variables are presented below in primary study analyses.

Table 1

Descriptive Statistics for Observed Study Variables at Time 1

Study Outcomes	<i>M</i> (<i>SD</i>)	Range	Skew	Kurtosis
Child-Reported Self-Control Items	3.48 (0.50)	1 – 4	-1.24	4.98
Parent-Reported Child Self-Control Items	3.32 (0.52)	1 – 4	-0.82	3.35
Go/No-Go D-prime	0.41 (1.06)	-4.76 – 2.68	-1.40	5.79
Flanker Trials Correct	49.84 (9.18)	0 – 60	-1.63	6.18
Child-Reported Aggressive Behavior Items	1.13 (0.30)	1 – 4	3.39	16.53
Child-Reported Aggression Propensity Items	1.44 (0.57)	1 – 4	1.49	5.55
Parent-Reported Child Aggressive Behavior Items	1.26 (0.39)	1 – 4	2.81	14.94
Individual Differences	<i>M</i> (<i>SD</i>) or %	Range	Skew	Kurtosis
Child Age	11.33 (1.25)	10 – 14	0.62	2.36
Child Female Gender	50.9%	--	--	--
Child Stress Exposure	1.34 (1.41)	0 – 8	1.46	3.33
Raven's CPM Score	11.27 (2.56)	0 – 17	-0.66	3.57
High Socioeconomic Status	58.5%	--	--	--
Parent University Education	0.99 (0.83)	0 – 2	.004	-1.54
None	34.3%	--	--	--
One Parent	31.7%	--	--	--
Both Parents	34.0%	--	--	--

Note. CPM = Colored Progressive Matrices.

Table 2

Bivariate Correlations Among Observed Study Variables at Time 1

Study Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
1. C Self-Control	--											
2. P Self-Control	.38**	--										
3. GNG D-prime	.12*	.16**	--									
4. Flanker	.23**	.24**	.31**	--								
5. C Agg Behavior	-.35**	-.21**	-.15**	-.21**	--							
6. C Agg Propensity	-.30**	-.16**	-.10*	-.14*	.47**	--						
7. P Agg Behavior	-.22**	-.33**	-.08	-.23**	.23**	.23**	--					
Individual Differences												
8. C Age	-.11**	.05	.10*	.19**	.004	-.01	-.05	--				
9. C Female	.06	.21**	.10*	-.02	-.13*	.10*	.02	-.07	--			
10. C Stress Exp	-.13**	-.11**	-.07	.01	.06	.18**	.10*	.01	-.05	--		
11. P University Ed	-.01	.21**	.06	.17**	-.08	-.12**	-.08	-.11*	.10*	-.06	--	
12. Raven's CPM	.10*	.16**	.15**	.41**	-.21**	-.18**	-.12**	.10*	-.02	-.03	.22**	--
13. High SES	-.09*	.04	.03	.13**	-.12**	-.14**	-.04	-.002	-.07	.001	.28**	.16**

Note. C = child-reported; P = parent-reported; GNG = Go/No-Go; agg = aggressive;

Exp = exposure; CPM = Colored Progressive Matrices; SES = socioeconomic status.

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

Missing Data

I examined patterns of missing data due to either non-response or study attrition by generating a binary missing data variable (missing = 1) and regressing this outcome on observed Time 1 study variables. Standard errors in these analyses were clustered around parent reporter, to account for siblings in the study nested within the same household. Missing data impacted 38.9% of the sample. Logistic regressions using observed parent-reported and child-reported item means for child self-control and aggressive behavior, as well as Flanker and Go/No-Go scores, showed no significant associations between observed Time 1 study outcomes and missing data. However, logistic regression using individual differences (child age, female gender, child stress exposure, parental education, Raven's CPM intelligence scores, and SES) showed some associations between these variables and missingness. Older children were slightly more likely to have missing data, odds ratio = 1.16, $z = 1.95$, $p = .05$, 95% CI [1.00-1.35]. Children with higher stress index scores were also marginally more likely to have missing data, odds ratio = 1.14, $z = 1.72$, $p = .09$, 95% CI [.98-1.32].

Although some individual differences were associated with missingness due to non-response or study drop-out, I concluded that data were missing at random (MAR) and as such could be handled using full maximum likelihood estimation in Mplus. Maximum likelihood procedures use all available participant information to estimate effects and are more robust than other missing data procedures, like mean substitution or pairwise deletion (Gallop & Tasca, 2009; Schafer & Graham, 2002). Concluding

that data are MAR assumes that the probability of missing data is independent of study outcome variables (Gallop & Tasca, 2009; Little, 1995), which is consistent with logistic regression results showing that Time 1 self-control and aggressive behavior outcomes were not associated with missingness. Additionally, MAR holds that missingness can be associated with other observed variables (Gallop & Tasca, 2009), such as the two individual differences that were related to missingness in the present study.

Primary Analyses

Primary analyses and related hypothesis testing were conducted in Mplus. Because preliminary analyses indicated that the majority of study variables showed significant skew and kurtosis, I employed maximum likelihood estimation with robust standard errors (MLR) for primary study analyses, as the MLR estimation technique is robust to violations of normality. MLR estimation requires the use of the scaled Santorra-Bentler chi-square statistic (S-B χ^2 ; Santorra & Bentler, 1994; Muthén & Muthén, 2005), which adjusts for a non-normal distribution. This statistic and a combination of additional goodness-of-fit indices were examined to determine the fit of the structural models. Goodness-of-fit indices included the Comparative Fit Index (CFI; Bentler, 1990), Root Mean Square Error of Approximation (RMSEA; Steiger & Lind, 1980), and Standardized Root Mean Square Residual (SRMR; Hu & Bentler, 1999). Values below .050 for RMSEA and SRMR are considered evidence of good model fit, with values between .050 and .080 indicating acceptable fit, and values between .080 and .100 indicating mediocre fit (Kaplan, 2000). Although a CFI of .950

or above has typically been used to indicate good model fit (Hu & Bentler, 1999), recent work has shown that this cutoff may be too stringent, and that values closer to .920 are more appropriate estimates of good fit (Bryne, 2008; Marsh, Hau, & Wen, 2004), with values approaching .90 indicating acceptable fit (Kaplan, 2000).

Consistent with recommendations by Raykov and Marcoulides (2008), observed items that were loading below $\pm .400$ at either time point were removed from latent factors.

Aim 1: Latent Structure of Self-Control Indicators Over Time

To address aim 1, I used Confirmatory Factor Analysis (CFA) to examine the latent structure of child-reported, parent-reported, and performance-based measures of self-control outcomes at Time 1 and Time 2.

First, I examined child- and parent-reported self-control questionnaire items at Time 1 and Time 2. Given small intercorrelations among observed item means for child- and parent-reported self-control measures at Time 1, I first specified separate child-reported and parent-reported models to examine item loadings and remove poorly loading items (Raykov & Marcoulides, 2008). For the initial child-reported self-control CFA at Time 1 and Time 2, I used the 9 CSCRS and 2 SDQ items that were available in the dataset. Error terms were allowed to covary (e.g., item 1 at Time 1 correlated with item 1 at Time 2), to account for the shared residual variance that is associated with repeated measures over time (Cole, Ciesla, & Steiger, 2007). Non-significant covarying error terms were removed during model fitting. The initial model had fair to adequate fit estimates, (S-B $\chi^2_{(207)} = 505.44, p < .001$, RMSEA = .051; CFI = .770; SRMR = .065), with 4 items loading below $\pm .400$ at one or both time points.

These items were those that were reverse-coded and asked about children bothering others, taking items from others, and generally getting along with others. Items were removed in a stepwise fashion, beginning with the lowest loading item at both time points, however, removing all 4 poorly loading items substantially improved overall model fit. The final model with 5 SCRS and 2 SDQ items (Figure 4) showed good model fit (S-B $\chi^2_{(75)} = 153.211, p < .001$, RMSEA = .044; CFI = .914; SRMR = .050), with all items loading significantly on the latent factor at above $\pm .400$. As shown in Figure 4, there was one significant correlation between item error terms that was retained in this model. All other correlations between item error terms across time were non-significant and were removed from the final model.

