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The Effects of Chronic Stress on Predictors of Academic Learning

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The Effects of Chronic Stress on Predictors of Academic Learning

& The Mediating Role of Executive Functioning

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Abstract

Executive functioning, goal orientations, and intrinsic motivation in education have shown to predict outcomes in academic learning. Research has shown that for students in chronically stressed environments, the development of all three may be influenced by their ecological contexts. The current study examines how chronic stress at the systems level impacts the development of adaptive learning approaches, specifically mastery goal orientation and intrinsic motivation, among diverse youth. Further, this study seeks to examine the role of executive functioning in the relationship between systemic stress—a conceptualization of chronic stress at the systems level—and mastery goal orientation and intrinsic motivation.

The study included data from 373 children and adolescents between the ages of 10 and 18 (M=14.23; SD=4.5) recruited from three diverse urban schools (two K-8th; one high school). Participants were racially and ethnically diverse (34.7% Black/African American, 38.2% Latino, 36.6% White/European American, 10.8% Asian American, 1.1% American Indian, and 16.4% Multi-racial) and evenly split between genders (53.4% female). Survey data were collected during two all-day sessions. Measures were completed by both students and their parents.

Pearson *r* correlational statistics were used to determine bivariate relationships among chronic stress, executive functioning, mastery goal orientation, and intrinsic motivation. Structural equation modeling (SEM) with bootstrapping was used to test two mediation models in which a) systemic stress predicts mastery goal orientation via a mediation path of executive functioning, and b) systemic stress predicts mastery goal orientation via a mediation path of intrinsic motivation.

Results showed that systemic stress, specifically in the form of chronic loss or deprivation, predicts mastery goal orientation and intrinsic motivation through increased

challenges in executive functioning, especially planning/organization. Findings highlight the significance of supporting the development of executive functioning in contexts of high chronic stress to influence academic learning related outcomes.

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Introduction

Why do we go to school? A 2012 qualitative study explored this question among students, parents, and teachers and found responses ranging from the emphasizing the importance of academic learning, self-knowledge, and learning life skills to increasing employment opportunities and improving one's economic well-being and quality of life (Widdowson et al., 2012). Further, responses differed across students, parents, and teachers, as well as socioeconomic backgrounds (Widdowson et al., 2012). A student's purpose for going to school can frame their goals, their measures of success, and the steps they take to attain those goals and become successful. For instance, a student oriented to learning for personal edification may be more inclined to seek additional challenges for the sake of increasing learning and believe in the importance of effort (Nicholls et al., 1985; Widdowson et al., 2012). In contrast, a student whose goal is to get good grades to ultimately attain socioeconomic opportunity is more likely to engage in learning behaviors such as memorizing rather than understanding material, engage in easy work, and avoid work that does not directly benefit their grades (Nicholls et al., 1985). Furthermore, students in low socioeconomic contexts may be positioned to orient themselves to wealth-based goals as opposed to learning life skills (Widdowson et al., 2012). One's goal orientation can play a formative role in academic learning, and, moreover, understanding how one's goals are formed can play a seminal role in fostering adaptive learning approaches, or approaches comprised of motivations and behaviors that are effective within a given environment.

The current study aims to examine how chronic systems-level stress impacts the development of adaptive learning approaches, specifically mastery goal orientation and intrinsic motivation, among diverse youth. Further, this study seeks to examine the role of executive

functioning in the relationship between chronic stress and mastery goal orientation and intrinsic motivation. The current study hypothesizes that greater chronic stress will predict lower mastery goal orientation and lower intrinsic motivation. Additionally, the current study hypothesizes that executive functioning will mediate the adverse effects of chronic stress on mastery goal orientation and intrinsic motivation. Furthermore, this study aims to identify which type of chronic stress (e.g., loss such as low SES; conflict such as exposure to violence) is most associated with executive functioning, mastery goal orientation, and intrinsic motivation. Lastly, this study seeks to identify which specific executive functions are most associated with chronic stress, mastery goal orientation, and intrinsic motivation.

Goal Orientation Theory

Goal orientation theory is a social-cognitive theory of academic motivation which focuses on an individual's perceptions of the purposes of achievement (Anderman & Anderman, 2009). In other words, it focuses on how students define success and failure within the scope of academic achievement. It also considers what students attribute the causes of their successes and failures to be, how they react emotionally, and how they respond behaviorally (Urdan, 1997). Goal orientations are often organized in three categories: mastery, performance-approach, and performance avoid (Midgley et al., 2000). Mastery goal orientation refers to a student's focus on learning, improving, and mastering content and skills, whereby success is defined by individual progress toward these goals of deepening competency (Anderman & Anderman, 2009). Performance-approach goal orientation refers to goals of exhibiting competence and ability in an achievement setting in comparison to others', and performance-avoid goal orientation describes when a student's goal is to avoid demonstrating incompetence or a deficit in ability (Anderman

& Anderman, 2009; Midgley et al., 2000). The current study focuses on mastery goal orientation and factors that impact its development.

Within the body of research on goal orientation theory, the most consistent findings demonstrate positive associations between mastery goal orientation and learning-related outcomes (Anderman & Anderman, 2009). Students with mastery goal orientation are more likely to choose appropriately challenging tasks as opposed to ones that are too easy or too difficult (Anderman & Maehr, 1994). Students with mastery goal orientation tend to use deeper cognitive processing strategies during learning such as incorporating newly presented information with prior material or existing knowledge (Anderman & Maehr, 1994). Furthermore, students who are oriented to mastery are more likely to put forth effort, persist when faced with challenges, and attribute failures to a lack of effort rather than a lack of ability (Anderman & Anderman, 2009; Meece et al., 2006).

Within class settings, mastery goal orientation has been associated with adaptive behaviors that promote learning and achievement. For instance, a study examining help-seeking behaviors in middle schoolers found that mastery goal orientation was associated with understanding the benefits of seeking help, higher levels of adaptive help-seeking behaviors, and lower avoidance of help-seeking, compared to other orientations which were associated with lower likelihood of engaging in effective help-seeking behaviors (Ryan & Pintrich, 1997). Additionally, some research suggests that mastery goal orientation is associated with lower levels of procrastination (Wolters, 2004). Studies have also found that students with mastery goal orientation are less likely to engage in academic cheating, even after controlling for other predictors of cheating (Anderman & Anderman, 2009; Stephens & Gehlbach, 2007). A longitudinal study of students transitioning from middle to high school found that students

engaged in fewer cheating behaviors when in classes with teachers who emphasized mastery orientation and demonstrated an increase in cheating behaviors when they transitioned into classes with teachers who placed less of an emphasis on mastery orientation (Anderman & Midgley, 2004).

Intrinsic Motivation

Intrinsic motivation shares similarities with mastery orientation. Intrinsic motivation refers to the enjoyment or interest of an activity for its own sake (Elliot & Harackiewicz, 1994). It is distinguished from mastery goal orientation in that it concerns interest and enjoyment, whereas with mastery orientation, focus is placed on acquiring and refining skill and ability. Intrinsic motivation has been associated with similar positive outcomes in learning and engagement. In academic settings, studies have generally found a positive predictive relationship between intrinsic motivation and learning (Larson & Rusk, 2011; Lepper, Corpus, & Iyengar, 2005; Ryan & Deci, 2009). Similar to mastery orientation, studies have also found that students with higher intrinsic motivation in academic contexts show greater conceptual learning than their peers, suggesting the use of deeper cognitive processes in their engagement with concepts (Larson & Rusk, 2011; Vansteenkiste et al., 2004). Given their similar findings in relation to learning outcomes, some studies have examined the relationship between intrinsic motivation and mastery orientation. One study found that mastery goal orientation was predictive of intrinsic motivation but not vice versa (Bieg et al., 2017), and another found that mastery goal orientation even mediates the relationship between intrinsic motivation and academic performance (Cerasoli & Ford, 2014). Further research on how to develop intrinsic motivation tends to highlight a sense of agency or competency in ability combined with an optimal level of novelty and challenge whereby too little results in boredom and too much results in anxiety (Di Domenico & Ryan,

2017; Larson & Rusk, 2011). Taken together, positive learning outcomes may effected by targeting the development of intrinsic motivation.

Executive Functioning

Another major factor in the literature shown to predict academic learning and achievement outcomes is executive functioning (Best et al., 2011; Cortés Pascual et al., 2019; Miller & Hinshaw, 2010). Executive functioning (EF) refers to higher-level cognitive processes involved in planning, forethought, and goal-directed action (Shields et al., 2016; Fuhs et al., 2014; Diamond, 2013). These processes involve abilities such as planning and sequencing complex behaviors, sustaining behavior and attention for prolonged periods of time, simultaneously attending to multiple sets of information, patterns, or perspectives and integrating new information, and inhibiting cognitive and behavioral tendencies that may interfere with progress toward a goal (Latzman et al., 2010; Spiegel et al., 2021). The abilities and processes captured by the EF construct have shown to predict better outcomes in reading, science, language, and other areas of overall academic success (Cortés Pascual et al., 2019; Spiegel et al., 2021). A study of 8,330 children in the Early Childhood Longitudinal Study, 2010-11 Cohort found that from K-3rd grade—the extent of the data available at the time of publishing—children with executive functioning challenges, especially in working memory, are ten times more likely to experience repeated difficulties in math, three times more likely to experience difficulties in reading, and twice as likely to experience difficulty in science (Morgan et al., 2017; 2019). A meta-analysis focusing on longitudinal studies concluded that children showing deficits in cognitive flexibility and inhibitory control have also shown risk of general academic failure, and academic gaps related to deficits in executive functioning can be seen as early as kindergarten and frequently widen throughout K-12 (Allee-Herndon & Roberts, 2019). Burgeoning research

has focused on understanding how executive function relates to academic learning and achievement outcomes to early identification of students who are at-risk academically and provide optimal support in their educational trajectory (Spiegel et al., 2021). Using longitudinal and cross-sectional data from 305 studies, a 2021 meta-analysis examined the relationships between some specific executive functions (working memory, inhibition, shifting) and academic outcomes in reading, mathematics, and language) in an overall racially/ethnically diverse sample of elementary school-aged children (Spiegel et al., 2021). Results from this meta-analysis showed that all relations between executive functions and academic outcomes were significant throughout elementary school (Spiegel et al., 2021). Given that research has demonstrated that individual executive functions can determine outcomes in academic learning, the current study sought to examine specific executive functions to assess which ones were most associated with chronic stress, mastery goal orientation, and intrinsic motivation.

Despite their long-demonstrated associations with academic learning and achievement-related outcomes, research examining the relation between executive functioning and mastery orientation is limited. One study examining the ascription of value among adolescents found that mastery orientation and executive functioning shared the same predictors (Somers et al., 2022). However, the relationship between executive functioning and mastery orientation was not examined. Further research is needed to better understand the relationship between executive functioning and mastery orientation.

Core Executive Functions

Executive functioning is generally described as a multifaceted construct involving an array of high-order cognitive abilities (Chung et al., 2013; DeFrias et al., 2006). Although multiple conceptualizations and operational definitions for the construct exist, a 2016 systematic

review on executive functioning found that research most frequently examines four core executive function processes: inhibition, working memory, cognitive flexibility, and planning/organizing (Baggetta & Alexander, 2016). Examining individual executive functions can enable research to better understand which specific processes are contributing to academic outcomes. A 2021 meta-analysis examining relations between core executive functions and academic outcomes found a total of 531 research articles containing significant bivariate correlations between an executive functioning measure and an academic and/or behavioral measure. All core executive functions have shown to be important for different domains of academic outcomes at different stages of development (Spiegel et al., 2021). Among elementary school children, working memory had the largest effect size when examined in relation to math ($r = .39$), reading ($r = .35$), and oral language ($r = .31$) (Spiegel et al., 2021). On overall academics, working memory showed the largest effect size ($r = .35$) while inhibition and shifting shared identical effect sizes ($r = .26$) (Spiegel et al., 2021). Other research on adolescents found similar associations between specific executive functions and academic outcomes. For example, a 2018 longitudinal study found that working memory predicted outcomes in reading comprehension (Ahmed et al., 2019). A 2009 study found that cognitive flexibility predicted outcomes in reading and science, and inhibition predicted outcomes in math and science (Latzman et al., 2010). Given their individual positive associations with academic learning outcomes, relevant findings for each of these core executive functions are discussed below.

Inhibition, or inhibitory control, refers to the ability to control one's thoughts, attention, and behaviors in order to prevent or restrain reflexive thoughts, actions, and tendencies and instead selectively attend to relevant information and engage in goal-directed behaviors rather than habitual, reflexive, or impulsive ones (Bull & Lee, 2014; Diamond, 2013; Shields et al.,

2016). Inhibition has shown consistent positive associations with performance in mathematics and reading such that higher inhibitory control was associated with higher performance in mathematics and reading (Best et al., 2011; Blair & Razza, 2007; Bull & Scerif, 2001; Protopapas et al., 2007). Studies have shown that inhibition predicts mathematical ability in children as young as preschool-aged (Bull & Lee, 2014). Others have shown similar associations between inhibition and both mathematics and science among a sample of youth males ages 11-16 years (Latzman et al., 2010).

Working memory refers to the ability to hold information in the mind and update/integrate it with new information (Shields et al, 2016). Similar to inhibition, working memory has demonstrated consistent positive associations with mathematics and reading (Best et al., 2016). This may be because mathematical tasks such as solving arithmetic equations may rely on retrieval of arithmetic facts or formulae from long-term memory or working memory (Best et al., 2011). Compared to inhibition and cognitive flexibility, working memory has shown stronger relationships to mathematics, reading, oral language, and overall achievement (Spiegel et al., 2021).

Cognitive flexibility, or shifting, refers to the ability to shift between different sets of rules or modes of thought (Shields et al., 2016). Research has been somewhat mixed on the role of cognitive flexibility in academic learning and achievement. Compared to inhibition and working memory, cognitive flexibility has the least strong associations with overall academic achievement. Nevertheless, cognitive flexibility has been shown to predict performance in reading and social studies among adolescents (Latzman et al., 2010). Similarly, impairments in cognitive flexibility are related to negative academic outcomes in children (Costa et al., 2017).

Further, cognitive flexibility maintains significant positive relationships with mathematics, reading, and oral language (Spiegel et al., 2021).

Planning/Organization measures the ability to manage current and future-oriented task demands via planning (i.e., anticipating future events, setting goals, and developing appropriate sequential steps to complete a task) and organization (i.e., ordering information and appraising key concepts when receiving information (Gioia et al., 2000). These skills have shown to be significant in predicting outcomes in self-guided work such as homework (Langberg et al., 2013).

Metacognition refers to one's self-regulation of abilities, including awareness of strengths and weaknesses and recognition of strategies effective in a given task (Muncer et al., 2022). Within the literature, the components of metacognition are frequently conceptualized as individual executive functions themselves (e.g., initiation, working memory, planning/organizing, task-monitoring, and/or organization of materials) (Giola et al., 2000; Muncer et al., 2022). In other words, metacognition is often comprised of an array of executive functions involved in the process of preparing, organizing, and regulating execution of a task. While the individual executive functions comprising metacognition have their own associations with academic outcomes, a 2022 meta-analysis found that metacognition positively correlated with math performance in adolescents.

Many studies that examine individual executive functions commonly examine overall executive functioning. Although working memory shows the strongest effects on academics (r =.35), overall executive functioning has stronger relationships with overall academics (r = .33) than inhibition (r = .26) and cognitive flexibility (r = .26) (Spiegel et al., 2021). These stronger effects of overall executive functioning relative to inhibition and cognitive flexibility are

consistent in individual domains of academics such as mathematics, reading, and oral language (Spiegel et al., 2021). These findings on general executive functioning are also supported by a 2016 longitudinal study which found that global executive composite (GEC; a measure of overall executive functioning) scores on the Behavior Rating Inventory of Executive Function (BRIEF) predicted subject-specific and overall GPA in middle school students (Samuels et al., 2016). Examining individual executive functions may provide nuanced insight to how specific domains relate to outcomes while examining overall executive functioning can provide an element of convergence of the various domains of executive functioning and its relation to outcomes.

Environmental Factors Influence Executive Functioning

Because executive functioning impacts academic learning and achievement, it is important to highlight some of the determinants of executive functioning to better understand how its development in youth can be supported to improve academic outcomes. Executive functioning's development is impacted by the environment (Cumming et al., 2019). Persistent environmental stressors that chronically activate the body's stress response have profound adverse effects on the PFC and executive functioning (Cumming et al., 2019). Chronic life stressors such as low parental income, low parental education, household poverty, neighborhood poverty, neighborhood SES, and exposure to violence and trauma among others are determinants of low outcomes in executive functioning (Hackman et al., 2015; Meyer et al., 2018; Nelson & Sheridan, 2011; Roy et al., 2014) In contrast, presence of resources and supportive relationships can foster positive development of executive functioning (Cumming et al., 2019).

Many studies have examined the link between stress and executive functioning with the finding that stress has nuanced but generally adverse effects on executive functioning (Shields et al., 2016). Specifically, acute stress impairs executive functioning with the exception of response

inhibition, which is enhanced by acute stress (Shields et al., 2016). However, studies specifically examining the impacts of chronic stress on executive functioning are relatively limited as most studies tend to examine acute stress instead (Shields et al., 2016). Chronic stress exposure causes structural changes in the PFC (Arnsten, 2009), and individuals who experience damage or dysfunction in PFC regions often experience difficulty in executive domains such as shifting and cognitive flexibility (Morton, 2010). Whereas acute stress's effects are typically examined in the temporary presence of an acute stressor, children exposed to chronic stress experience cumulative damage which can permeate functioning not exclusive to a short period or acute stressor. For these reasons, it is especially important that research examine chronic stress to better understand its adverse impact on functioning.

Chronic stressors such as child maltreatment and early life stress have been areas of focus for existing executive functioning literature. However, these chronic stressors have not been thoroughly studied in child/adolescent samples. A 2013 systematic review on child maltreatment's effects on cognitive functioning found 17 articles, six of which focused on children and adolescents (Irigaray et al., 2013). In a 2012 review of literature examining executive functioning in individuals with PTSD, 18 articles were included, none of which used child/adolescent samples (Polak et al., 2012). A 2010 review examining early life stress and executive functioning did not report the number of studies included but did report findings for youth and adolescents (Pechtel & Pizzagalli, 2010). Despite the limited number of child/adolescent samples, the findings from these systematic reviews of varying types of chronic stress demonstrate similar findings: pervasive chronic stressors such as poverty, neglect, abuse, and violence exposure have marked adverse impact on the PFC as well as executive functioning (Spiegel et al., 2021). The Systems Level Stress measure (Grant et al., 2021) captures these

chronic stressors in its indices of loss (poverty, neglect) and conflict (abuse, violence exposure). Examining these domains of chronic stress will extend findings in the literature on their impacts on specific areas of executive functioning.

Stress's Impacts on Executive Functioning

The physiological processes that occur in response to stress influence executive functioning. The PFC, which is responsible for higher-level cognitive processes and is most associated with executive functioning, can become markedly impaired by stress, negatively impacting executive functions, most notably working memory (Arnsten, 2009; Orellana & Slachevsky, 2013; Shansky & Lipps, 2013). Mild acute stress can cause rapid marked changes in prefrontal cognitive and executive abilities, and chronic exposure to stress causes structural changes in the PFC (Arnsten, 2009). While substantial research suggests that stress relates to executive functioning via its impact on the PFC, the most prevailing theoretical perspective of how posits that stress responses triage or "bias" cognition to process information most relevant to the current stressor (Mather & Sutherland, 2011). In other words, the limited cognitive resources that normally support executive functions are reallocated to focus on/attend to/respond to a given stressor (Shield et al., 2016). Support for this theory can be found in several studies demonstrating nuanced effects of acute stress on executive functioning in which, for example, stress was positively related to working memory in some cases (Duncko et al., 2009; Schoofs et al., 2013; Yuen et al., 2009) but negatively related in others (Schoofs et al., 2009, 2008). The meta-analysis conducted by Shields and colleagues (2016) examining the effects of stress on EF concluded that, across the 51 studies included, acute stress impaired working memory and cognitive flexibility but enhanced inhibition. However, the literature examining effects of chronic stress on executive functioning is much less developed (Shields et al., 2016).

Chronic Stress & Executive Functioning

The vast majority of literature examining the effects of stress on core executive functions has focused primarily on acute stress, which is often measured using previously validated stress tasks or stressors or using biological markers such as cortisol (Shields et al., 2016). Chronic activation of the HPA axis has primarily been studied in non-human subjects. Findings in non-human samples suggest that chronic stress exposure results in adverse development of brain structures and neural systems integral to regulation of the stress response and to executive functioning (Blair et al., 2005). The low number of chronic stress studies in humans may be because chronic stress is more difficult to manipulate in controlled settings and subjecting participants to prolonged stress is unethical (Shields et al., 2016). However, survey methods are able to capture participants' chronic stress exposure (Borders et al., 2007; Steptoe & Feldman, 2001).

Our own literature search in the PubMed database using Medical Subject Headings (MeSH) for psychological stress and executive function generated a total of 116 results, of which only 14 examined chronic stress in human samples of children/adolescents under the age of 18 years. Findings from these studies suggest that, in youth, chronic stress such as poverty is related to executive functioning (Mance et al., 2019; da Rosa Piccolo et al., 2016), perhaps through cumulative damage to the developing brain, specifically the PFC (Blair & Raver, 2016; Nusslock & Miller, 2016). Within Systems Level Stress measure used in the current study, the chronic stress related to poverty is best captured by the Loss index.

In chronic stress literature involving human samples, chronic stressors at the systems level are often areas of focus. Systems-level stressors can be conceptualized as chronic distressing phenomena related to or manifesting from meso-level systems (e.g., neighborhood or

school stressors) or macro-level systems (e.g., public policy) where circumstances and conditions are determined by collective influence. Chronic stressors at the systems level such as neighborhood poverty, low neighborhood SES, and exposure to violence and trauma among others are determinants of low outcomes in executive functioning (Hackman et al., 2015; Meyer et al., 2018; Nelson & Sheridan, 2011; Roy et al., 2014)**.** Studies have tended to use self-report or U.S. Census Tract data to measure income-to-needs ratio and neighborhood SES as indicators of systemic stress and task-based measures to assess specific domains of executive functioning such as Tower of Hanoi for planning and the Woodcock-Johnson Psychoeducational Battery—Revised, Tests of Cognitive Ability (WJ-RCOG) for working memory (Hackman et al., 2015; Meyer et al., 2018; Nelson & Sheridan, 2011). Systems-level stressors can have domain-specific effects on executive functions (Chen et al., 2021; Alvarez, 2020). For example, racial discrimination and poverty, examples of conflict and loss in the Systems Level Stress measure, are linked to deficits in working memory (Alvarez, 2020; Chen et al., 2021). Youth living in contexts of chronic stress such as low-income environments are more likely to experience high levels of prolonged stress than youth in higher income environments (Blair et al., 2005). Consequently, youth who are constantly exposed to various manifestations of chronic stress may experience executive functioning deficits compared to their better resourced peers (Cumming et al., 2019).

Conceptualizations Of Chronic Stress

Individuals who live in contexts of chronic stress such as poverty are likely to experience an array of stressors (e.g., neighborhood disadvantage/disinvestment, community violence, lack of resources). However, there is variability in how frequently individuals living in poverty are exposed to such stressors. Further, individuals not living in poverty may also be exposed to some

of these stressors. Therefore, it is important to examine specific chronic stressors. The present study sought to examine systems-level stress, a conceptualization of chronic, environmental stress, to understand how these pervasive adverse circumstances impact the development of executive functioning and academic learning behaviors in youth and adolescents.

Systems-level stressors are conceptualized in four indices: Loss, Conflict, Threat, and Humiliation. The Loss index includes stressors such as financial or housing insecurity, or lack of safe places to play, neighborhood employment, or grocery stores in one's community. Many of these stressors are largely the result of systemic disenfranchisement of ethnic minorities and other historically oppressed groups of people who were systematically prevented from opportunities of socioeconomic mobility. These opportunities include property ownership, educational attainment, occupational attainment, and opportunities to accumulate and pass on wealth to future generations (Cole & Omari, 2003; Williams, 1999). The insidious permeation of such disenfranchisement now manifests in the form of economically disadvantaged households, neglected neighborhoods and communities (loss), racial bias (threat), discriminatory experience (conflict), and social stigma (humiliation) (Williams & Williams-Morris, 2000). These manifestations, as well as many others, encapsulate loss, threat, conflict, and humiliation, respectively, factors that are not directly accounted for by measuring poverty or other individual chronic stressors. These stressors at the systems level have shown to have an impact on youth's neurodevelopment. For example, recent studies have found that chronic loss and conflict are associated with neurodevelopmental deficits in regions that support executive functions, which can yield deficits in executive functioning (Mackey et al., 2015; Noble et al., 2015; Sheridan et al., 2017). Chronic conflict and especially chronic loss have shown associations with deficits in executive functioning such as inhibitory control, working memory, and cognitive flexibility

(Johnson et al., 2021; McLaughlin et al, 2019; Sheridan et al., 2017). In order to better understand the complex nature of systemic oppression in modern society, research must consider the impacts of systems-level stressors such as loss and conflict on youth development. For these reasons, these systems-level stressors were examined to more comprehensively consider the chronic stressors individuals may face in different contexts. Throughout the remainder of this manuscript, the chronic stress associated with systems-level stressors will be referred to as "systemic stress."