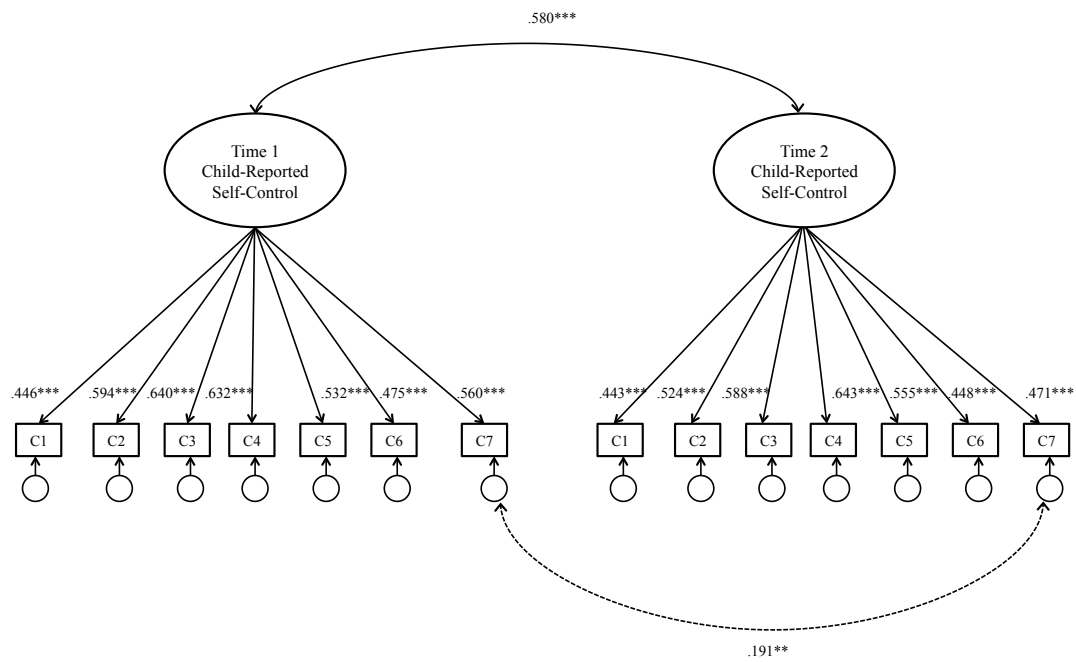


Figure 4

Final Child-Reported Child Self-Control Model Over Two Time Points

*** $p < .001$

Next, for parent-reported child self-control, I initially tested a one-factor model over the two time points with 9 SCRS items and 2 SDQ items that corresponded to the child-reported CSCRS items and SDQ items, respectively. Similar to the initial child-reported model, several parent-reported reverse-coded items showed small loadings on the latent factor, and model fit improved when these items were removed. The preliminary model showed adequate model fit (S-B $\chi^2_{(203)} = 405.072, p < .001$, RMSEA = .043; CFI = .879; SRMR = .054). However, two items that asked about the child interrupting the games of others and bothering others loaded below $\pm .40$ and were removed. The subsequent final model with 7 SCRS and 2 SDQ items (Figure 5) showed improved model fit (S-B $\chi^2_{(130)} = 248.057, p < .001$, RMSEA = .041; CFI = .915; SRMR = .053), with all items loading significantly on the latent factor at above $\pm .400$. In this final model (Figure 5), there were 4 parent-reported items that had significant covarying errors terms across time; as in the child model, all non-significant associations between error terms were removed.

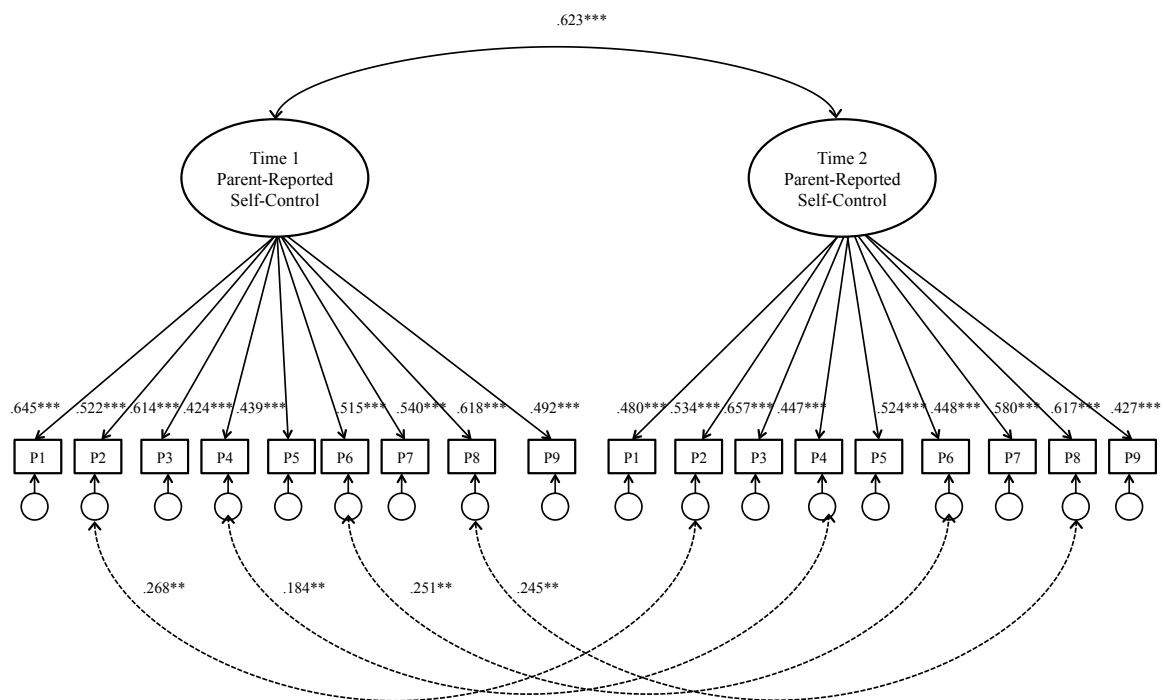


Figure 5

Final Parent-Reported Child Self-Control Model Over Two Time Points

*** $p < .001$

I then specified a model over two time points for performance-based self-control using the Flanker total raw score and the GNG D-prime score as the two observed indicators. Because two observed variables is the minimum number necessary to specify a latent factor, this model with was run in conjunction with the child- and parent-reported models, allowing the performance-based model to “borrow strength” from the child- and parent-reported models that met the criteria for forming latent factors (Raykov & Marcoulides, 2008). Figure 6 shows this model at Time 1, although it was run at both time points. For the performance-based factor, both the Flanker score and the GNG D-prime loaded significantly onto the latent variable at each time point. The Flanker score loaded at .664 ($p < .001$) for Time 1 and .677 ($p < .001$) for Time 2, and the GNG D-prime index loaded at .509 ($p < .001$) for Time 1 and .621 ($p < .001$) for Time 2. Model fit for this three-factor lower-order model with correlations between child-reported, parent-reported, and performance-based self-control across time showed adequate to good model fit (S-B $\chi^2_{(568)} = 851.779$, $p < .001$, RMSEA = .030; CFI = .904; SRMR = .053).

Finally, I tested an alternative self-control model, in which the three lower-order child-reported, parent-reported, and performance-based self-control factors at each time point loaded onto a higher-order self-control factor. The model yielded slightly lower fit indices (S-B $\chi^2_{(576)} = 908.878$, $p < .001$, RMSEA = .032; CFI = .888; SRMR = .060). A scaled chi-square test with a Santorra Bentler correction to compare model fit showed that this alternative higher-order model fit the data significantly worse than the lower-order three-factor model, $\Delta\chi^2 = 38.745$, $\Delta df = 8$, $p < .001$. This

result is in line with the hypothesis that these different indicators of child self-control would comprise distinct lower-order factors as opposed to one larger self-control factor.

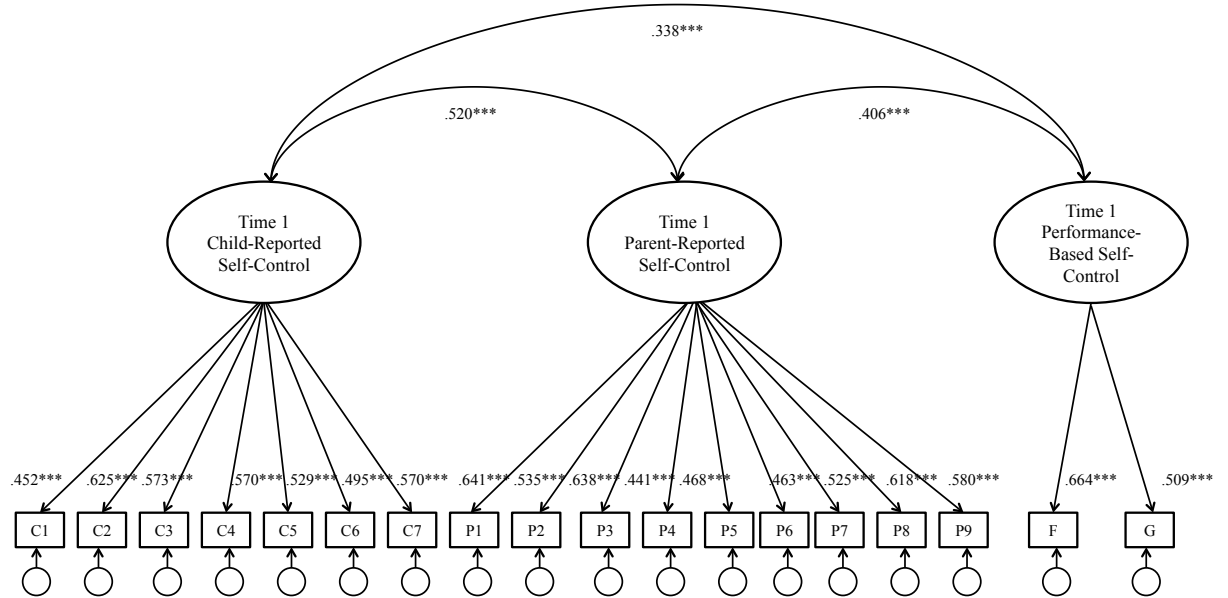


Figure 6

Final Model of Child-Reported, Parent-Reported, and Performance-Based Child Self-Control at Time 1

Time 2 model and significant covarying error terms are not pictured; F = Flanker score; G = Go/No-Go D-prime; *** $p < .001$

Aim 2: Associations Between and Stability of Self-Control Indicators Over Time

To test hypotheses related to the second study aim, I specified the above lower-order three-factor model of child self-control (Figure 6) at Time 1 and Time 2. In this model, I examined interrelations between child-reported, parent-reported, and performance-based self-control concurrently at each time point. I additionally regressed each Time 2 latent factor on the corresponding Time 1 variable in order to obtain stability estimates. Fit for this model was acceptable to good (S-B $\chi^2_{(574)} = 857.730, p < .001$, RMSEA = .030; CFI = .904; SRMR = .054).

As shown in Figure 7, at Time 1, there were significant positive correlations among the child-reported, parent-reported, and performance-based self-control factors. Consistent with hypotheses, correlations among report-based measures were stronger than those between report-based and performance-based measures, with the child-reported and parent-reported indicators associated at $r = .522 (p < .001)$. The performance-based indicator was associated with parent-reported self-control at $r = .446 (p < .001)$ and with child-reported self-control at $.353 (p < .001)$.

Similar estimates were found at Time 2, although correlations among latent factors were attenuated. Child-reported and parent-reported self-control continued to show a moderate and positive intercorrelation at Time 2 ($r = .410, p < .001$), whereas the associations between parent- and child-reported factors and the performance-based factor were small and marginally significant (with parent-reported, $r = .286 p = .072$) or non-significant (with child-reported, $r = .237, ns$). Contrary to study hypotheses, the performance-based indicator of child self-control emerged as the most stable latent

factor across time, with a stability coefficient of $B = 0.722, p < .001$. The parent-reported child self-control factor was less stable ($B = 0.604, p < .001$), with child-reported self-control being the least stable of the three factors ($B = 0.571, p < .001$).

I then conducted an exploratory analysis to examine whether if, controlling for the Time 1 factor, additional Time 1 self-control factors predicted any variation in the latent self-control factors at Time 2. This analysis involved regressing each Time 2 factor on the Time 1 factor, along with the other two Time 1 factors (i.e., regressing Time 2 performance-based self-control on the Time 1 performance-based factor as well as the Time 1 child-reported and parent-reported factors). As shown in Table 3, additional self-control factors did not significantly predict any variation in Time 2 outcomes over and above the Time 1 indicator.

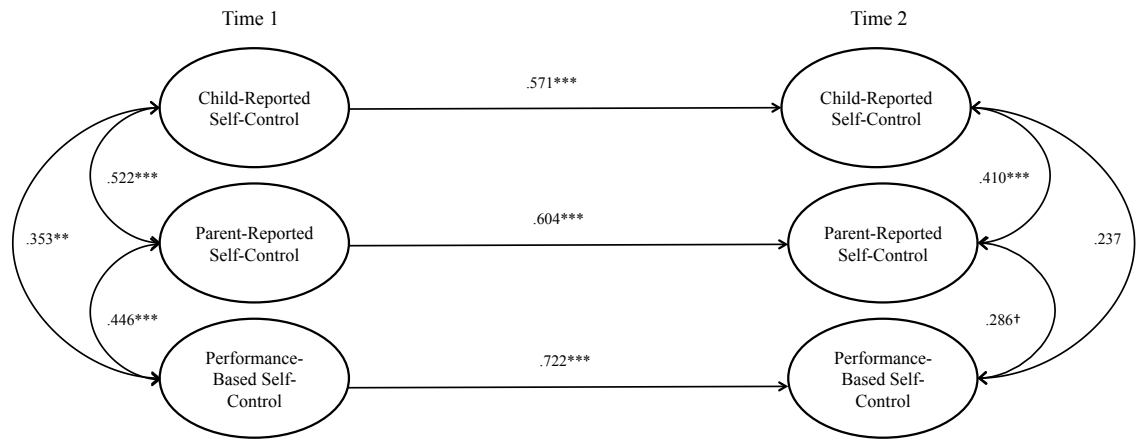


Figure 7

Model Showing Associations Among Self-Control Indicators Over Time and Stability Coefficients

Observed items and error terms are not pictured; † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 3

Regressions of Time 2 Self-Control Factors on Time 1 Self-Control Factors

Predictors	Time 2 Child-Reported Self-Control				Time 2 Parent-Reported Child Self-Control				Time2 Performance-Based Self-Control			
	<i>B</i>	<i>SE</i>	<i>t</i> -ratio	<i>p</i>	<i>B</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>t</i> -ratio	<i>p</i>
Time 1 Child-Reported Self-Control	0.600	0.110	5.463	<.001	0.056	0.080	0.700	.484	0.054	0.110	0.361	.718
Time 1 Parent-Reported Child Self-Control	0.063	0.111	0.569	.569	0.651	0.085	7.672	<.001	0.181	0.149	1.492	.136
Time 1 Performance- Based Self-Control	-0.140	0.113	-1.232	.218	-0.161	0.098	-1.645	.100	0.538	0.122	3.756	<.001

Note. Coefficients are standardized.

Aim 3: Individual Differences Associated With Self-Control

To conduct the exploratory Aim 3 analyses related to individual differences in self-control, I used the above Time 1-Time 2 models of self-control (Figure 7) and specified regression models for different self-control factors at each of the two time points. Time 1 models examined associations between observed individual differences and the various self-control factors by regressing the Time 1 self-control factors on binary child gender (female = 1), mean-centered continuous child age, composite parental education, SES (high SES = 1), and standardized intelligence scores and stress exposures scores at Time 1 (z-scored Raven's CPM and child stress exposure index, respectively). Next, Time 1-Time 2 models examined whether these individual differences were associated with residualized change in self-regulation factors over time, by regressing Time 2 self-control factor scores on the observed individual difference variables and the Time 1 self-control factor scores.

Results for both the Time 1 and the Time 1-Time 2 regressions appear in Table 3. These regressions were run simultaneously and yielded the following fit indices: S-B $\chi^2_{(748)} = 1043.723, p < .001$, RMSEA = .030; CFI = .888; SRMR = .055. Although the RMSEA and SRMR indices showed good fit, the CFI was mediocre, according to standard goodness-of-fit indices. For the Time 1 models, higher intelligence scores on the Raven's CPM was significantly associated with increased child-reported ($B = 0.169, p = .018$) and parent-reported child self-control ($B = 0.150, p = .016$), as well as higher performance-based self-control ($B = 0.448, p < .001$). Child age was also significantly associated with self-control factors, but the direction of these associations

was inconsistent across different factors. Although older child age was associated with higher performance-based self-control ($B = 0.191, p = .003$), it was also associated with *lower* levels of child-reported self-control ($B = .150, p = .006$). Female child gender was only associated with parent-reported self-control, such that parents reported females as having increased self-control relative to males ($B = 0.211, p < .001$). Higher levels of parental university education were significantly associated with increased parent-reported child self-control ($B = 0.161, p = .008$), and were marginally associated with increased performance-based self-control ($B = 0.101, p = .094$). Higher SES was marginally associated with lower child-reported self-control ($B = -0.108, p = .085$), but was unrelated to the other self-control factors.

Time 1-Time 2 regressions showed that few individual differences were predictive of Time 2 self-control over and above Time 1 levels. However, female children showed marginally increased Time 2 levels of child-reported self-control ($B = 0.134, p = .066$) and significantly increased parent-reported self-control ($B = 0.143, p = .025$) relative to males, controlling for Time 1 levels. Additionally, child-reported Time 1 self-control significantly predicted increased Time 2 performance-based self-control ($B = 0.288, p = .041$), although this was not initially significant in the previous regression using only the three different Time 1 self-control factors to predict Time 2 factors (Table 3). Higher SES was also marginally associated with increased Time 2 performance-based self-control, controlling for Time 1 levels ($B = 0.116, p = .094$).

Table 4

Regressions Examining Associations Between Observed Individual Differences and Self-Control Factors at Time 1 and Time 2

Predictors	Time 1 Child-Reported Self-Control				Time 1 Parent-Reported Child Self-Control				Time1 Performance-Based Self-Control			
	<i>B</i>	<i>SE</i>	<i>t-ratio</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>t-ratio</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>t-ratio</i>	<i>p</i>
Child Female Gender	0.008	0.059	0.130	.897	0.211	0.053	3.989	<.001	-0.026	0.060	-0.427	.669
Child Age	-0.150	0.055	-2.739	.006	0.084	0.052	1.605	.109	0.191	0.063	3.021	.003
Child Stress Exp	-0.039	0.057	-0.686	.493	-0.066	0.059	-1.105	.269	-0.001	0.050	-0.027	.978
Parent University Ed	-0.005	0.066	-0.079	.937	0.161	0.060	2.660	.008	0.101	0.060	1.675	.094
Raven's CPM	0.169	0.071	2.372	.018	0.150	0.063	2.407	.016	0.448	0.066	6.766	<.001
High SES	-0.108	0.063	-1.723	.085	-0.009	0.060	-0.158	.874	0.043	0.059	0.724	.469
Predictors	Time 2 Child-Reported Self-Control				Time 2 Parent-Reported Child Self-Control				Time2 Performance-Based Self-Control			
	<i>B</i>	<i>SE</i>	<i>t-ratio</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>t-ratio</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>t-ratio</i>	<i>p</i>
Child Female Gender	0.134	0.073	1.836	.066	0.143	0.064	2.243	.025	0.045	0.076	0.596	.551
Child Age	0.105	0.071	1.475	.140	0.003	0.062	0.054	.957	0.110	0.072	1.519	.129
Child Stress Exp	-0.062	0.062	-0.933	.321	-0.013	0.057	-0.219	.827	0.029	0.062	0.468	.640
Parent University Ed	0.091	0.069	1.312	.190	0.091	0.073	1.253	.210	0.105	0.074	1.407	.159
Raven's CPM	-0.008	0.096	-0.083	.933	-0.044	0.075	-0.582	.561	0.112	0.099	1.135	.257
High SES	0.107	0.073	1.457	.145	-0.059	0.061	-0.964	.335	0.116	0.069	1.672	.094
Time 1 Child-Reported Self-Control	0.756	0.131	5.779	<.001	0.131	0.104	1.260	.208	0.288	0.141	2.045	.041
Time 1 Parent-Reported Child Self-Control	0.144	0.122	-1.182	.237	0.578	0.099	5.827	<.001	0.042	0.137	0.307	.759
Time 1 Performance-Based Self-Control	-0.174	0.126	-1.374	.169	-0.132	0.086	-1.524	.123	0.347	0.173	2.001	.045

Note. Coefficients are standardized; Exp = exposure; Ed = education; CPM = Colored

Progressive Matrices.