Rationale: The Current Study

The proposed study presents a number of contributions to existing literature. First, while the effects of acute stress on executive functions are well documented, research examining the effects of chronic stress on executive functions is far less abundant. Second, of studies that have examined the effects of chronic stressors on executive functions, few if any have utilized a comprehensive chronic stress measure like the Systems Level Stress Measure (Grant et al., 2021), which accounts for stressors in the home, school, neighborhood, and community environments. Furthermore, through its indices (Loss, Conflict, Humiliation, and Threat), this comprehensive measure allows for greater specificity on the types of chronic stressors most linked to executive functions, mastery goal orientation, and intrinsic motivation. Third, the proposed study examines executive functioning as a mediator, whereas most existing literature has generally examined executive functioning as a predictor (e.g., executive functioning effects on academic learning and achievement behaviors) or an outcome variable (e.g., stress effects on executive functioning). Fourth, of the existing literature reviewed in this proposed study, very few studies have utilized ratings-based measures of executive functioning. Rather, most utilized various task-based measures to assess executive functioning. This is of particular importance as

research has well documented that task-based and ratings-based measures of executive functioning cannot be used interchangeably because they assess different underlying processes (Pino Muñoz & Arán Filippetti, 2019; Soto et al., 2020). As put by Silver (2014), level of impairment indicated by one source often does not match with that indicated by the other. Similarly, both methods have shown to uniquely predict academic behaviors and achievement (Soto et al., 2020). Research has called for more evidence-based work on the two modalities to enhance the use of both (Nyongesa et al., 2019; Pino Muñoz & Arán Filippetti, 2019; Silver et al., 2014), which is why the current study uses ratings-based measures. Further, because the ratings-based measure examines various domains of executive functioning, distinct subscales and indices of executive functioning will be assessed to examine their relations to variables in this study. Lastly, the majority of literature examining forms of chronic stress at the systems level, executive functioning, and learning outcomes has focused on children. The current study focuses on adolescents as this is an important developmental period in education which also has implications for subsequent opportunities in post-secondary education and adulthood. Additionally, this study poses another contribution to existing literature in its use of a racially diverse sample as most studies have focused on predominantly White samples.

The primary aim of the current study is to examine a mediation model in which 1a) chronic stress predicts both executive functioning and mastery goal orientation, and 1b) executive functioning shows an indirect mediation effect on mastery goal orientation.

Research Questions & Hypotheses

1. Which systemic stressors (loss, conflict, humiliation, and threat) are most associated with different types of executive functioning? Consistent with existing literature, it is predicted that loss will show the strongest correlation with executive functioning.

2. Which components of executive functioning are most associated with mastery goal orientation?
3. Does executive functioning mediate the relationship between systemic stress and mastery goal orientation? It is predicted that all domains of executive functioning that are significantly correlated with variables in this study will mediate the relationship between systemic stress and mastery goal orientation such that high systemic stress will result in lower executive functioning which will result in lower mastery orientation.
    a. Systemic stress will show an indirect effect on mastery goal orientation (through EF) such that higher levels of systemic stress will predict lower levels of mastery goal orientation.
4. Which components of EF are most associated with intrinsic motivation?
5. Does executive functioning mediate the relationship between chronic stress and intrinsic motivation? It is predicted that executive functioning will mediate the relationship between chronic stress and intrinsic motivation such that high chronic stress will result in lower EF which will result in lower IM.
6. Does systemic stress show an indirect effect on intrinsic motivation through executive functioning? Systemic stress will show an indirect effect on intrinsic motivation such that higher levels of systemic stress will predict lower levels of intrinsic motivation.

Method

Sample

The study included data from 373 children and adolescents between the ages of 10 and 18 (M=14.23; SD=4.5) recruited from three diverse urban schools (two K-8th; one high school). Two hundred and twenty-eight census tracts were represented. Overall, participants were racially

and ethnically diverse and evenly split between genders. The sample was approximately 53.4% female, 34.7% Black/African American, 38.2% Latino, 36.6% White/European American, 10.8% Asian American, 1.1% American Indian, and 16.4% Multi-racial (see Table 1). Adolescents' parents also contributed survey data to the study. At T2, 201 surveys were completed.

Table 1

Demographics for Study Participants

Variable	Mean ± SD	*N*	%
Age (years)	14.23 ± 4.5		
Grade Level	9.53 ± 1.9		
SES	42.91 ± 13.59		
Female gender		165	44.3
Race			
Black/African American		129	34.7
Asian/Asian American		40	10.8
American Indian/Alaskan Native		4	1.1
Native Hawaiian/Other Pacific Islander		2	0.5
White/Caucasian		137	36.6
Bi-/Multi-racial		61	16.4
Ethnicity			
Hispanic/Latino		125	33.5

Procedures

Participants were recruited at participating schools via informational talks and flyers. Research assistants attempted to reach out to all students at participating schools by talking with students directly during their lunch periods, with parents/guardians during report card pickup days, and by asking teachers to send students home with informational flyers about the study. Interested parties provided their contact information for follow-ups to confirm their interest and

participation in the study. Active consent was used as required by the school district. Survey data used in this study were collected during all-day sessions in which three meals were provided as well as breaks for recreation/relaxation, short films, college informational sessions, and a college tour. Students participated in the measures and tasks summarized in a randomized order. Upon completion of each session, all participants were provided with a $50 gift card to a store of their choosing (Target, Best Buy, or Old Navy). Students received an additional $20 in gift cards if they returned parent rating forms ($10 for themselves and $10 for their parents).

Measures

Systems Level Stress

Levels of systemic stress were measured using the Systems Level Stress Measure (Grant et al., 2021). The 175-item measure assesses stressors present at the systems level in four domains: Loss, Conflict, Humiliation, and Threat. Items vary in structure across domains. The Loss index is comprised of 82 items. Sample items include, “Check all that has happened to your family because of not having enough money” and some possible options include “My family has had to move,” “An adult in my family works two jobs,” “We can’t pay our bills,” “Our electricity, heat or phone was shut off.” Because this measure assesses systems level stress, negative-oriented items are scored regularly, and positive-oriented items are reverse scored so that higher scores from this measure reflect higher levels of systems-level stress. Such positive-oriented items include “My neighborhood has” and some possible options listed include “Safe places for children to play,” “A grocery store,” “Lots of businesses and places to get jobs,” and “A nice place for running or sports.” Internal consistency for this measure in this sample was .85.

The Humiliation index is comprised of 28 items. It asks participants, “About what percentage of people in your family would agree with the sentences listed below?” and provides

a list of items such as “Rich people are better than poor people” and “White people are better than black people.” To indicate the percentage for each item, participants can choose from a list of five options (“0%,” “25%,” “50%,” “75%,” and “100%”). The index then asks participants to indicate the beliefs of people in their school and their neighborhood, repeating the same list of items and percentage options for both the school and neighborhood settings. Internal consistency for this measure in this sample was .93.

The Threat index is comprised of 30 items. The index asks participants, “Have you seen someone mistreated because they are different?” with possible responses being “Yes” or “No.” The measure lists options to specify the relationship of that person to them (e.g., “An adult family member,” “A friend,” and an option to write in any relationship not listed). The measure then lists options for reasons why someone has been mistreated and options to indicate the frequency on a five-point scale with response ranging from “Never” to “Four or more times.” Samples include “What their body or face looks like” and “Their race or skin color.” The measure then asks participants to indicate where they have seen others mistreated (e.g., “In my classroom, “At home”). Internal consistency for this measure in this sample was .87.

The Conflict index is comprised of 15 items. It asks participants “What reasons have people given for mistreating you, and how often has that happened to you?” The index provides an identical list of reasons as provided in the Threat index (e.g., “What my body or face looks like,” “My race or skin color.”) and provides frequency options on a five-point scale ranging from “Never” to “Four or more times.” Although it shares similarities with the Threat index, an important distinction between the two is that the Threat index focuses on mistreatment experienced by others whereas the Conflict index focuses on mistreatment experienced by the

individual. Additionally, both indices capture both major and minor life events. Internal consistency for this measure in this sample was .87.

Executive Functioning

Executive functioning was measured using the Behavior Rating Inventory of Executive Function, Second Edition (BRIEF; Gioia et al., 2000) Self-Report form, a scale of executive function for youth, ages 11 to 18 years. The measure is comprised of 80 items assessing everyday behaviors associated with executive functioning in the home and educational environments. The items are organized into seven factors: Inhibit, Self-Monitor, Shift, Emotional Control, Task Completion, Working Memory, and Plan/Organize. These primary scales combine to form two composite indexes: Behavior Regulation Index (BRI; comprised of the Inhibit, Shifting, and Emotional Control domains) and the Metacognition Index (MI; comprised of the Initiate, Working Memory, Plan/Organize, Task-Monitoring, and Organization of Materials domains), and a unitary Global Executive Composite (GEC) (Hendrickson & McCrimmon, 2019). Additionally, three validity scales (Inconsistency, Infrequency, and Negativity) are embedded in the measure comprised of items used to evaluate participants' response patterns. Participants indicate responses to items on the BRIEF on a three-point Likert-type scale (*N* = "Never"), S = "Sometimes", O = "Often") to reflect the frequency at which an indicated behavior is performed. The inhibition and planning/organization subscales are comprised of nine and 13 items, respectively. The metacognition index is a comprised of 42 items. The self-report forms have demonstrated a range of internal consistency with reliability coefficients spanning from .71 to .97, and index and composite scores ranging from .84 to .97 (Hendrickson & McCrimmon, 2019). In the current sample, internal consistency was .79 for the inhibition subscale, .89 for the planning/organization subscale, .96 for the metacognition index, and .97 for the GEC,

comparable to the internal consistency found in other studies with similar samples (Kechter et al., 2019).

Goal Orientation

Mastery goal orientation was measured using the Patterns of Adaptive Learning Scales (PALS) Student Survey, which is a 14-item survey designed to capture the relationship between student motivation, affect, and behavior and the learning environment (Midgley et al., 2000). Items are rated on a five-point Likert-type scale (*1 = "Not at all true"; 3 = "Somewhat true"; 5 = "Very true"*). Within this measure, the five-item Mastery Goal Orientation subscale was utilized, which assesses the extent to which a child's goal or purpose in an achievement setting is to develop their competence and extend their understanding. Sample items from this subscale include "It's important to me that I thoroughly understand my class work," and "One of my goals in class is to learn as much as I can." In the current sample, internal consistency was .89 for this subscale and comparable to the internal consistency found in other studies with similar samples (Patrick et al., 2011).

Intrinsic Motivation

Intrinsic motivation was measured using a 17-item self-report survey designed to capture youth's internal drive and motives for learning and engaging in schoolwork. Items are rated on a seven-point Likert-type scale (*1 = "Not at all true"; 4 = "Somewhat true"; 7 = "Very true"*). Sample items include "I like to learn as much as I can in school," "I read things because I am interested in the subject," and, "I like difficult problems because I enjoy trying to figure them out." Internal consistency for this measure in the current sample was .96.

Demographics

Students' gender, age, race, and ethnicity were self-reported on the demographic survey. For gender, students responded to a single item ("I am a…") and were provided the option to indicate either "male" or "female"; the survey did not provide options to indicate gender identities beyond the binary construct. For grade, students responded to a single item ("My grade is… (fill in one)") by filling in one of 9 options (5th-12th grade, or "other"). Students indicated their race by responding to an item ("I consider my racial group to be…(pick all that are true)") and choosing from seven options provided (Black or African-American; Asian or Asian-American; American Indian or Alaskan Native; Native Hawaiian or Other Pacific Islander; White or Caucasian; Mixed parents from two different groups; or "other" with the option to write in their response). Ethnicity was self-reported by selecting one of two options ("Hispanic"; "Not Hispanic").

Data Analytic Plan

The proposed analysis for this project focused on testing two mediation models in which a) systemic stress predicts mastery goal orientation via a mediation path of executive functioning, and b) systemic stress predicts mastery goal orientation via a mediation path of intrinsic motivation. Pearson *r* correlational statistics were used to determine bivariate relationships among chronic stress, executive functioning, mastery goal orientation, and intrinsic motivation.