Aim 4: Self-Control and Aggressive Behavior Over Time

To test Aim 4 hypotheses related to associations between Time 1 report- versus performance-based measures of self-control and Time 2 aggressive behavior measures, I first used CFA to obtain a child- and parent-report aggressive-behavior model over Time 1 and Time 2. Similar to the self-control CFAs, I first examined one-factor models for each measure (child-reported aggressive behavior, child-reported aggression propensity, and parent-reported child aggressive behavior) and removed items that loaded lower than $\pm.400$, of which there were few (3 aggression propensity items). I also allowed error terms to covary over time when these associations were significant.

To create a combined child-and parent-reported model of aggressive behavior, I initially specified a higher-order CFA in which three lower-order factors (child-reported aggressive behavior, child-reported aggression propensity, and parent-reported child aggressive behavior) loaded onto a higher-order child aggression factor. This model had acceptable to good fit (S-B $\chi^2_{(511)} = 753.965, p < .001, RMSEA = .029; CFI = .912; SRMR = .063$), with all observed items loading significantly above $\pm.400$ onto the lower-order factors, and all lower-order factors loading significantly onto the higher-order factor. However, comparing this model to a more parsimonious model without the higher-order factor showed that the initial higher-order model had worse model fit, $\Delta\chi^2 = 19.968, \Delta df = 8, p < .010$. The final model, which was a three-factor lower-order model at Time 1 and Time 2, is shown in Figure 8. This model had acceptable to good fit (S-B $\chi^2_{(503)} = 731.562, p < .001, RMSEA = .029; CFI = .917$;

SRMR = .057), with all observed items loading significantly above .400. Regressing Time 2 factors on Time 1 factors to obtain stability estimates showed that all three indicators were moderately stable over time (child-reported aggressive behavior $B = 0.417$, $p < .001$; child-reported aggression propensity $B = 0.454$, $p < .001$; parent-reported child aggressive behavior $B = 0.414$, $p < .001$).

I then specified a model with the three self-control factors and the three aggressive behavior factors at Time 1 and Time 2, with correlations at each time point, which are reported in Table 5. This model yielded adequate fit according to most indices (S-B $\chi^2_{(2258)} = 3256.245$, $p < .001$, RMSEA = .029; CFI = .860; SRMR = .055), although the CFI indicated mediocre fit. Intercorrelations among factors ranged from very small and non-significant to moderate and significant (Table 5). Associations among self-control and aggressive behavior were generally stronger within measurement modalities/reporters and time points (e.g., child-reported self-control and child-reported aggressive behavior at Time 1, $r = -.473$, $p < .001$) as opposed to across measures and time points (e.g., parent-reported child self-control at Time 1 and child-reported aggressive behavior at Time 2 $r = -.150$, $p < .05$).

Next, I ran a series of regressions in which all three Time 1 self-control factors and aggressive behavior factors predicted each Time 2 aggressive behavior factor. A conceptual schematic of these models along with the hypothesized directionality of the effects appears in Figure 9, although models predicting each Time 2 aggressive behavior factor were specified separately (Table 6). The goal of these regressions was to examine whether Time 1 child-reported, parent-reported, and performance-based

self-control factors predicted any variation in Time 2 aggressive behavior factors, over and above Time 1 aggressive behavior factors. After running these models, I then added the individual difference variables of child gender, child age, child stress exposure, parent university education, child intelligence, and SES as additional predictors, to explore whether these variables were associated with any change in child aggressive behavior, over and above Time 1 aggressive behavior and self-control factors (Table 7).

For the regressions predicting child-reported aggressive behavior at Time 2, the model using only Time 1 self-control and aggressive behavior factors revealed no significant predictors of Time 2 child-reported aggressive behavior (Table 6). Similarly, when individual difference variables were added to this model, there were no significant predictors (Table 7). This is in contrast to my hypothesis that Time 1 child-reported self-regulation would be predictive of Time 2 child-reported aggressive behavior, controlling for Time 1 levels. In the same way, the models predicting Time 2 child aggression propensity showed that neither Time 1 self-control and aggressive behavior factors (Table 6) nor individual differences (Table 7) were predictive of Time 2 aggression propensity. However, models predicting parent-reported self-control at Time 2 showed some significant results for Time 1 parent-reported variables. In the first model for this outcome, both increased parent-reported Time 1 child aggressive behavior ($B = 0.303, p = .007$) and decreased parent-reported Time 1 child self-control ($B = -0.232, p = .047$) were predictive of increased Time 2 parent-reported child aggressive behavior. These results are in line with study hypotheses.

However, when individual difference variables were added to the model (Table 7), significance for Time 1 parent-reported self-control diminished ($B = -.156, ns$), and there were no significant individual difference predictors.

Finally, I tested for bidirectional effects by running models in which Time 1 self-control and aggressive behavior factors predicted each Time 2 self-control factor (see Figure 10 for a conceptual model). Results are briefly summarized here.

Aggressive behavior factors at Time 1 did not predict any variation in Time 2 child-reported self-control or performance-based self-control factors, controlling for Time 1 levels of these indicators. Consistent with the results presented in Table 6 for parent-reported outcomes, however, increased Time 1 parent-reported child aggressive behavior significantly predicted decreased Time 2 parent-reported child self-control ($B = -0.219, SE = 0.096, t\text{-ratio} = -2.287, p = .022$). Taken with the results for the Time 2 parent-reported aggressive behavior model shown in Table 6, these results for the Time 2 parent-reported child-self control model indicate that parent-reporting of child aggressive behavior and self-control are bidirectionally and inversely related over time. Stated otherwise, higher Time 1 parent-reported child self-control is predictive of lower parent-reported child aggressive behavior at Time 2, and at the same time, lower Time 1 parent-reported aggressive behavior is predictive of higher parent-reported child self-control at Time 2. No individual difference factors were significant predictors of Time 2 self-control factors when added to these bidirectional models, which is consistent with results using Time 1 self-control factors to predict Time 2 aggressive behavior factors.

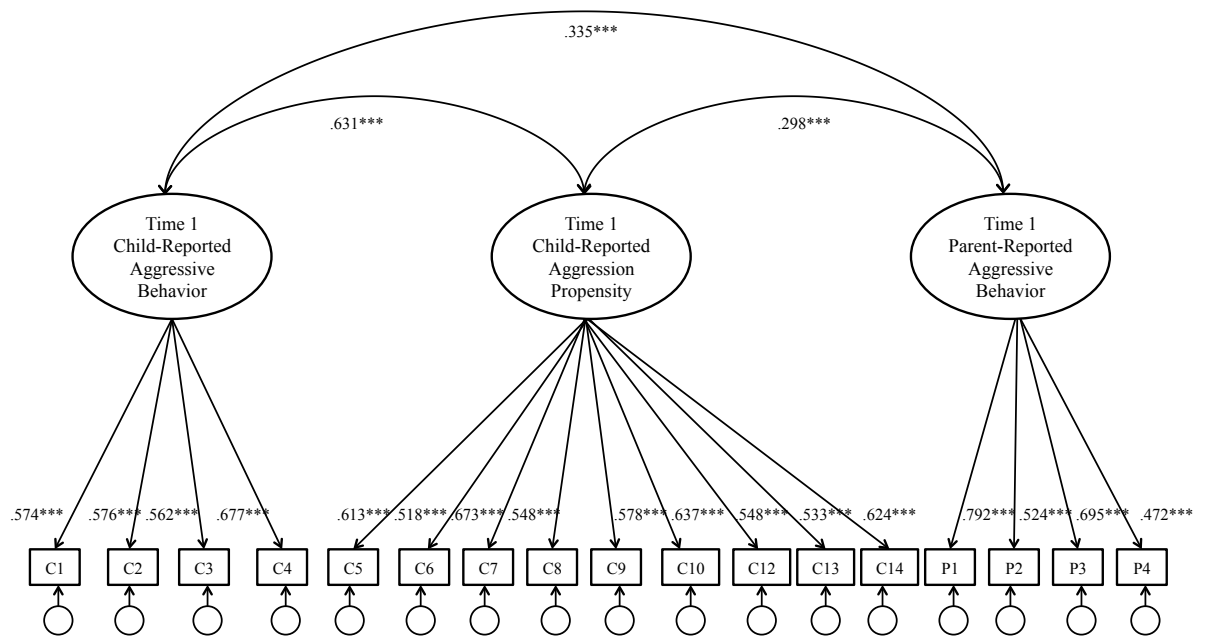


Figure 8

Final Model of Child-Reported and Parent-Reported Aggressive Behavior at Time 1

Time 2 model and significant covarying error terms are not pictured; *** $p < .001$

Table 5

*Bivariate Correlations Among Self-Control and Aggressive Behavior Latent Factors**at Time 1 and Time 2*

Time 1 Factors	1	2	3	4	5	6	7	8	9	10	11
1. C Self-Control	--										
2. P Self-Control	.521***	--									
3. PB Self-Control	.336***	.401***	--								
4. C Agg Behavior	-.473***	-.303***	-.387***	--							
5. C Agg Propensity	-.367***	-.203***	-.252**	.628***	--						
6. P Agg Behavior	-.296***	-.440***	-.324**	.333***	.298***	--					
<hr/>											
Time 2 Factors											
7. C Self-Control	.588**	.316***	.078	-.299**	-.232**	-.284**	--				
8. P Self-Control	.339***	.619***	.119	-.163†	-.157*	-.102	.466***	--			
9. PB Self-Control	.347**	.422***	.622***	-.258*	-.229**	-.366***	.303**	.359***	--		
10. C Agg Behavior	-.343***	-.150*	-.106	.461***	.328***	.355**	-.528***	-.316***	-.412***	--	
11. C Agg Propensity	-.328***	-.178*	-.083	.401***	.452***	.250**	-.480***	-.281***	-.340**	.511***	--
12. P Agg Behavior	-.194*	-.286***	-.145	.242†	.181**	.416***	-.284**	-.359***	-.151	.231*	.147*

Note. C = child-reported; P = parent-reported; PB = performance-based; Agg =

aggression. † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

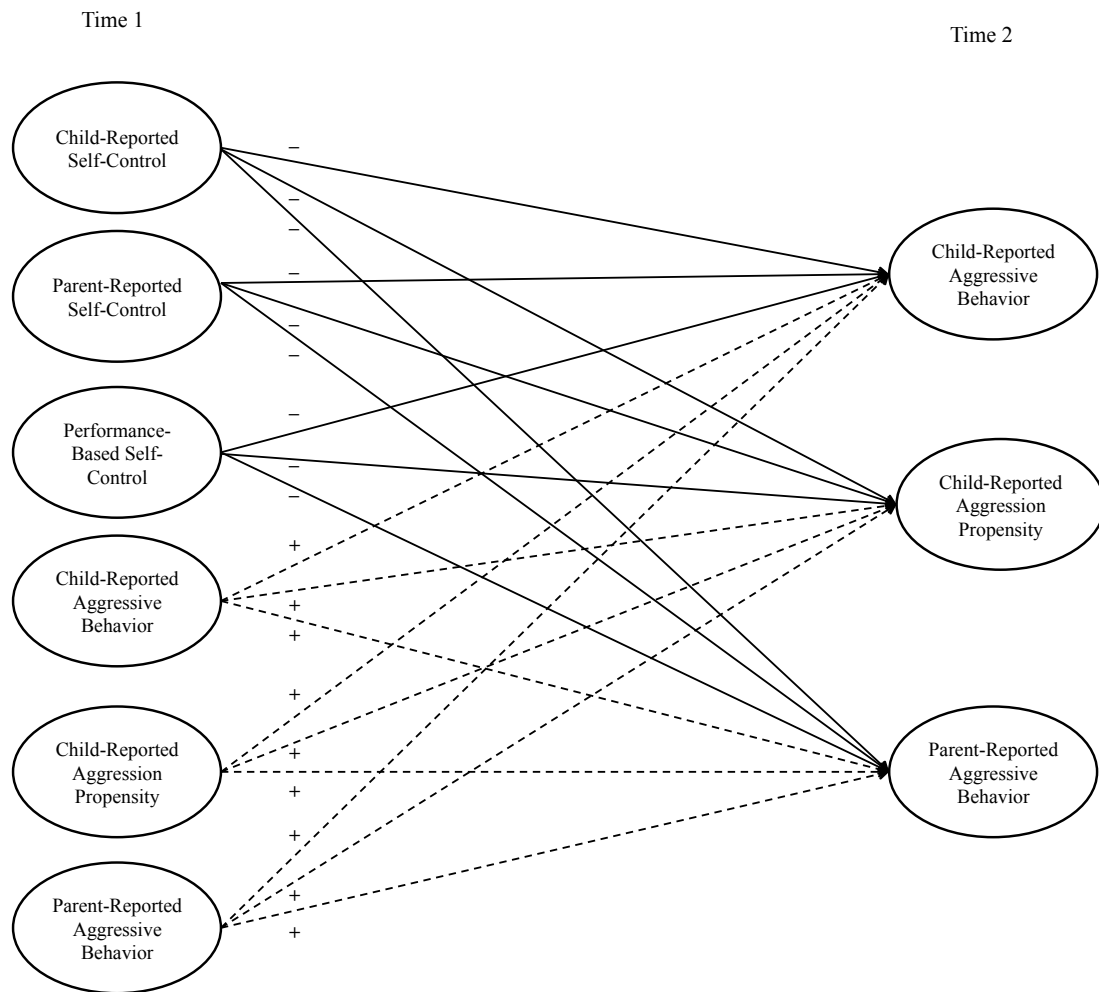


Figure 9

Conceptual Model Showing Regressions of Time 2 Aggressive Behavior Factors on Time 1 Self-Control Factors with Hypothesized Directionality of Effects

Dashed lines indicate Time 1 controls.

Table 6

*Regressions Using Time 1 Self-Control Factors to Predict Time 2 Aggressive**Behavior Factors*

Predictors	Time 2 Child-Reported Aggressive Behavior				Time 2 Child-Reported Aggression Propensity				Time 2 Parent-Reported Child Aggressive Behavior			
	<i>B</i>	<i>SE</i>	<i>t-ratio</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>t-ratio</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>t-ratio</i>	<i>p</i>
Time 1 C Self-Control	-0.339	0.513	-0.660	.509	-0.243	0.148	-1.649	.099	0.023	0.113	0.200	.842
Time 1 P Self-Control	-0.509	0.819	-0.621	.535	0.031	0.123	0.252	.801	-0.232	0.117	-1.983	.047
Time 1 PB Self-Control	1.526	1.266	1.206	.228	0.260	0.193	1.344	.179	0.152	0.138	1.105	.269
Time 1 C Agg Behavior	1.171	1.009	1.161	.246	0.233	0.291	0.800	.424	0.148	0.237	0.625	.532
Time 1 C Agg Propensity	-0.159	0.451	-0.352	.725	0.246	0.178	1.384	.166	0.002	0.153	0.014	.989
Time 1 P Agg Behavior	0.556	0.492	1.129	.259	0.138	0.110	1.259	.208	0.303	0.113	2.688	.007

Note. Coefficients are standardized; C = child-reported; P = parent-reported; PB = performance-based; Agg = aggression.

Table 7

Regressions Using Time 1 Self-Control Factors and Individual Differences to Predict Time 2 Aggressive Behavior Factors

Predictors	Time 2 Child-Reported Aggressive Behavior				Time 2 Child-Reported Aggression Propensity				Time2 Parent-Reported Child Aggressive Behavior			
	<i>B</i>	<i>SE</i>	<i>t-ratio</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>t-ratio</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>t-ratio</i>	<i>p</i>
Time 1 C Self-Control	-0.083	.390	-0.212	.832	-0.081	0.372	-0.217	.828	-0.043	0.166	-0.259	.796
Time 1 P Self-Control	0.177	0.303	0.585	.558	0.051	0.261	0.196	.845	-0.156	0.134	-1.168	.243
Time 1 PB Self-Control	0.578	0.753	0.768	.443	0.517	0.601	0.862	.389	0.142	0.173	0.819	.413
Time 1 C Agg Behavior	1.753	1.232	1.422	.155	1.218	1.032	1.180	.238	0.171	0.605	0.283	.777
Time 1 C Agg Propensity	-1.153	0.980	-1.176	.240	-0.537	0.828	-0.649	.516	-0.048	0.408	-0.117	.907
Time 1 P Agg Behavior	0.369	0.278	1.331	.183	0.181	0.202	0.893	.372	0.313	0.129	2.423	.015
Child Female Gender	0.001	0.049	0.014	.989	-0.061	0.070	-0.877	.380	0.012	0.077	0.153	.879
Child Age	-0.033	0.051	-0.641	.521	0.004	0.064	0.058	.954	0.045	0.062	.725	.468
Child Stress Exp	-0.022	0.036	-0.601	.548	-0.020	0.047	-0.429	.668	0.080	0.079	1.023	.306
Parent University Ed	-0.037	0.045	-0.829	.407	-0.029	0.072	-0.405	.686	-0.021	0.071	-0.298	.765
Raven's CPM	0.043	0.063	0.680	.497	0.054	0.074	0.734	.463	-0.046	0.077	-0.598	.550
High SES	0.038	0.053	0.714	.475	-0.042	0.057	-0.737	.461	0.002	0.082	0.020	.984

Note. Coefficients are standardized; C = child-reported; P= parent-reported; PB = performance-based; Agg= aggression; Exp = exposure; Ed = education; CPM = Raven's Colored Progressive Matrices.