Preliminary analyses were conducted to determine influence of age and gender on all variables included in the analyses. A Pearson *r* correlational statistic was used to determine whether age, gender, and grade are significantly related to primary study variables to ultimately control for these effects in later analyses. For Hypotheses 1 and 2, Pearson *r* correlations were

used examine which domains of systems level stress and executive functioning are most related to mastery goal orientation to ultimately be used in the mediation model. Multiple models were created to test the predictive qualities of multiple individual domains of systemic stress and executive functioning on mastery goal orientation.

To test Hypothesis 3, structural equation modeling (SEM) was conducted in AMOS Version 23.0 (Arbuckle, 2014). To test Hypothesis 3, the bootstrapping method were utilized to estimate the effects of executive functioning in the mediation model. In this method, mediation is indicated when the presence of a mediating variable (executive functioning) results in an indirect effect from the predictor variable (systemic stress) to the outcome variable. Because the bootstrapping method can only be performed when there is no missing data, all cases in the dataset with missing values for variables included in the analyses had to be removed, which resulted in a sample of 246. A one-way analysis of variance (ANOVA) was conducted to assess for differences between the full and reduced samples across study variables. The analysis indicated no significant differences between the full and reduced samples. The bootstrapping resampling method in AMOS is recommended for moderate sample sizes (Collier, 2020; Mallinckrodt et al., 2006). In these analyses, mediation is significant if the 95% confidence intervals for the indirect effect do not include 0 (Mallinckrodt et al., 2006; Preacher & Hayes, 2004; Preacher et al., 2007).

For Hypothesis 4, Pearson *r* correlations were used examine which domains of executive functioning are most related to intrinsic motivation; those that are most related were used in the model. Multiple models were created based on these results to assess which domains of systemic stress and executive functioning are most predictive of intrinsic motivation.

To test Hypothesis 5, structural equation modeling (SEM) was conducted in AMOS Version 23.0 (Arbuckle, 2014), and the bootstrapping method was used to estimate indirect effects of executive functioning in the mediation model.

All models were tested for fitness using Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and root mean square error of approximation (RMSEA) to determine whether the sample size was adequate for the model. Values for the CFI and TLI range from 0 to 1 with values greater than .90 indicating acceptable fit (Xia & Yang, 2019). Values less than .08 for the RMSEA suggest reasonable model fit (Xia & Yang, 2019). All changes made to the model were documented. Significance of paths in the model were interpreted from the output table. All statistical tests were analyzed at the .05 significance level.

Results

Preliminary Analyses

Correlation analyses were conducted to determine whether there were associations with age, gender, and grade and primary study variables at both time points (see Table 2). Grade level was significantly correlated with all primary study variables with the exception of intrinsic motivation and SLS conflict. Specifically, grade was positively correlated with mastery goal orientation and the systemic stress variables such that students in higher grade levels tended to show higher mastery goal orientation and greater systemic stress. Grade level positively correlated with all executive functioning variables such that students in higher grade levels exhibited greater challenges in executive domains. Among executive functioning variables, grade was most strongly correlated with general executive functioning (GEC; $r = .243$, $p < .01$) and planning & organization ($r = -.249$, $p < .01$). Age positively correlated with working memory ($r = .126$) and organization of materials ($r = .122$) at the $p = 0.05$ level. Gender was not

significantly correlated with any of the primary variables for this study. Full results from the correlational analyses can be found in Table 2.

Table 2

Pairwise Correlational Analyses of Study Variables

	1. Loss	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.
2. Hum	.29**																		
3. Threat	.24**	.22**																	
4. Con	.17*	.17*	.45**															*N=373*	
5. PALS	-.24**	-.12**	-.17*	-.24**															
6. IM	-.15**	-.03	-.06	.06	.34**														
7. GEC	.30**	.21**	.23**	.38**	-.26**	-.23**													
8. BRI	.29**	.18**	.20**	.33**	-.24**	-.21**	.94**												
9. MI	.29**	.22**	.22**	.37**	-.26**	-.22**	.96**	.82**											
10. Inhibit	.25**	.18**	.18**	.26**	-.27**	-.20**	.84**	.90**	.72**										
11. Shift	.28**	.17**	.23**	.37**	-.19**	-.18**	.88**	.88**	.81**	.80**									
12. EC	.26**	.12*	.14**	.25**	-.15**	-.20**	.78**	.88**	.64**	.71**	.69**								
13. TM	.20**	.14**	.15**	.28**	-.27**	-.13*	.79**	.81**	.71**	.69**	.69**	.60**							
14. WM	.26**	.22**	.21**	.37**	-.22**	-.21**	.90**	.77**	.93**	.69**	.74**	.60**	.66**						
15. PO	.27**	.22**	.22**	.30**	-.26**	-.23**	.92**	.77**	.94**	.66**	.78**	.60**	.68**	.83**					
16. OM	.23**	.15**	.21**	.30**	-.20**	-.15**	.79**	.64**	.84**	.60**	.59**	.48**	.58**	.74**	.75**				
17. TC	.27**	.16**	.19**	.34**	-.25**	-.21**	.90**	.77**	.92**	.64**	.81**	.62**	.65**	.79**	.87**	.66**			
18. Age	.08	.02	.09	.00	-.09	.00	.09	.09	.09	.09	.08	.06	.06	.11*	.09	.09	.05	.00	.06
19. Grade	.38**	.22**	.20**	.17	-.28**	-.09	.23**	.20**	.23**	.14*	.21**	.15**	.21**	.20**	.25**	.18**	.23**	-.09	-.04
20. Gend	.03	-.04	.11	.22*	.09	.00	.05	.03	.05	.01	.08	.01	-.01	.02	.05	.05	.05	.06	-.04

** Indicates significance at the .05 level*

***Indicates significance at the .01 level*

1. SLS Loss; 2. SLS Humiliation; 3. SLS Threat; 4. SLS Conflict; 5. PALS Mastery; 6. Intrinsic Motivation; 7. BRIEF GEC; 8. BRIEF BRI; 9. BRIEF MI; 10. BRIEF Inhibit; 11. BRIEF Shifting; 12. BRIEF Emotional Control; 13. BRIEF Task Monitoring; 14. BRIEF Working Memory; 15. BRIEF Planning/Organization; 16. BRIEF Organization of Materials; 17. BRIEF Task Completion; 18. Age; 19. Grade; 20. Gender

Systemic Stress & Executive Functioning (RQ1)

To determine what type of systemic stress was most associated with executive functioning, Pearson *r* correlational analyses were conducted using the four indices from the systemic stress measure (i.e., Loss, Conflict, Humiliation, and Threat) and the subscales (inhibition, shifting, emotional control, task monitoring, working memory, planning & organizing, organization of materials, task completion) and indices (GEC, BRI, MI) from the BRIEF. Across subscales, all four indices of the systemic stress measure were significantly correlated with each subscale of the BRIEF at the $p < .01$ level. The BRI is comprised of the Inhibit, Shifting, and Emotional Control subscales, and the MI is comprised of the Initiate, Working Memory, Plan/Organize, Task-Monitoring, and Organization of Materials subscales. The GEC is a unitary composite comprised of all eight subscales. At the index level, all four indices of the systemic stress measure were significantly correlated with the BRI, the MI, and the GEC at the $p < .01$ level. Across the four indices of the systemic stress measure, two indices showed the strongest correlations across all subscales and indices from the BRIEF: SLS Conflict and SLS Loss. Both SLS indices were most strongly correlated with the GEC (Loss, $r = .31$, $p < .01$; Conflict, $r = .38$, $p < .01$). Full results from these correlational analyses can be found in Table 2. Based on these results, both the SLS Loss and SLS Conflict indices of systemic stress will be used in subsequent mediation analyses.

Executive Functioning & Mastery Goal Orientation (RQ2)

To assess which components of executive functioning were most associated with mastery goal orientation, Pearson *r* correlational analyses were conducted using the subscales (inhibition, shifting, emotional control, task monitoring, working memory, planning & organizing, organization of materials, task completion) and indices (GEC, BRI, MI) and mastery goal

orientation. Results from these analyses showed that mastery goal orientation significantly correlated with GEC (r = -.26, p < .01), BRI (r = -.24, p < .01), metacognition (r = -.26, p < .01), inhibition (r = -.27, p < .01), shifting (r = -.19, p < .01), emotional control (r = -.15, p < .01), task monitoring (r = -.27, p < .01), working memory (r = -.22, p < .01), planning & organizing (r = -.26, p < .01), organize materials (r = -.20, p < .01), and task completion (r = -.25, p < .01). Among subscales, inhibition (r = -.27, p < .01) and planning and organization (r = -.26, p < .01) showed the strongest correlations with mastery goal orientation. Across indices, the GEC (r = -.31, p < .01) showed the strongest correlations with mastery goal orientation. Complete results from these correlational analyses can be found in Table 2.

Based on these results, parallel mediation models will be conducted with the GEC and the inhibition and planning/organization subscales.

Executive Functioning & Intrinsic Motivation (RQ4)

To determine which components of executive functioning were most associated with intrinsic motivation, similar procedures were followed by conducting Pearson r correlational analyses using all indices and subscales of the BRIEF and the intrinsic motivation measure. Results from these analyses showed that intrinsic motivation significantly correlated with GEC (r = -.23, p < .01), BRI (r = -.21, p < .01), metacognition (r = -.22, p < .01), inhibition (r = -.20, p < .01), shifting (r = -.18, p < .01), emotional control (r = -.20, p < .01), task monitoring (r = -.13, p < .01), working memory (r = -.21, p < .01), planning & organizing (r = -.23, p < .01), organize materials (r = -.15, p < .01), and task completion (r = -.21, p < .01). Among subscales, planning and organization (r = -.23, p < .01) showed the strongest correlations with intrinsic motivation. Across indices and composites, the GEC (r = -.23, p < .01) and metacognition (r = -.22, p < .01)

showed the strongest correlations with intrinsic motivation. Complete results from these correlational analyses can be found in Table 2.

Based on these results, parallel mediation models will be conducted with the GEC, the metacognition index, and the planning/organization subscale.

Mediation Analyses

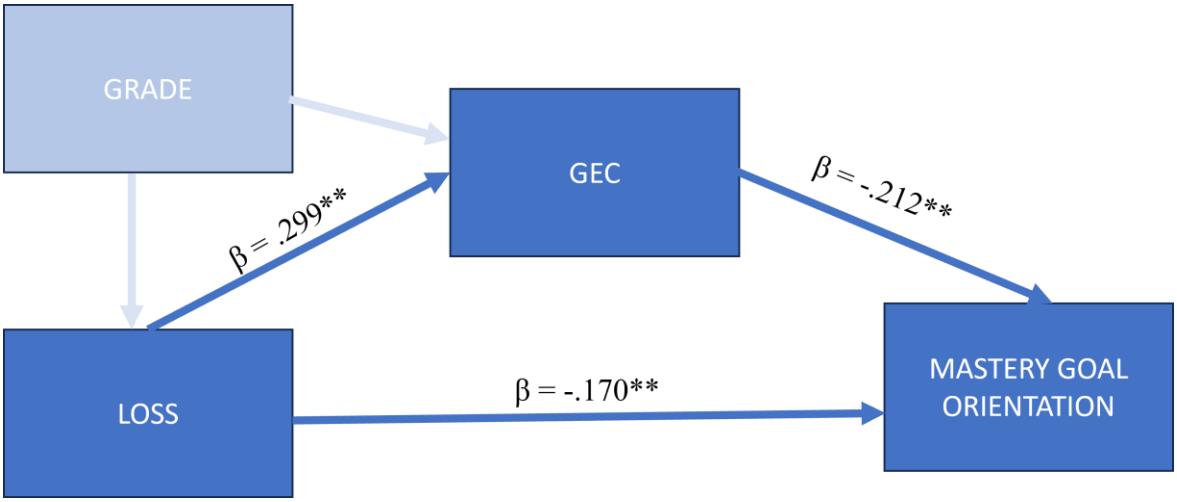
Executive Functioning Mediating Systemic Stress and Mastery Orientation (RQ3)

Structural equation modeling (SEM) was conducted in AMOS Version 24.0 (IBM, 2020) to examine the prospective relationships among SLS Loss and SLS Conflict, the BRIEF GEC, and mastery goal orientation. In the first model, SLS Loss was entered as a predictor of mastery goal orientation with GEC as a mediator. Given its significant correlations with study variables, the effects of grade level were controlled for in this and subsequent models. Based on the results from the correlational analyses, both SLS Loss and SLS Conflict were examined in separate models as predictors of mastery goal orientation. Because three executive functioning measures emerged as being highly correlated with mastery goal orientation (GEC, inhibition, and planning/organization), three separate models were tested to analyze each executive functioning variable in question.

GEC & Mastery Goal Orientation. Because GEC is a wider ranging construct comprised of all measured domains of executive functioning, the model was first tested using GEC as a measure of executive functioning. The model provided poor fit to the data $\chi 2(2, N = 422) = 16.538$, $p = .000$; RMSEA = .131, CFI = .878, TLI = .392, thus, results should be interpreted with caution. SLS Loss predicted GEC ($\beta = .299$; $p = .000$) and mastery goal orientation ($\beta = -.170$; $p = .002$). Grade level significantly predicted SLS Loss ($\beta = .375$; $p = .000$). GEC predicted mastery goal orientation ($\beta = -.212$; $p = .000$).

Figure 1

Mediation Model with Loss, GEC, and Mastery



To test the mediational model of GEC as a mediator of the relationship between systemic stress and mastery goal orientation, the bootstrapping resampling method was used in AMOS. Results based on 2000 bootstrapped samples indicated poor model fit $\chi 2(2, N = 246) = 11.188$, $p = .004$; RMSEA = .137, CFI = 0.902, TLI = .705, so significant paths should be interpreted cautiously. Within this model, SLS Loss predicted GEC (β = .318; $p = .001$) such that greater systemic stress predicted greater challenges in global executive functioning. GEC predicted mastery goal orientation (β = -.288; $p = .001$) indicating that greater challenges in global executive functioning predicted lower mastery goal orientation. Grade level had significant effects on SLS Loss (β = .367; $p = .001$), GEC (β = .117; $p = .001$), and mastery goal orientation (β = -.062; $p = .004$) indicating that higher grade level predicted greater systemic stress, greater challenges in executive functioning, and lower mastery goal orientation. The bootstrapped mediation model showed significant indirect effects of systemic stress on mastery goal orientation (β = -.092, SE = .005, $p = .001$, 95% CI [-.149, -.048]). The 95% confidence interval

for the indirect effect did not include zero indicating that the indirect mediation pathway was significant.

SLS Conflict. Next, a similar model was tested using SLS Conflict as the systemic stress variable, GEC as the executive functioning mediator variable, and mastery goal orientation as the dependent variable. The model provided very poor fit to the data $\chi 2(2, N = 422) = 18.465$, $p = .000$; RMSEA = .140, CFI = .746, TLI = .271, thus, results should be interpreted with caution. SLS Conflict predicted GEC ($\beta = .396$; $p = .000$) and mastery goal orientation ($\beta = -.177$; $p = .034$). Grade level significantly predicted SLS Loss ($\beta = .301$; $p = .000$). GEC predicted mastery goal orientation ($\beta = -.196$; $p = .002$).

The bootstrapping resampling method was used in AMOS to test the significance of the indirect effect. The model provided poor fit to the data $\chi 2(2, N = 101) = 7.918$, $p = .019$; RMSEA = .172, CFI = .886, TLI = .658, thus, results should be interpreted with caution. Results based on 2000 bootstrapped samples showed that SLS Conflict significantly predicted GEC ($\beta = .549$; $p = .002$) such that higher SLS Conflict results in greater challenges in GEC. GEC showed a direct effect on mastery goal orientation ($\beta = -.252$; $p = .026$) such that greater challenges in GEC predicted lower mastery goal orientation. Grade level showed a direct effect on SLS Conflict indicating that higher grade level predicted higher SLS Conflict. Mediation results showed significant indirect effects of systemic stress on mastery goal orientation ($\beta = -.139$, SE = .005, $p = .047$, 95% CI [-.300, -.023]). The 95% confidence interval for the indirect effect did not include zero indicating that the indirect mediation pathway was significant. The mediation pathways show that higher SLS Conflict predicts lower mastery goal orientation through greater challenges in GEC. Due to the poor fitness of this model and increased missing data for the SLS

Conflict index contrasted with the strengths of the former model with SLS Loss as a predictor, succeeding analyses were conducted with SLS Loss as the independent variable.

Inhibition & Mastery Goal Orientation. The model was tested using inhibition as a measure of executive functioning. This model provided very poor fit to the data $\chi 2(2, N = 422) = 13.922$, $p = .001$; RMSEA = .119, CFI = .890, TLI = .449, thus, results should be interpreted cautiously. SLS Loss predicted Inhibition ($\beta = .243$; $p = .000$) and mastery goal orientation ($\beta = -.180$; $p = .000$). Grade level significantly predicted SLS Loss ($\beta = .375$; $p = .000$). Inhibition predicted mastery goal orientation ($\beta = -.222$; $p = .000$).

To test the mediational model of inhibition as a mediator of the relationship between SLS Loss and mastery goal orientation, the bootstrapping resampling method was repeated in AMOS. The model fit for the 2000 bootstrapped samples was adequate $\chi 2(2, N = 246) = 8.700$, $p = .013$; RMSEA = .117, CFI = .919, TLI = .757. All paths in this model were significant. Systemic stress showed significant effects on inhibition ($\beta = .253$; $p = .001$) and mastery goal orientation ($\beta = -.169$; $p = .006$), and inhibition showed significant effects on mastery goal orientation ($\beta = -.293$; $p = .001$) indicating that higher systemic loss predicted greater challenges in inhibitory control and lower mastery goal orientation, and greater challenges in inhibitory control predicted lower mastery goal orientation. Grade level had significant effects on systemic stress ($\beta = .367$; $p = .001$), inhibition ($\beta = .093$; $p = .001$), and mastery goal orientation ($\beta = -.062$; $p = .004$) indicating that higher grade level predicted greater systemic stress, greater challenges in inhibitory control, and lower mastery goal orientation. The bootstrapped mediation model indicated significant indirect effects of SLS Loss on mastery goal orientation ($\beta = -.074$, SE = 0.028, $p = .001$, 95% CI [-.130, -.036]). The 95% confidence interval for the indirect effect did

not include zero indicating a significant mediation effect such that higher SLS Loss predicts lower mastery goal orientation through greater challenges in inhibitory control.

Planning/Organization & Mastery Goal Orientation. Next, this model was tested using planning/organization as the executive functioning variable. The model provided very poor fit to the data $\chi 2(2, N = 422) = 18.680$, $p = .000$; RMSEA = .141, CFI = .858, TLI = .288, thus, results should be interpreted cautiously. SLS Loss predicted planning/organization (β = .273; p = .000) and mastery goal orientation (β = -.175; p = .001). Grade level predicted SLS Loss (β = .375; p = .000). Planning/organization predicted mastery goal orientation (β = -.215; p = .000). To test the mediational model of planning/organization as a mediator of the relationship between systemic stress and mastery goal orientation, the bootstrapping resampling method was repeated in AMOS. Results based on 2000 bootstrapped samples indicated poor model fit $\chi 2(2, N = 246) = 13.129$, $p = .001$; RMSEA = .151, CFI = .883, TLI = .648, therefore significant paths should be interpreted with caution. Within this model, all paths were significant. SLS Loss showed significant effects on planning/organization (β = .290; p = .001) and mastery goal orientation (β = -.169; p = .006), such that higher systemic loss predicted greater challenges in planning and organization and lower mastery goal orientation. Planning/organization showed significant effects on mastery goal orientation (β = -.312; p = .001) indicating that greater challenges in planning and organization predicted lower mastery goal orientation.. Grade level had significant effects on SLS Loss (β = .367; p = .001), planning/organization (β = .106; p = .001), and mastery goal orientation (β = -.062; p = .004) indicating that higher grade level predicted greater systemic stress, greater challenges in planning and organizing, and lower mastery goal orientation. The bootstrapped mediation model showed significant indirect effects of SLS Loss on mastery goal orientation (β = -.090, SE = .029, p = .001, 95% CI [-.143, -.049]). The 95% confidence interval

for the indirect effect did not include zero, indicating a significant mediation effect such that higher SLS Loss predicts lower mastery goal orientation through greater challenges in planning and organization.

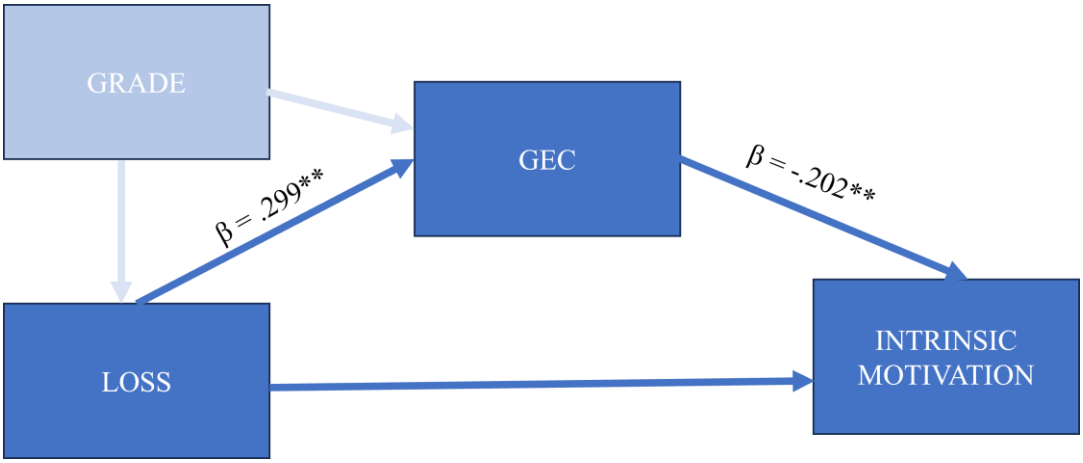
Mediation Model 2: Intrinsic motivation (RQ 5)

In the second model, SLS Loss was entered as a predictor of intrinsic motivation with executive functioning as a mediator while controlling for the effects of grade level. As mentioned above, given that intrinsic motivation demonstrated its strongest correlations with GEC, metacognition, and planning/organization in the preliminary analyses, three separate models were tested to analyze each executive functioning variable in question. Full results can be seen in Table 3.

GEC & Intrinsic Motivation. First, this model was examined with GEC as the executive functioning mediator variable. This model provided adequate fit to the data $\chi 2(2, N = 422) = 5.765$, $p = .056$; RMSEA = .067, CFI = .960, TLI = .798. SLS Loss predicted GEC ($\beta = .299$; $p = .000$. Grade level predicted SLS Loss ($\beta = .375$; $p = .000$). GEC predicted intrinsic motivation ($\beta = -.202$; $p = .000$).

Figure 2

Mediation Model with Loss, GEC, and Intrinsic Motivation

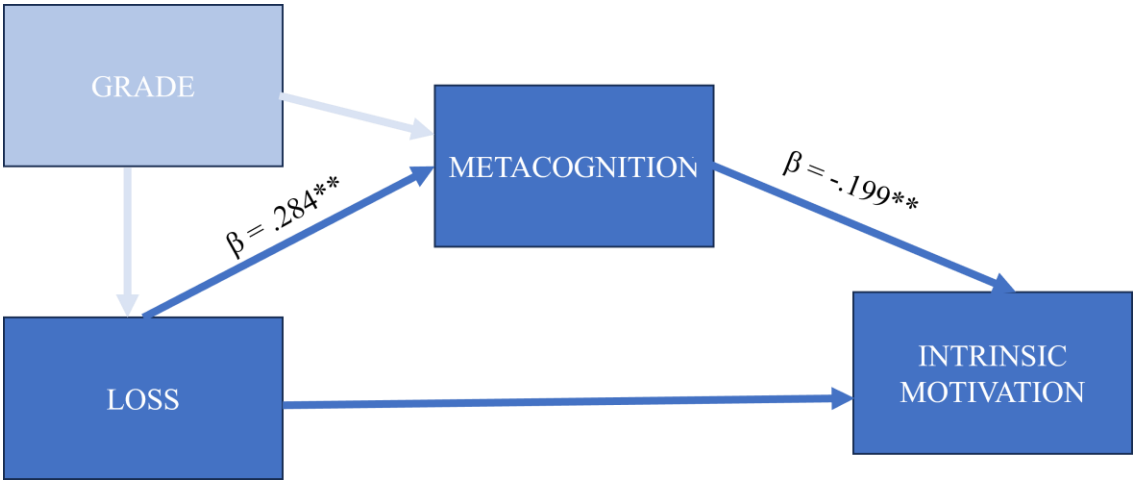


To test the mediational model of GEC as a mediator of the relationship between SLS Loss and intrinsic motivation, the bootstrapping resampling method was repeated in AMOS. This model provided an adequate fit to the data $\chi 2(2, N = 246) = 5.469$, $p = .001$; RMSEA = .084, CFI = .955, TLI = .864. Results based on 2000 bootstrapped samples indicated significant direct effects of SLS Loss on GEC (β = .318; $p = .001$) and significant direct effects of GEC on intrinsic motivation (β = -.233; $p = .001$) such that higher SLS Loss predicted greater challenges in GEC, and greater challenges in GEC predicted lower intrinsic motivation. The bootstrapped mediation model showed significant indirect effects of SLS Loss on intrinsic motivation (β = -.074, SE = .026, $p = .000$, 95% CI [-.127, -.038]). The 95% confidence interval for the indirect effect did not include zero indicating that the indirect mediation pathway was significant such that higher SLS Loss predicts lower intrinsic motivation through greater challenges in planning and organization.