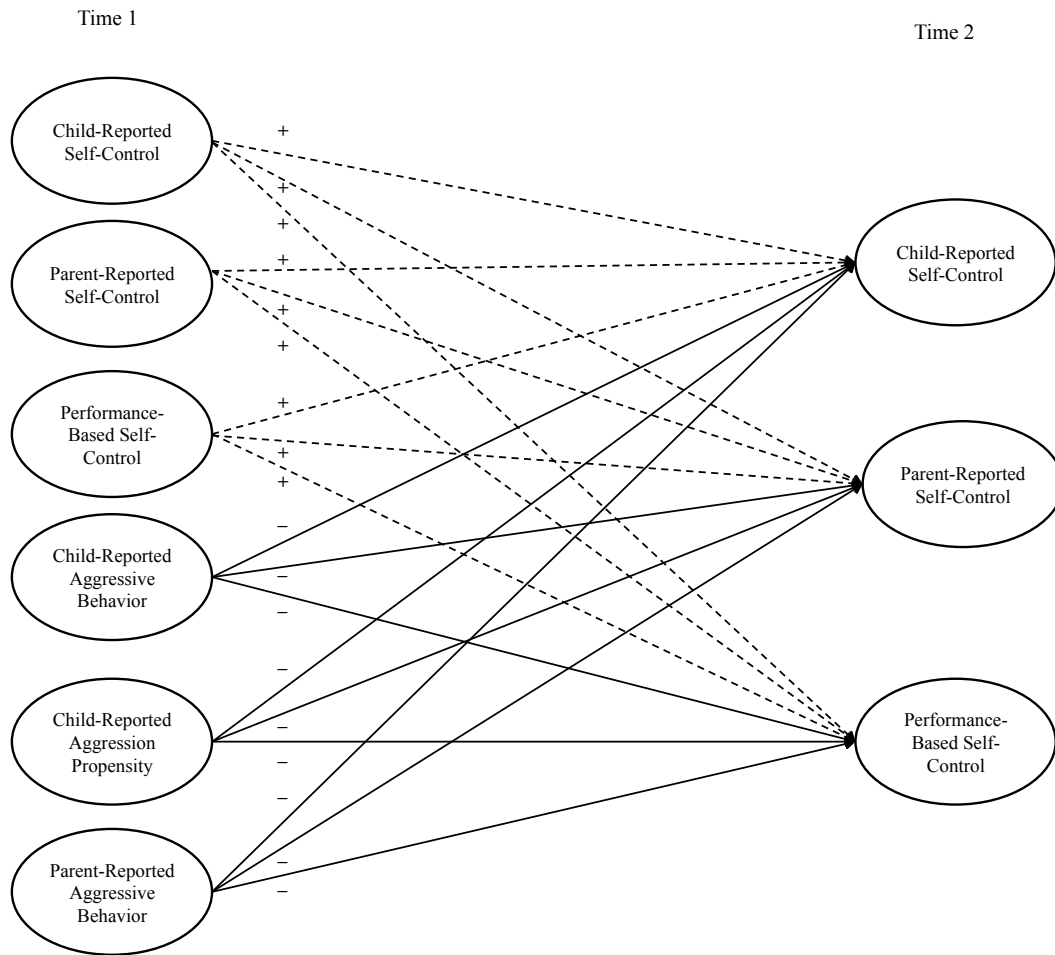


Figure 10

Conceptual Bidirectional Model Showing Regressions Testing Time 2 Self-Control Factors on Time 1 Aggressive Behavior Factors with Hypothesized Directionality of Effects

Dashed lines indicate Time 1 controls.

Chapter 4

DISCUSSION

This study used a multi-informant and multi-method approach to replicate and extend U.S. and European findings on child self-control and its association with aggressive behavior among a Venezuelan youth sample, in an effort to examine the cross-cultural generalizability of these constructs, and to additionally inform the aggression prevention literature. Specifically, I examined the latent structure of, associations among, and stability of self-control indicators during the transition to adolescence (Aims 1 and 2), as well as the impact of individual differences on child-reported, parent-reported, and performance-based self-control factors (Aim 3). I then examined associations between self-control factors and aggressive behavior factors (Aim 4) at two time points, in order to assess whether self-control factors were differentially related to or predictive of child- and parent-reported child aggressive behavior.

Structure of, Associations Among, and Stability of Self-Control Indicators

Findings for Aim 1 related to the latent structure of self-control across child-reported, parent-reported, and performance-based observed indicators were supportive of study hypotheses, in that confirmatory factor analysis showed that these three measurement indicators comprised distinct latent factors. Comparing this lower-order three-factor model to a higher-order model in which these factors loaded onto an

overarching self-control factor indicated that the lower-order, three-factor model was a better fit to the data. Given that latent factor structures represent the strength of the co-variation among the observed data (Raykov & Marcoulides, 2008), these results are in line with meta-analytic studies showing only modest intercorrelations among observed child, parent, and performance-based self-control measures (e.g., Duckworth & Kern, 2011; Sharma, Markon, & Clark, 2014). Because observed intercorrelations among these different measurement strategies were fairly small to begin with (see Table 2), it is not surprising that in a latent variable modeling context, observed items formed distinct factors according to reporter and measurement type, and that these factors fit the data better when correlated over time instead of when loading onto a higher-order self-control factor.

In line with study hypotheses for Aim 2, the three latent self-control factors were also intercorrelated, with stronger associations among the report-based indicators. Specifically, Time 1 child-reported self-control and parent-reported self-control showed a strong, significant positive association, whereas associations across report- and performance-based measurement types were moderate. Although indicators remained positively intercorrelated at Time 2, associations were attenuated due to stability analyses being specified in the same model (see Figure 7). However, the associations between the report-based measures remained the strongest among the Time 2 self-control factors. These results are again consistent with expectations drawn from the extant literature, although many of the correlations among these latent factors were slightly larger than those found in meta-analytic data for observed report- and

performance-based measurement strategies (Duckworth & Kern, 2011). For instance, Duckworth and Kern (2011) reported that correlations between performance-based and report-based measures were small ($r = .10$ to $.21$) and correlations between child- and informant-reported measures were moderate ($r = .48$). Stronger correlations among latent rather than observed variables are likely due to the reduction of measurement error in the latent variable modeling context (Raykov & Marcoulides, 2008).

Aim 2 results for the stability of the different self-control indicators over time were not consistent with the hypothesis that performance-based self-control would be less stable than the parent- and child-reported factors. When regressing Time 2 self-control factors on the Time 1 factors, results indicated that performance-based self-control was the *most* stable of the three factors, although parent-reported and child-reported self-control stability coefficients were still large. Because psychometric studies of performance-based tasks have shown test-retest stability to be variable and often low (e.g., Kindlon, Mezzacappa, & Earls, 1995), the stability finding for the performance-based factor was somewhat surprising.

However, this finding may have emerged for a number of reasons. First, the stability of performance-based tasks is not typically examined in SEM. This study's latent variable modeling approach may have strengthened stability coefficients over time due to the partitioning of shared and error variance (Raykov & Marcoulides, 2008). Second, the duration of time between measurements was fairly short, at only 12 months, and occurred during a developmental period in which there may not be large gains or changes in self-control. Additionally, research indicates that

individuals show rank order stability in their self-control over time (Berger, 2011; Moffitt et al., 2011). Study findings generally converge with previous work showing that self-control between the ages of 10 and 14 tends to be highly stable, at least when measured using broad report-based measures of child self-control and performance tasks that tap response inhibition and executive attention skills. For instance, Murphy et al. (1999) found no change in task-based response inhibition and executive attention performance from middle childhood to early adolescence. Studies have also shown that report-based indicators of self-control are moderately stable between middle childhood and early adolescence (e.g., $r = .41$ to $.67$, Murphy et al., 1999; $r = .50$, Raffaelli et al., 2005), particularly when assessed over shorter periods of time (e.g., Hay & Forrest, 2006). Finally, as discussed further below, there may be ceiling effects for these particular self-control report- and performance-based measures, especially as the majority of observed study outcomes were skewed (Table 1). Such ceiling effects for measures over time could contribute to the stability of these estimates, as well as the little change in the latent factors from Time 1 to Time 2.

Individual Differences in Self-Control Indicators

Results for the exploratory analyses related to Aim 3 showed that there were few significant differences across the latent self-control indicators at Time 1 and from Time 1 to Time 2. However, there were some findings for gender that were consistent with the childhood self-control literature. At Time 1, female gender was associated with greater parent-reported self-control, although child-reported and performance-based self-control showed no gender differences. The lack of gender differences in

performance-based self control in particular converges with other studies indicating that male and female youth show no differences in their response inhibition, executive attention, and planning skills when measured using decontextualized performance tasks like the Flanker and the Go/No-Go (e.g., Brocki & Bohlin, 2004; Dias & Seabra, 2012).