Metacognition & Intrinsic Motivation. Next, this model was tested using metacognition as the executive functioning mediator variable. The model provided adequate fit to the data $\chi 2(2, N = 422) = 6.320$, $p = .042$; RMSEA = .072, CFI = .952, TLI = .761. SLS Loss predicted metacognition (β = .284; $p = .000$. Grade level predicted SLS Loss (β = .375; $p = .000$). Metacognition predicted intrinsic motivation (β = -.199; $p = .000$).

Figure 3

Mediation Model with Loss, Metacognition, and Intrinsic Motivation



To test the mediational model of metacognition as a mediator of the relationship between SLS Loss and intrinsic motivation, the bootstrapping was repeated resampling method in AMOS. Results based on 2000 bootstrapped samples indicated adequate fit to the data $\chi 2(2, N = 246) = 6.245$, $p = .044$; RMSEA = .093, CFI = .943, TLI = .830. Within this model, SLS Loss showed significant direct effects on metacognition (β = .295; $p = .001$) such that greater systemic loss predicted greater challenges in metacognitive executive functioning skills. Metacognition showed significant direct effects on intrinsic motivation (β = -.241; $p = .001$) indicating that greater challenges in metacognition predicted lower intrinsic motivation. The bootstrapped mediation model showed significant indirect effects of systemic stress on mastery goal orientation (β = -.071, SE = .025, $p = .001$, 95% CI [-.122, -.037]). The 95% confidence interval for the indirect effect did not include zero suggesting a significant indirect mediation pathway that indicates that higher systemic loss predicts lower intrinsic motivation through greater challenges in metacognitive executive functioning skills.

Planning/Organization & Intrinsic Motivation. Lastly, planning/organization was examined as the executive functioning mediator variable within this model. The model provided poor fit to the data $\chi 2(2, N = 422) = 8.501$, $p = .014$; RMSEA = .088, CFI = .929, TLI = .645, thus, results should be interpreted cautiously. SLS Loss predicted planning/organization ($\beta = .273$; $p = .000$. Grade level predicted SLS Loss ($\beta = .375$; $p = .000$). Planning/organization predicted intrinsic motivation ($\beta = -.206$; $p = .000$).

To test the mediational model of metacognition as a mediator of the relationship SLS Loss and intrinsic motivation, the bootstrapping resampling method was repeated in AMOS. Results based on 2000 bootstrapped samples indicated poor model fit to the data $\chi 2(2, N = 246) = 8.449$, $p = .015$; RMSEA = .115, CFI = .917, TLI = .752, so significant paths should be interpreted with caution. SLS Loss showed significant effects on planning/organization ($\beta = .290$; $p = .001$), and planning/organization showed significant effects on intrinsic motivation ($\beta = -.256$; $p = .001$). The bootstrapped mediation model showed significant indirect effects of systemic stress on intrinsic motivation ($\beta = -.074$, SE = .025, $p = .015$, 95% CI [-.124, -.039]). The 95% confidence interval for the indirect effect did not include zero indicating that the indirect mediation pathway was significant such that higher SLS Loss predicts lower intrinsic motivation through greater challenges in planning and organization.

Table 3

Indirect Effects for Mediation Models

Mediation Model	Hypothesis	Coefficient	SE	95% CI		Conclusion
				Lower	Upper	
Model 1	Los->GEC->PALS	-.092**	.005	-.149	-.048	Full mediation
Model 2	Con->GEC->PALS	-.139*	.005	-.300	-.023	Full mediation
Model 3	Los->Inhib->PALS	-.074**	.028	-.130	-.036	Full mediation
Model 4	Los->P/O->PALS	-.090**	.029	-.143	-.049	Full mediation
Model 5	Los->GEC->IM	-.074**	.026	-.127	-.038	Full mediation
Model 6	Los->MI->IM	-.071**	.025	-.122	-.037	Full mediation
Model 7	Los->P/O->IM	-.074*	.025	-.124	-.039	Full mediation

** Indicates significance at the .05 level*

***Indicates significance at the .01 level*

SLS Loss (Los); BRIEF: Global Executive Composite (GEC); Patterns of Adaptive Learning: Mastery Goal Orientation (PALS); BRIEF: Inhibition (Inhib); BRIEF: Planning/Organization (P/O); Intrinsic Motivation (IM)

Discussion

The purpose of this study was to examine factors that contribute to the development of adaptive learning approaches including goal orientation and intrinsic motivation. The current study explored this by first identifying which form of systemic stress was most associated with overall and specific executive functions. Results showed that loss and conflict showed the strongest associations with all domains of executive functioning, providing partial support for the original hypothesis that loss would be most strongly associated with domains of executive functioning. Next, correlational analyses were conducted to determine which executive functions were most associated with mastery goal orientation and intrinsic motivation. Results showed that global executive functioning, inhibition, and planning/organization were most strongly associated with mastery goal orientation. Global executive functioning, metacognition, and planning/organization were most strongly related to intrinsic motivation.

Next, the current study examined the mediating role of executive functioning on the relationship between systemic stress and a) mastery goal orientation and b) intrinsic motivation. Results of this study revealed that systemic stress indeed predicted mastery goal orientation. While both chronic loss and conflict predicted mastery goal orientation, loss provided a better fitting model compared to conflict. These results provide support for existing findings that students from higher resourced environments show higher mastery goal orientation (Berger & Archer, 2016). Further, this study's findings underscore the significance of environmental factors in *shaping* learning outcomes among youth. Specifically, as systemic stressors become more prevalent in the lives of children and adolescents, their orientation toward mastery decreases.

Results from the second set of theoretical models showed that systemic stress also predicted intrinsic motivation. Specifically, loss again showed a negative relationship such that

lower systemic stress predicted greater intrinsic motivation. Interestingly, greater systemic stress predicted both lower mastery goal orientation and lower intrinsic motivation. Although the two outcomes share similarities and share predictors in this study, intrinsic motivation is distinct in its focus on interest and enjoyment (Elliot & Harackiewicz, 1994). Perhaps the increased presence of stressors become distracting and ultimately undermine a child's ability to fully engage or enjoy school. Another possibility could be that greater prevalence of stressors make school settings and experiences less enjoyable than in low systemic stress environments. Perhaps if the circumstances of youth in contexts of high systemic stress are framed within a hierarchy of needs (Maslow, 1954), lower outcomes in mastery goal orientation and, perhaps especially, intrinsic motivation can be explained as secondary or tertiary to more essential physiological needs. Nevertheless, the findings from the current study may provide some insight in the pursuit of a theoretical perspective to guide empirical research in examining the permeating adverse effects of systemic stress.

Results from both sets of mediation models showed that executive functioning mediated the relationship between systemic stress and a) mastery goal orientation as well as b) intrinsic motivation providing support for the hypothesis of mediation. Among executive functions assessed, global executive functioning demonstrated the largest effect on mediating the relationship between systemic stress and both mastery goal orientation and intrinsic motivation. However, planning and organizing also showed comparable effects as a mediator of this relationship. Results from this study provide support to existing findings that youth exposed to chronic stressors experience greater deficits in executive functioning compared to their better resourced peers (Cumming et al., 2019). Existing theoretical perspectives on how stress affects executive functioning have been generally limited to acute stress as opposed to chronic stress.

For example, one study posited that acute stress responses triage cognition to prioritize processing the information associated with the immediate stressor (Mather & Sutherland, 2011). However, the literature providing theoretical perspectives framing what happens when stressors are more systemic than immediate and more chronic than acute are not as abundant. Nevertheless, there is a growing body of research providing a neurodevelopmental framework to contextualize the effects of chronic stress on executive functioning. A number of recent studies have found that chronic stressors, specifically forms of loss and conflict, are associated with reductions in cortical thickness and surface area throughout the cortex (Mackey et al., 2015; Noble et al., 2015; Sheridan et al., 2017). Because these are regions that support executive functions, reductions in these regions can yield deficits in higher order cognitive functions, including executive functions (Sheridan et al., 2017). One study found that chronic stress in the form of loss was associated with poor working memory performance and inefficient neural recruitment in the parietal and prefrontal cortex during high working memory load among adolescents even after controlling for other forms of chronic stress such as conflict, providing evidence to support the neurodevelopmental framework (Sheridan et al., 2017). Other studies have shown similar findings linking childhood chronic stress to later deficits in other executive functions such as inhibitory control, working memory, and cognitive flexibility (Johnson et al., 2021; McLaughlin et al, 2019). Although no aspects of neurodevelopment were explicitly measured in the present study, its findings align with the neurodevelopmental perspective contextualizing EF deficits associated with high chronic stress.

Intrinsic Motivation and Mastery Goal Orientation

Findings from the current study provide some insight on the factors that predict mastery goal orientation and intrinsic motivation. These constructs are especially relevant among youth

in contexts of high chronic stress who are at greater academic risk (Johnson et al., 2021; Miller et al., 2019; Reardon, 2011). Youth experiencing chronic stress, particularly loss, begin school with greater academic skills deficits which translate into disparities in academic achievement, and ultimately educational attainment and economic stability later in life (Miller et al., 2019). Furthermore, as economic inequality continues to rise, the academic achievement gap widens (Reardon, 2011). To reduce this widening achievement gap, we must streamline our understanding of relevant predictors of academic achievement in contexts of high chronic stress. Intrinsic motivation and mastery goal orientation have each shown positive predictive relationships with academic learning skills and academic achievement (Larson & Rusk, 2011; Lepper, Corpus, & Iyengar, 2005; Ryan & Deci, 2009; Vansteenkiste et al., 2004). However, less is known about what predicts mastery goal orientation and intrinsic motivation and what makes some interventions to promote intrinsic motivation and mastery goal orientation more successful than others. By deepening our understanding of predictors of academic achievement, systems, teachers, and families can perhaps have greater success in promoting academic achievement in contexts of high chronic stress.

Intrinsic motivation and mastery goal orientation both have shown associations with academic achievement while capturing distinct factors. Intrinsic motivation is distinguished by a focus on enjoyment whereas mastery goal orientation pertains to a focus on skill and ability. Although mastery goal orientation and intrinsic motivation are distinct constructs, the current study's findings highlight similarities in their predictors. These findings show that executive functioning mediates the deleterious effects of chronic stress on these constructs, underscoring the formative, permeating nature of chronic stress and further highlighting executive functioning as an important point of focus for intervention in promoting academic achievement in high stress

contexts. This aligns with previous findings demonstrating associations with theses constructs and EF-related skills, such as fewer cheating behaviors (i.e., inhibition), less procrastination (i.e., task initiation), and adjusting and persisting when faced with challenges (i.e., cognitive flexibility) (Anderman & Anderman, 2009; Stephens & Gehlbach, 2007; Wolters, 2004). However, these findings are correlational and thus without directionality. Perhaps when executive functioning is high, students are able to approach tasks in more manageable ways that promote intrinsic motivation and mastery goal orientation. More research is needed to further evaluate the directionality of the relationships between these constructs.

Recommendations

The current study's findings suggest that for youth in diverse contexts of chronic stress, providing focus and support on planning and organizing can aid in the development of adaptive learning approaches. This should ultimately have positive implications for overall achievement. This notion aligns with findings from Smeding and colleagues (2013) who conducted a set of three studies among three cohorts of first-year undergraduate students, with each study finding that focus on mastery goal orientation in academic contexts reduced the SES achievement gap. In the first study, scores from a traditional multiple-choice norm-based exam were compared with scores from a mastery-oriented continuous assessment which was presented as a way to assist students' learning and consolidation of knowledge (Smeding et al., 2013). For the mastery-oriented continuous assessment, students received a list of learning goals at the end of each class to prepare them for a short continuous assessment of said goals at the beginning of the succeeding class to continue to orient their focus toward mastery of the learning goals. Results from comparing scores on the traditional exam to the mastery-oriented continuous assessment demonstrated a traditional socioeconomic achievement gap in the traditional exam. In other

words, students from high socioeconomic backgrounds performed better than their low-SES peers. In contrast, scores from the mastery-oriented continuous assessment revealed comparable scores among both low- and high-SES students. The second study examined self-ratings of mastery orientation and final exam scores. Results showed a typical socioeconomic achievement gap on final exams among students who endorsed lower levels of mastery orientation. However, among students with high mastery goal orientation, the achievement gap virtually disappeared. In the third study, students were presented with an exam which was either framed to them as a tool to train students (mastery-oriented assessment) or a way to select the best among them (selection-oriented assessment). Results again revealed a socioeconomic achievement gap among scores on the selection-oriented assessment with high-SES students outperforming low-SES students. On the mastery-oriented assessment, low-SES students performed slightly better than their high-SES peers. These findings illustrate the significance of promoting mastery goal orientation among students from disadvantaged backgrounds, and the findings from the current study suggest that a focus on developing executive functions, specifically planning and organization, can help to promote mastery goal orientation among youth in contexts of high chronic stress.

Interventions promoting changes in motivations and other abstract constructs can sound challenging to implement at a large scale. However, teaching students the fundamentals of planning and organizing and other executive functions could perhaps be a more tangible, accessible area for parents, teachers, and schools to target. In a 2022 study, one middle school had its teachers participate in an intensive five-day summer workshop training them in the Strategic Memory Advance Reasoning Training (SMART ©, Chapman & Gamino, 2008) program developed by The University of Texas at Dallas's Center for BrainHealth (Gamino et

al., 2022). The program is a manualized higher-order executive function training curriculum comprised of 10 45-minute classroom sessions that are delivered over a one-month period teaching students fundamental skills in metacognitive strategies and top-down processing (Gamino et al., 2022). The executive functioning training program focuses on core EF skills such as inhibition and planning and organizing, among other skills (Gamino et al., 2022). Results from this intervention demonstrated overall improvements in executive functions as well as performance on state-mandated standardized tests. Other research has similarly shown that school-based implementation of programs targeting executive functions leads to positive outcomes in EF development. A 2020 study enrolled students from four different middle schools in two distinct types of programs targeting EF skills: a mindfulness-based curriculum (Stop & Breathe; Kuyken et al., 2013) designed to improve emotional awareness, sustained attention, and attentional and emotional regulation, and a modified active relaxation curriculum designed teach relaxation skills and holistic wellbeing (Lassander et al., 2020). Results from this study showed that both interventions demonstrated similar positive outcomes in overall executive functioning. Similar to the SMART © program, both curricula in this study comprised of nine 45-minute sessions, providing additional support to the idea that substantial outcomes can occur from just brief, targeted intervention.

Aspects of planning and organizing tasks are already embedded in school curricula in some form (e.g., providing students with planners/agendas to keep track of assignments, rubrics and outlines for planning and structuring essays, etc.) such that these skills have been referred to as the “hidden curriculum” to emphasize the lack of any local, state, or national curriculum standards mandating that students learn executive functioning skills (Dawson, 2021). Perhaps interventions could seek to emphasize the development of planning and organizing skills and

provide tailored support to target students' varying levels of need in this domain throughout the entirety of their education. Dawson (2020) emphasizes that among elementary school-aged children, fundamental executive functions (i.e., inhibition, working memory, emotional control, cognitive flexibility, sustained attention, and task initiation) should considered as emerging, while among middle school-aged youth, advanced skills (i.e., planning/organization, time management, goal-directed persistence, and metacognition) should be emerging. Furthermore, Dawson (2021) highlights three strategies parents and schools can utilize to strengthen the acquisition of executive functions: making environment more supportive than punitive for children with greater executive functioning challenges; explicitly teaching executive functions by embedding them into daily routines; and using incentives to motivate children to practice skills that are laborious in the early stages of acquisition. Because acquiring new skills can be laborious, using incentives to motivate children to practice skills during the early stages of acquisition can perhaps aid the development of effective EF habits (Dawson, 2021).

Strengths

The present study presented a number of strengths and contributions to the literature. In a body of literature with a predominant focus on acute stress's effects on executive functioning, the current study provides much needed findings on the effects of chronic stress on executive functioning. Chronic stress has frequently been shown to correlate with and in many cases predict academic achievement (Banerjee, 2016; Goodman et al., 2012; Miller et al., 2019), and racial/ethnic minorities are at greater risks of experiencing and being subjected to various forms of chronic stress (Cole & Omari, 2003; Williams, 1999; Williams & Williams-Morris, 2000). However, the vast majority of studies examining the effects of chronic stress on determinants of academic outcomes utilize predominantly White samples of young children. The current study

contributes to a much-needed area of the literature in its focus on a racially diverse sample of adolescents. Furthermore, the present study's findings demonstrated predictive qualities of chronic stress at the systems level, highlighting the formative impact of chronic stress on shaping the lives of youth. Additionally, far more abundant than research examining chronic stressors at the systems level is research examining SES, which, as evidenced by this study's correlational analyses, serves as a less robust proxy to capture the various manifestations of one's ecological context and its relation to outcomes. The Systems Level Stress Measure (Grant et al., 2021) allowed the current study to examine manifestations of chronic stress in the home, neighborhood, school, and community environments in which each child exists and within which they interact. Moreover, this study examined executive functioning as a mediator of the adverse effects of chronic stress at the systems level, providing a specific area of focus for potential intervention (see below).

Another strength of the current study is its individual examination of specific types of chronic stress. Traditionally, studies have examined chronic stress via an accumulation-oriented approach (e.g., cumulative risk model, adverse childhood experiences) (Sheridan et al., 2017). Some researchers argue that these approaches fail to distinguish between different types of stress that may influence development through distinct mechanisms (Sheridan et al., 2017). Growing research examining the effects of chronic stress on executive functioning through a neurodevelopmental lens underscores the importance of examining loss (i.e., deprivation) and conflict (i.e., threat) separately as their neurodevelopmental impacts are at least partially distinct (McLaughlin & Sheridan, 2016; Sheridan et al., 2017). Conflict stress in children has shown associations with reduced amygdala, medial prefrontal cortex (mPFC), and hippocampal volume as well as heightened amygdala activation to threat (McLaughlin et al., 2019). Loss stress in

children has shown associations with reduced volume and altered function in frontoparietal regions. Due to their distinct impacts on neurodevelopment, some studies have advocated for more research examining loss and conflict separately. The present study presents an additional strength in its examination of loss and conflict separately. Further, among the studies that have examined loss and conflict separately, many have found that loss was a stronger predictor of executive deficits, or that its effects remained present even after controlling for conflict (Johnson et al., 2021; McLaughlin et al, 2019; Sheridan et al., 2017). These findings align with those of the current study which showed that loss was a more robust predictor of executive functioning.

The current study also examined the relationship between executive functions and mastery goal orientation. Typically, research has focused on how executive functioning and mastery goal orientation relate to academic achievement rather than how they relate to one another. The findings from this study provide evidence to support that executive functioning plays a role in predicting mastery goal orientation as well as intrinsic motivation. Additionally, whereas studies examining executive functioning often utilize task-based measures, the present study provides a contribution to the literature in its use of a gold-standard ratings-based measure. This is a notable facet of this research as the existing literature has well documented that task-based and ratings-based measures of executive functioning cannot be used interchangeably because they assess different underlying processes (Pino Muñoz & Arán Filippetti, 2019; Soto et al., 2020) and have unique predictive qualities (Soto et al., 2020).

Limitations and Future Directions

Of course, this study is not without its limitations. First, and most notably, although the analyses produced many significant findings that support or extend those within existing literature, the fitness for the analytical models was generally poor. Consequently, the findings

from this study should be considered with caution. It is possible that other variables not accounted for in the presented models also contribute to the relationships between study variables. For example, research on intrinsic motivation shows cultural differences in that individuals from interdependent cultures are more intrinsically motivated by opportunities to promote harmony and belonging within their group whereas individuals from independent cultures are more intrinsically motivated by opportunities to assert their individualistic sense of self (Iyengar & Lepper, 1999). Perhaps intrinsic motivation for learning may yield different results based on the independent/interdependent nature of the motivation. Additionally, more robust measurement of executive functions via multi-informant reporting and task-based measures could potentially impact model fit. Future research should seek to account for those variables to elucidate these findings and relationships among variables.

Second, while the current used a ratings-based measure of executive functioning, data were self-reported only. The current study could have been strengthened using a multi-informant approach to measure ratings-based executive functioning. Furthermore, task-based measures still provide additional insight into the construct of executive functioning. Evidence-based research that utilizes both task- and ratings-based measures accounts for the unique predictive qualities of both and provide a more robust, holistic assessment of executive functioning (Nyongesa et al., 2019; Pino Muñoz & Arán Filippetti, 2019; Silver et al., 2014). Importantly, research has shown culture-based differences on task-based measures of executive functioning. Specifically, European American, African American, Asian American, or Latin American were compared and European Americans consistently performed better on task-based measures of executive functioning, which researchers attribute to social inequalities and measurement that is normed using monolingual European Americans (Gasquoine, 2009; Rea-Sandin et al., 2021).

Consequently, there is a call for more consideration of racial/ethnic differences when utilizing task-based executive functioning measures (Rea-Sandin et al., 2021). Measures such as continuous performance tasks (e.g., Test of Variables of Attention; Leark et al., 2007) or the Dimensional Change Card Sort (DCCS; Zelazo, 2006) are recommended as they are less likely to demonstrate racial/ethnic differences (Rea-Sandin et al., 2021). Third, the current study was cross-sectional, weakening its predictive qualities. To most effectively test for mediation, future studies testing mediation would benefit from longitudinal design with three timepoints of data. Lastly, the outcome variables utilized in the current study are themselves predictors of academic achievement. Adequate measures of academic achievement were not available to sufficiently test the theory behind the proposed models as predictors of academic achievement. Future studies could seek to test analytical models that include these variables as well as a measure of academic achievement to better understand the relationships between variables and further guide interventions on how to promote academic achievement in contexts of high chronic stress.

Conclusion

Why students go to school matters. Students' goal orientations and intrinsic motivations frame their academic learning and engagement, and their ecological contexts can impact their goals and motivations. Adolescents in contexts of high systemic stress, specifically chronic loss, are exposed to myriad stressors that have deleterious impacts on the development of executive functions, which can result in lower intrinsic motivation and orientation to mastery. Taken together, these deficits may translate into disparities in academic achievement, and ultimately educational attainment and economic stability later in life. Through this framing, economic inequality reinforces the academic achievement gap, and the academic achievement gap reinforces economic inequality. Moreover, as the economic inequality continues to increase, so

to will the academic achievement gap, making it especially important to understand and intervene on the predictors of academic achievement in contexts of high chronic stress, especially loss. By building habits and targeting executive functions, parents, teachers, and systems can support youth's development of adaptive learning behaviors that may better position them for academic success despite their ecological contexts.

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Appendix

Stress and Learning Survey (FA-E)

IM

1. For each of the following statements, please indicate how true it is for you:

	Not at all true			Somewhat true			Very true
I like hard work because it's a challenge.	◯	◯	◯	◯	◯	◯	◯
I like to learn as much as I can in school.	◯	◯	◯	◯	◯	◯	◯
I like to go on to new work that's at a more difficult level.	◯	◯	◯	◯	◯	◯	◯
I like those school subjects that make me think pretty hard and figure things out.	◯	◯	◯	◯	◯	◯	◯
I like difficult problems because I enjoy trying to figure them out.	◯	◯	◯	◯	◯	◯	◯
I like difficult schoolwork because I find it more interesting.	◯	◯	◯	◯	◯	◯	◯

2. For each of the following statements, please indicate how true it is for you.

	Not at all true			Somewhat true			Very true
I ask questions in class because I want to learn new things.	◯	◯	◯	◯	◯	◯	◯
I do extra projects because I can learn about things that interest me.	◯	◯	◯	◯	◯	◯	◯
I read things because I am interested in the subject.	◯	◯	◯	◯	◯	◯	◯
I do my schoolwork to find out about a lot of things I've been wanting to know.	◯	◯	◯	◯	◯	◯	◯
I work really hard because I really like to learn new things.	◯	◯	◯	◯	◯	◯	◯
I work on problems to learn how to solve them.	◯	◯	◯	◯	◯	◯	◯

Stress and Learning Survey (FA-E)

3. For each of the following statements, please indicate how true it is for you.

	Not at all true			Somewhat true			Very true
I like to try to figure out how to do school assignments on my own.	◯	◯	◯	◯	◯	◯	◯
When I don't understand something right away I like to try to figure it out by myself.	◯	◯	◯	◯	◯	◯	◯
When I make a mistake I like to figure out the right answer by myself.	◯	◯	◯	◯	◯	◯	◯
If I get stuck on a problem I keep trying to figure out the problem on my own.	◯	◯	◯	◯	◯	◯	◯
I like to do my schoolwork without help.	◯	◯	◯	◯	◯	◯	◯

Stress and Learning Survey (FA-E)

Patterns of Adaptive Learning Scales (PALS) - SHORT

1. The following questions are about school and about the work you do in school. Remember to say how you really feel. No one at school or home will see your answers.