Additionally, the finding that parents reported higher self-control for female youth at Time 1 is in line with many studies of childhood self-control (Berger, 2011; Kochanska et al., 2000; Moffitt et al., 2011; Pender-Tessler et al., 2013; Raffaelli et al., 2005). As suggested by Murphy et al. (1999), among others (e.g., Bull, Espy, Wiebe, Sheffield, & Nelson, 2011), social expectations may play a role in informant reports of child self-control, as gender norms in both the United States and in Latin America (Alemán et al., 2013) dictate that females should exhibit self-controlled behaviors. Interestingly, there were also some Time 1-Time 2 differences by gender, such that parents also rated females as showing significantly increased self-control relative to males at Time 2, controlling for Time 1 levels. Females also rated themselves higher in self-control at Time 2, although this finding was marginal. Parental social expectations could again influence parent-reported increases in females' self-control from Time 1 to Time 2 (Bull et al., 2011; Murphy et al., 1999). Findings for parent-reported and female child reported-increases in this domain could also be attributable to proposed biological differences by gender in maturational processes related to response inhibition (Bull et al., 2011; Pender-Tessler et al., 2013) although this interpretation would require validation using additional biological data.

Like the gender effect for parent-reported child self-control, parental expectations and characteristics may also relate to the finding that higher levels of parental education were associated with increased parent-reported child self-control. It is possible that more educated parents have higher expectations for self-controlled child behavior, and rate their children accordingly. Parental education could also serve as a proxy for parents' own levels of self-control, based on the idea that self-controlled behavior is necessary for academic achievement and the attainment of an advanced degree (i.e., beyond high school; Gottfredson & Hirschi, 1990; Phythian, Keane, & Krull, 2008). Thus, a higher parent rating of child self-control among more educationally advanced parents could be reflective of shared genetic and environmental characteristics, as self-control is thought to be heritable (Beaver, DeLisi, et al., 2008; Beaver, Wright, et al., 2008) and parenting behaviors and expectations have been found to impact child self-control (Berger, 2011; Phythian et al., 2008). However, parental education was unrelated to Time 1 child-reported and performance-based self-control, indicating that the effect could be more attributable to parent report bias than to an effect of parent education on child behavior per se. Additionally, the cross-sectional nature of the Time 1 findings precludes any causal conclusions about the effects of parental education on child self-control.

Child age was also associated with variation in the latent self-control factors; however, this effect was only significant at Time 1, and was inconsistent across factors. Older youth showed increased Time 1 performance-based self-control, but rated themselves as having decreased self-control at the same time point. It may be

that during the transition to adolescence, older youth in the 10 to 14 age group still have some improved response inhibition and executive attention skills relative to their younger peers, which is consistent with work by Murphy et al. (1999) in comparing 10 to 12 and 13 to 15-year-old age groups on the Go/No-Go task. The finding for lower self-control among older youth on the report-based measure could be related to older youth having a more nuanced understanding of their own self-control, and as such rating themselves more carefully than their younger peers (i.e., being able to distinguish between rating themselves as a “3” or a “4” on a Likert-scale). Report-based measures can also be biased due to social desirability (Bezdjian et al., 2009; Kazdin, 2003), which may have had a greater influence on the younger children in the sample, causing them to rate themselves as being higher on self-control. This is plausible given that during late childhood, youth tend to be more oriented toward rule-bound and socially appropriate behaviors (Steinberg et al., 2011).

The only individual difference consistently associated with self-control across indicators at one time point was child non-verbal intelligence, which was positively associated with higher levels of child-reported, parent-reported, and performance-based self-control factors at Time 1. Child non-verbal intelligence was measured using the Raven’s Colored Progressive Matrices (CPM). To complete the Raven’s CPM and receive a high score, children likely had to exhibit well-controlled behavior, which may have contributed to the association between higher non-verbal intelligence and higher self-control scores across all latent indicators. This finding is in line with other studies of performance-based childhood self-control as well, which

often include child intelligence as a control variable, given the overlap between intelligence and executive functioning (Best & Miller, 2010; Miyake et al., 2000).

No significant findings emerged for individual differences in SES and childhood stress exposure in relation to self-control indicators at Time 1 or from Time 1 to Time 2. There are several salient issues that could contribute to these null effects. As discussed further below, this study's sample was relatively high-SES, and was fairly homogenous with regard to childhood stress exposure. Associations between SES and self-control have been primarily studied in low-SES or more heterogeneous samples (Raver, 2004; Raver et al., 2013). Additionally, relationships between low SES, high child stress exposure, and low self-control are likely dynamic, and unfold over time in the context of continued ecological and developmental risk factors (Blair, 2010; Raver et al., 2013). Indeed, many of the findings in this regard are drawn from longitudinal studies over early to late childhood (Blair, 2010; Raver, 2004). The present study was conducted over a short period of time using a middle childhood to early adolescent sample, which likely contributed to null findings with regard to these individual differences.

Self-Control and Aggressive Behavior

Contrary to study hypotheses for Aim 4, few self-control factors at Time 1 were associated with aggressive behavior at Time 2 (and vice versa when bidirectional analyses were run). Only higher parent-reported child self-control at Time 1 was associated with lower levels of parent-reported child aggressive behavior at Time 2, controlling for Time 1 child aggressive behavior. This finding also held when using

Time 1 parent-reported aggressive behavior to predict Time 2 parent-reported child self-control. However, the self-control and aggressive behavior latent factors were all significantly and moderately intercorrelated at each time point, although associations across time were weak for many of the variables. The within-time-point correlations were in the expected directions, with child-reported aggressive behavior and aggression propensity positively correlated with parent-reported child aggressive behavior, and these three aggressive behavior factors inversely correlated with all three self-control indicators.

The moderate inverse associations among self-control and aggressive behavior factors at each time point align with the many cross-sectional and longitudinal studies showing that higher levels of self-control are associated with lower levels of aggressive behavior (e.g., Piquero et al., 2010; Pratt & Cullen, 2000; White et al., 1994). The null findings for regressions using Time 1 self-control and aggressive behavior to predict Time 2 child aggressive behavior are likely due to the high stability of these outcomes in the middle childhood to early adolescent study sample. As discussed in the context of the self-control factors, above, self-control is thought to be largely stable by this developmental period, particularly over short time periods (Hay & Forrest, 2006) and when measured using these particular performance- and report-based assessment tools.

Additionally, it should be noted that the child- and parent-reported aggressive behavior indicators were mostly based on acts of child physical and verbal aggression, both of which tend to stabilize by middle childhood (Steinberg et al., 2011). Levels of

physical and verbal aggressive behavior are also likely to be quite stable over only a 12-month time period between assessment points. Other longitudinal work has shown that lower preschool levels of child self-control are predictive of subsequent increases in childhood aggression between the ages of 4.5 and 10.5 years, when change in aggressive behavior is more likely to occur (Vazsonyi & Huang, 2010). Delinquent and rule-breaking behaviors like stealing, cutting class, and using substances may be more appropriate to measure in relation to self-control among a sample transitioning to adolescence. For instance, low self-control and high impulsivity have been found to predict the onset, frequency, and escalation of delinquent and rule-breaking behaviors over time in adolescent samples (Piehler et al., 2012; Romer et al., 2010; Wills & Stoolmiller, 2002).

Summary and Implications for Intervention

Overall, many of the study findings presented here align with the literature on measuring self-control during middle childhood to early adolescence using broad report-based surveys and discrete performance-based tasks. Self-control was found to be highly stable across Time 1 and Time 2 child-reported, parent-reported, and performance-based latent factors, with small to moderate intercorrelations among the different factors. Few individual differences were associated with variation in self-control in this sample, or with change in self-control from Time 1 to Time 2. Although self-control at Time 1 was not predictive of residualized change in child aggressive behavior at Time 2, self-control and aggressive behavior factors were significantly intercorrelated in the expected directions at each study time point. These results

collectively replicate a number of U.S.-based findings, and provide preliminary evidence for the validity of these assessment strategies in a Venezuelan youth sample.

Taken together, study findings on the structure, associations among, and stability of self-control indicators raise important questions about how to accurately measure the multifaceted nature of the self-control construct during childhood and adolescence and in the context of preventive interventions. The three self-control factors were moderately positively associated, which suggests that they are related, but likely tap different facets of self-control. Whereas the parent- and child-reported items comprising the report-based factors asked about broad and socially-contextualized self-control processes (Kendall & Wilcox, 1979; Rohrbeck et al., 1991), the Go/No-Go and Flanker task outcomes used to represent the performance-based factors likely tap much more discrete, decontextualized processes (Berger, 2011). In their meta-analysis of self-control measures, Duckworth and Kern (2011) summarized various theoretical models that could help guide the selection of tools to assess different facets of self-control, but concluded that ultimately, multiple report- and performance-based measures should be used when examining the self-control construct. Similarly, when de Ridder, Lensvelt-Mulders, Finkenauer, Stok and Baumeister (2012) conducted a meta-analysis of interrelations among self-control scales and behaviors outcomes, the authors reported that using only self-report measures could overestimate the strength of the associations between self-control and other behaviors.

Reconciling what different measures of self-control may tap and the potential discrepancies in study results among such measures can be challenging, especially in

applied contexts. For example, choosing measures to use to when evaluating self-control longitudinally or in the context of an intervention evaluation often depends on the cost-effectiveness of such measures and their sensitivity to change (Kazdin, 2003). Employing multiple measures of self-control across report- and performance-based modalities may not be feasible, and yet relying on only one type of measure or strategy to assess this multifaceted construct may limit the validity of the results. In the current study, exploratory analyses that examined whether the different self-control factors predicted variation in other self-control outcomes at Time 2, over and above the original measurement strategy (i.e., Table 3) found that the use of additional self-control measures did not predict variation in Time 2 outcomes. Study findings may have been impacted by the stability of these factors and their low observed intercorrelations, but these results nonetheless raise questions about the incremental validity and utility of using multiple measures to assess this construct (Hunseley, & Meyer, 2003). More studies are needed to address these issues, as described below. Further, in line with other work, (e.g., Achenbach et al., 1987; De Los Reyes et al., 2013) there were inter-informant discrepancies in report-based outcomes, given that parent and child reports were only moderately intercorrelated. Questions about how to understand discrepancies across reporters, particularly in the context of intervention evaluations, are still open (De Los Reyes & Kazdin, 2006; De Los Reyes et al., 2013), but may be especially relevant for future work on childhood self-control.