	Not At All True	2	Somewhat True	4	Very True
At my school, trying hard is very important.	◯	◯	◯	◯	◯
At my school, showing others that you are not bad at class work is really important.	◯	◯	◯	◯	◯
At my school, how much you improve is really important.	◯	◯	◯	◯	◯
At my school, getting good grades is the main goal.	◯	◯	◯	◯	◯
At my school, really understanding the material is the main goal.	◯	◯	◯	◯	◯
At my school, getting right answers is very important.	◯	◯	◯	◯	◯
At my school, it's important that you don't make mistakes in front of everyone.	◯	◯	◯	◯	◯
At my school, it's important to understand the work, not just memorize it.	◯	◯	◯	◯	◯
At my school, it's important not to do worse than other students.	◯	◯	◯	◯	◯
At my school, learning new ideas and concepts is very important.	◯	◯	◯	◯	◯
At my school, it's very important to not look dumb.	◯	◯	◯	◯	◯
At my school, it's OK to make mistakes as long as you are learning.	◯	◯	◯	◯	◯
At my school, it's important to get high scores on tests.	◯	◯	◯	◯	◯
At my school, one of the main goals is to avoid looking like you can't do the work.	◯	◯	◯	◯	◯

Stress and Learning Survey (FA-E)

SLS - Different Treatment

Sometimes people mistreat other people because they are different in some way. The next questions ask about situations like that, which you might have seen.

***1. Have you seen someone mistreated because they are different?**

- ◯ Yes
- ◯ No

Stress and Learning Survey (FA-E)

SLS - Different Treatment

1. WHO has mistreated other people because they were different? You may check more than one answer.

- ☐ an adult family member (like father or uncle)
- ☐ adult who is not family (like teacher, coach)
- ☐ boyfriend/girlfriend
- ☐ family member who isn't an adult (like older brother)
- ☐ friend
- ☐ someone else

Write in their exact relationship to you (like "my boyfriend and older kids at school"):

2. WHAT reasons did people give for mistreating them and HOW OFTEN have you seen people mistreated for this reason?

	Never	Once	Twice	Three times	Four or more times
What their body or face looks like	◯	◯	◯	◯	◯
What their clothes are like	◯	◯	◯	◯	◯
How strong or fast or athletic they are	◯	◯	◯	◯	◯
How they do in school	◯	◯	◯	◯	◯
Their race or skin color	◯	◯	◯	◯	◯
Their country or language	◯	◯	◯	◯	◯
Their religion or beliefs or values	◯	◯	◯	◯	◯
That they are a boy or girl	◯	◯	◯	◯	◯
How much money their family has	◯	◯	◯	◯	◯
Their personality, how cool they are	◯	◯	◯	◯	◯
Their behavior, how good or bad they are	◯	◯	◯	◯	◯
That they are straight or gay or bisexual	◯	◯	◯	◯	◯
A disability they have	◯	◯	◯	◯	◯
Whether they have had sex or not	◯	◯	◯	◯	◯
Whether they drink or use drugs or not	◯	◯	◯	◯	◯

Stress and Learning Survey (FA-E)

3. WHERE have you seen people mistreated because they are different? You may check more than one answer

- ☐ At school (outside my classroom)
- ☐ At a club (like Boys & Girls Club)
- ☐ On a sports team
- ☐ In my classroom
- ☐ In my neighborhood
- ☐ At someone else's house
- ☐ At home
- ☐ At a church, synagogue, mosque
- ☐ Someplace else; write in where it is:

4. WHAT reasons have people given for mistreating you and HOW OFTEN has that happened to you? Check all that have happened.

	Never	Once	Twice	Three times	Four or more times
What my body or face looks like	◯	◯	◯	◯	◯
What my clothes are like	◯	◯	◯	◯	◯
How strong or fast or athletic I am	◯	◯	◯	◯	◯
How I do in school	◯	◯	◯	◯	◯
My race or skin color	◯	◯	◯	◯	◯
My country or language	◯	◯	◯	◯	◯
My religion or beliefs or values	◯	◯	◯	◯	◯
That I'm a boy or girl	◯	◯	◯	◯	◯
How much money my family has	◯	◯	◯	◯	◯
My personality, how cool I am	◯	◯	◯	◯	◯
My behavior, how good or bad I am	◯	◯	◯	◯	◯
That I'm straight or gay or bisexual	◯	◯	◯	◯	◯
A disability I have	◯	◯	◯	◯	◯
Whether I have had sex or not	◯	◯	◯	◯	◯
Whether I drink or use drugs or not	◯	◯	◯	◯	◯

Stress and Learning Survey (FA-E)

SLS - Different Beliefs

People have different beliefs about different groups of people. Below, you will be asked to make your best guess about the beliefs of people in your family, school, neighborhood, and country.

1. About what percentage of people in your family would agree with the sentences listed below?

	0%	25%	50%	75%	100%
Thin people are better than fat people	◯	◯	◯	◯	◯
Rich people are better than poor people	◯	◯	◯	◯	◯
Boys are better than girls	◯	◯	◯	◯	◯
White people are better than black people	◯	◯	◯	◯	◯
Straight people are better than gay people	◯	◯	◯	◯	◯
U.S.-born people are better than foreign-born people	◯	◯	◯	◯	◯
People without disabilities are better than people with them.	◯	◯	◯	◯	◯

2. About what percentage of people in your SCHOOL would agree with the sentences listed below?

	0%	25%	50%	75%	100%
Thin people are better than fat people	◯	◯	◯	◯	◯
Rich people are better than poor people	◯	◯	◯	◯	◯
Boys are better than girls	◯	◯	◯	◯	◯
White people are better than black people	◯	◯	◯	◯	◯
Straight people are better than gay people	◯	◯	◯	◯	◯
U.S.-born people are better than foreign-born people	◯	◯	◯	◯	◯
People without disabilities are better than people with them.	◯	◯	◯	◯	◯

3. About what percentage of people in your NEIGHBORHOOD would agree with the sentences listed below?

	0%	25%	50%	75%	100%
Thin people are better than fat people	◯	◯	◯	◯	◯
Rich people are better than poor people	◯	◯	◯	◯	◯
Boys are better than girls	◯	◯	◯	◯	◯
White people are better than black people	◯	◯	◯	◯	◯
Straight people are better than gay people	◯	◯	◯	◯	◯
U.S.-born people are better than foreign-born people	◯	◯	◯	◯	◯
People without disabilities are better than people with them.	◯	◯	◯	◯	◯

Stress and Learning Survey (FA-E)

4. About what percentage of people in the U.S. would agree with the sentences listed below?

	0%	25%	50%	75%	100%
Thin people are better than fat people	◯	◯	◯	◯	◯
Rich people are better than poor people	◯	◯	◯	◯	◯
Boys are better than girls	◯	◯	◯	◯	◯
White people are better than black people	◯	◯	◯	◯	◯
Straight people are better than gay people	◯	◯	◯	◯	◯
U.S.-born people are better than foreign-born people	◯	◯	◯	◯	◯
People without disabilities are better than people with them.	◯	◯	◯	◯	◯

Stress and Learning Survey (FA-E)

SLS - Different Homes

Life is unfair. Some people have more than they need and other people don't have enough. The questions below ask about your family's situation. Answer as honestly as you can.

1. I live (most of the time)

- ◯ in a house
- ◯ in an apartment
- ◯ in a shelter or group home
- ◯ on the streets
- ◯ somewhere else (write in where):

2. How long have you lived where you live now? (like "2 years", "always", or "2 weeks")

3. Check all that are true about the place you live most of the time:

- ☐ has trees in front
- ☐ has a backyard
- ☐ is not a safe place to live
- ☐ has flowers in the summer
- ☐ has cockroaches
- ☐ has good air conditioning
- ☐ has good heating
- ☐ is clean
- ☐ has more than one bathroom
- ☐ has more people than bedrooms
- ☐ has more bedrooms than people
- ☐ has more bathrooms than people

4. My family

- ◯ does not have enough money to take a vacation
- ◯ can take one expensive vacation every year
- ◯ can take a vacation as long as we stay with relatives
- ◯ can take as many vacations as we want and stay any place in the world

5. Check all that you have in your home

- ☐ a phone
- ☐ more than one television
- ☐ a computer
- ☐ more than one phone
- ☐ a car
- ☐ more than one computer
- ☐ a television
- ☐ more than one car

Stress and Learning Survey (FA-E)

6. Check all that has happened to your family because of not having enough money

- ☐ my family has had to move
- ☐ an adult in my family works two jobs
- ☐ we don't have the furniture we need
- ☐ we can't pay our bills
- ☐ we get food stamps/ government checks
- ☐ my family has lost our house
- ☐ an adult in my family moved to find work
- ☐ we were kicked out of our apartment
- ☐ people in my family can't go to college
- ☐ our electricity, heat or phone was shut off
- ☐ we don't have a car
- ☐ we don't have healthy food
- ☐ we can't go to the doctor's
- ☐ we can't do fun things
- ☐ we can't live somewhere safe

7. Now think about the person who is most like a mother to you. If this person is no longer living, write that in the space below and go to question 9.

Write down all the jobs your mother (or the person most like your mother) has (like "janitor" or "lawyer" or "she stays home and takes care of the family" or "she can't work because she is in prison" or "she can't work because she is sick")

8. My mother (or the person most like a mother to me)

- ◯ finished elementary school
- ◯ finished high school or got her GED
- ◯ did some college
- ◯ finished college
- ◯ did some school beyond college
- ◯ finished her schooling beyond college (like medical school or graduate school)
- ◯ I don't know

9. Now think about the person who is most like a father to you. If this person is no longer living, write that in the space below and skip to the next page.

Write down all the jobs your father (or the person most like your father) has (like "janitor" or "lawyer" or "he stays home and takes care of the family" or "he can't work because he is in prison" or "he can't work because he is sick")

Stress and Learning Survey (FA-E)

10. My father (or the person most like a father to me)

- ◯ finished elementary school
- ◯ finished high school or got his GED
- ◯ did some college
- ◯ finished college
- ◯ did some school beyond college
- ◯ finished his schooling beyond college (like medical school or graduate school)
- ◯ I don't know

Stress and Learning Survey (FA-E)

SLS - Different Schools and Neighborhoods

The next questions ask you to think about your school and neighborhood. Answer the questions as honestly as you can.

1. Check all that your school has

- ☐ computers for everyone
- ☐ a beautiful building
- ☐ a lot of disrespect and arguments
- ☐ a gymnasium
- ☐ art supplies
- ☐ a lot of stealing and crime
- ☐ internet
- ☐ principals and staff who work well with kids
- ☐ after school programs
- ☐ a lot of people who are in gangs
- ☐ a building that is falling apart
- ☐ notebooks, pens, pencils, calculators
- ☐ books for everyone
- ☐ a lot of fights and violence
- ☐ a lot of safe places to hang out
- ☐ teachers who know their subjects
- ☐ clubs or activities
- ☐ sports teams
- ☐ teachers for every class
- ☐ sports equipment
- ☐ musical instruments
- ☐ a lot of drinking or using or selling drugs
- ☐ many trees
- ☐ quiet places to study
- ☐ teachers who work well with kids
- ☐ students who don't listen to adults
- ☐ a library
- ☐ metal detectors

2. How long have you been at this school? (like "all my life" or "since 9th grade")

3. Check all that your neighborhood has

- ☐ lots of trees and grass
- ☐ safe places for children to play
- ☐ streets and sidewalks that are clean
- ☐ neighbors who will help you
- ☐ people drinking or using or selling drugs
- ☐ safe places to hang out during the day
- ☐ a club or church where kids can go
- ☐ a liquor store
- ☐ a library
- ☐ buildings that no one is living in
- ☐ lots of graffiti
- ☐ a lot of disrespect and arguments
- ☐ flowers in spring and summer
- ☐ safe places to hang out at night
- ☐ a lot of crime
- ☐ a lot of trash
- ☐ a grocery store
- ☐ neighbors you can trust
- ☐ police who are kind and want to help
- ☐ parks with jungle gyms and sports courts
- ☐ restaurants where families can eat
- ☐ gangs
- ☐ fights and violence
- ☐ a nice place for running or sports
- ☐ lots of businesses and places to get jobs
- ☐ gang lines you can't cross safely
- ☐ a lot of noise

4. How long have you lived in this neighborhood? (like "since I was 2" or "about a year")

*Due to copyright law, full items from the Behavior Rating Inventory of Executive Function, Second Edition (BRIEF; Gioia et al., 2000) Self-Report form could not be included in this manuscript.