Study findings also have implications for timing of interventions that aim to prevent aggressive or risk-taking behaviors by improving child self-control. Both self-

control and aggressive behavior appeared to be quite stable over the 12-month period assessed by this study. Additionally, and as summarized above, the literature on these outcomes suggests that both are indeed fairly stable during the ages between 10 and 14 years. Although higher-order self-control processes, such as delay of gratification and planning skills may show some improvements during early adolescence (e.g., Berger, 2011; Steinberg et al., 2008, 2009), broad, behavioral self-control, response inhibition, and attention functioning appear to stabilize. Additionally, self-control has been found to show rank-order stability, with low self-control in childhood predicting a variation in adult psychosocial outcomes (Moffitt et al., 2011). As such, interventions that target broad self-control (i.e., rule-following, anger control, attention, etc.) as a method to prevent aggression may be more effective in changing behavior among young children (e.g., Lochman & Wells, 2010; Piquero et al., 2010) as opposed to those transitioning to adolescence (Moffitt et al., 2011). Although this assumption has not been directly tested, prevention programs for adolescents, which typically focus on improving self-control and other social-emotional skills to deter youth from violent and delinquent behaviors, tend to have diminished outcomes for older youth (Smith, 2010; Williamson, Modecki, & Guerra, 2015).

Limitations and Future Directions

Study findings should be considered in light of several limitations, each of which have implications for future research directions related to self-control during the transition to adolescence. First, and as mentioned above, study findings and conclusions about the stability of self-control during the transition to adolescence are

limited by the nature of the report- and performance-based measures that were used. Although study findings on the stability of these measures, as well as their interrelations, were consistent with other child-focused studies using broad report-based self-control scales and performance tasks that tapped response inhibition and executive attention (e.g., Brocki & Bohlin, 2004; Hay & Forrest, 2006; Murphy et al., 1999; Raffaelli et al., 2005), other measures may have yielded lower stability estimates.

For instance, whereas performance-based response inhibition and executive attention processes have found to stabilize during late childhood, a number of studies have shown that planning and delay of gratification skills continue to develop into adolescence and even young adulthood (e.g., Prencipe et al., 2010; Steinberg et al., 2008, 2009). In particular, performance-based tasks that include some sort of emotionally laden stimuli (e.g., the Go/No-Go emotional processing paradigm) or motivational significance (e.g., monetary consequences) have been found to change over adolescence, with lower performance on these tasks for adolescents compared to adults (Best & Miller, 2010; Casey & Caudle, 2013; Prencipe et al., 2010). This adolescent regression in self-controlled behavior as measured by socially contextualized performance tasks has been attributed to increased reward sensitivity and risk-taking behaviors among adolescents (Casey & Caudle 2013; Steinberg, 2010). Future studies that examine self-control during the transition to adolescence should include abstract and decontextualized performance-based tasks like the standard Go/No-Go and Flanker paradigms, as well as other performance tasks that

include emotionally laden or motivationally significant stimuli, in order to investigate differential task performance during this developmental period.

Additional studies on self-control and aggressive behavior during the transition to adolescence should also include report-based measures that are tailored specifically to an adolescent sample. The measures of child- and parent-reported self-control used in this study were originally developed for the early to middle childhood age range (e.g., age 12 and below; Kendall & Wilcox, 1979; Rohrbeck et al., 1991), which could have contributed to their negative skew in the current sample. The report-based self-control measures in this study reflected a broad conceptualization of childhood self-control, and included questions about cooperative and rule-following behaviors that may overlook more nuanced self-control processes in adolescence. For instance, Duckworth and Steinberg (2015) have proposed a model of self-control that distinguishes between an individual's volitional (goal-oriented) and impulsogenic (sensation-seeking) processes that facilitate and undermine self-controlled behavior, respectively. This conceptualization suggests that questionnaires on self-control should include a focus on both, rather than on simple processes like behavioral compliance (Duckworth & Steinberg, 2015).

The issue of heterotypic continuity, or the different manifestations of a behavior over development (Angold, Costello, & Erkanli, 1999), should be considered when measuring childhood and adolescent self-control. Expectations for and behavioral manifestations of self-controlled behavior change dramatically from early childhood to adulthood, making it difficult to consistently conceptualize and assess the

self-control construct. Recently, Petersen and colleagues (under review) examined heterotypic continuity in the measurement of self-control by looking at floor and ceiling effects of various performance-based tasks in an early childhood sample. Comparing how different adolescent report-based and performance-based self-control measures function in this regard is an exciting direction for future research, especially given the negative skew found across the report-based and performance-based measures of self-control used in the current study.

As noted above, it is also possible that broad report-based questions about socially contextualized self-controlled behaviors contributed to a potential social desirability bias, wherein parents and children provided very high child self-control scores. In the same way, questions about child aggressive behavior were focused on acts of physical and verbal aggression, which could have impacted socially desirable responding and may not be as developmentally relevant for emerging adolescents. Future studies on self-control during adolescence and its association with aggressive or deviant behavior should include questionnaires about substance use onset and other acts of delinquency, given that these behaviors tend to increase during adolescence and have been associated with poor adolescent self-control (Piehler et al., 2012; Romer et al., 2010; Wills & Stoolmiller, 2002).

The timing of this study also limits conclusions that can be drawn about self-control and aggressive behavior during the transition to adolescence. The study period was only 12 months total, focused only on 10 to 14-year-olds, and did not include other salient measures of adolescent development that have bearing on self-controlled

functioning. For instance, pubertal status is an important indicator of adolescent brain development, which impacts impulsivity and reward-sensitivity (Steinberg, 2010). Additionally, variables like parenting, parent-child interactions, and child exposure to deviant peers are environmental influences that have been associated with both self-control and aggressive or delinquent behavior during adolescence (Beaver et al., 2008, 2009; Crosswhite & Kerpelman, 2012; Dishion, Véronneau, & Meyers, 2010; Phythian & Keane, 2008). Further longitudinal work on relations between self-control and aggressive or delinquent behavior during the transition to adolescence that includes salient individual and environmental factors is necessary to better understand the self-control construct over this time period.

Study findings are also limited by characteristics of the study sample.

Primarily, this sample was drawn from a higher-SES population of Venezuelan youth and their parents, who were part of the control sample in a larger impact evaluation of the National System of Youth and Children's Orchestras of Venezuela. The non-clinical nature of the sample may have contributed to the skewed outcomes (i.e., high ratings of self-control and very low ratings of aggressive behavior) and the strength of the associations between the latent self-control and aggressive behavior variables. The higher-SES status and very low reporting of childhood stress exposure events also likely contribute to the weak associations between self-control and these outcomes. However, it should also be noted that such associations have primarily been found in early childhood as opposed to early adolescent samples (Raver, 2004; Raver et al., 2013). Finally, although many study findings converge with research based in the

United States and Europe, additional validation research on this topic is needed.

Future measurement-focused research on self-control and aggressive behavior in a Venezuelan sample should directly compare psychometric estimates with an age- and gender-matched U.S. sample and should conduct measurement invariance analyses to examine any assessment-related cross-cultural group differences in this regard (Bryne, 2008).

Despite these limitations, study findings represent an important step in replicating and extending U.S.-based work on self-control and aggressive behavior during the transition to adolescence. Self-control is a multifaceted construct with different behavioral manifestations throughout child and adolescent development. Interrelations among self-control and aggressive behavior are also likely quite complex, and should be studied further in diverse youth samples using additional report- and performance-based measures. It is my hope that this study's findings related to the structure of, stability of, and associations among different self-control indicators will inform the timing and evaluation of preventive interventions to improve self-control and reduce aggressive behavior during childhood.

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Appendix A

UNIVERSITY OF DELAWARE INSTITUTIONAL REVIEW BOARD APPROVAL



RESEARCH OFFICE

210 Hulihan Hall
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Newark, Delaware 19716-1551
Ph: 302/831-2136
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DATE: March 16, 2013

TO: Nancy Guerra, Ed.D.
FROM: University of Delaware IRB

STUDY TITLE: [423732-1] Impact Evaluation of the National System of Youth and Children's Orchestra of Venezuela

SUBMISSION TYPE: New Project

ACTION: DETERMINATION OF EXEMPT STATUS
DECISION DATE: March 16, 2013

REVIEW CATEGORY: Exemption category # 4

Thank you for your submission of New Project materials for this research study. The University of Delaware IRB has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations.

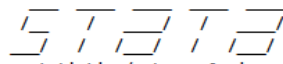
We will put a copy of this correspondence on file in our office. Please remember to notify us if you make any substantial changes to the project.

If you have any questions, please contact Jody-Lynn Berg at (302) 831-1119 or jlberg@udel.edu. Please include your study title and reference number in all correspondence with this office.

Appendix B

STATISTICAL SOFTWARE LICENSE

User: Ariel Williamson

 (R)
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