

Examining the Relationship Between Interest in Learning and School Engagement for Students

with

Attention-Deficit/Hyperactivity Disorder

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INTEREST AND ENGAGEMENT FOR STUDENTS WITH ADHD

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Abstract

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Attention-Deficit/Hyperactivity Disorder

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Engaging children with ADHD in learning can be challenging. Interest in learning is proposed as a potentially efficacious mechanism through which to target and increase the school engagement of students with ADHD. The present study establishes the relationship between interest in learning and school engagement for students with ADHD and measured the ability of interest in learning to moderate the effect of ADHD on school engagement. The constructs of ADHD, interest in learning, and school engagement are explored and analyzed. Results of the study support the important role of interest in learning for promoting school engagement for all students and the relationship between interest in learning and school engagement for students with ADHD. Implications for practice are discussed with an emphasis on the role of the clinician and educator in triggering and supporting the development of interest in learning. Additional

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research on interventions designed to increase interest in learning and school engagement of children with ADHD is needed to inform best practice for clinicians and educators.

INTEREST AND ENGAGEMENT FOR STUDENTS WITH ADHD

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Chapter 1: Introduction

Approximately seven percent of the student population worldwide is diagnosed with Attention-Deficit/Hyperactivity Disorder (ADHD) (Thomas et al., 2015). This means that, in almost any given classroom, there is at least one student with the disorder. Students diagnosed with Attention-Deficit/Hyperactivity Disorder struggle in school with both behavior and academic outcomes, including academic underachievement, disruptive behavior, and poor peer relationships (Barkley, 2006; DuPaul & Stoner, 2003). In fact, the measured academic achievement of students with ADHD is approximately 0.71 standard deviation units below their typically developing classmates (Frazier, Youngstrom, Glutting, & Watkins, 2007). Students with ADHD are at higher than average risk for dropping out of school and are less likely than their peers to initiate and complete postsecondary education (Barkley, Murphy, & Fischer, 2008).

These behavioral and academic difficulties can be partially attributed to lower rates of academic engagement and variable work productivity (DuPaul & Stoner, 2003) and are nonspecific – they occur across subjects (Junod, DuPaul, Jitendra, Volpe, & Cleary, 2006). Research investigating the connection between academic achievement difficulties and disruptive behavior disorders consistently indicates that ADHD is a key variable accounting for poor academic outcomes (Junod et al., 2006; Hinshaw, 1992, Rapport, Scanlan, & Denney, 1999).

One of the most fruitful and productive targets of interventions for students diagnosed with ADHD to improve their school performance is school engagement (Junod et al., 2006; Greenwood, 1996; Greenwood, Delquadri, & Hall, 1984; Greenwood, Horton, & Utley, 2002; Greenwood, Terry, Marquis, & Walker, 1994). Students diagnosed with ADHD show statistically significant lower rates of academic engagement and higher rates of off-task behavior; specifically, students with ADHD show increased rates of passive off-task behavior (Junod et al.,

2006). Engagement, as used in the classroom context, is the “intensity and emotional quality of children’s involvement in initiating and carrying out learning activities” (Skinner & Belmont, 1993) and is indicative of motivation. The concepts of engagement and motivation are surprisingly difficult to define within psychological literature and the terms are sometimes used interchangeably. The term “motivation” appears to refer to goals, values, and beliefs, while “engagement” refers more to the behavioral displays of effort and persistence (Klauda & Guthrie, 2015).

Academic engagement, when operationally defined to facilitate research, refers to specific classroom behaviors – such as writing, participating, reading, talking about academics, and asking and answering questions (Greenwood et al., 1984) – that are defined in the context to be “on-task.” Students that are engaged during academic instruction experience more opportunities to respond to instruction, which enhances their learning and acquisition of academic skills (DiPerna, Volpe, & Elliott, 2002). In addition, students that are engaged in on-task academic behaviors have increased opportunity to respond to academic instruction, which is correlated with performance on achievement tests (Junod et al., 2006; Fisher et al., 1980; Leach & Dolan, 1985).

Student engagement cannot be separated from the context in which a student learns and exists, including both the child’s background and learning environment practices. According to Renninger and Hidi (2016), it is possible for someone to be engaged but not interested. However, they state that is not possible to have a developing interest and not be engaged. So, interest presupposes engagement in a topic or activity. In supporting engagement and the development of interest, the learning environment (or context) is of critical importance; “both interest and engagement focus on the processes of a person’s engagement with the environment” (Renninger

& Hidi, 2016, p. 77). Therefore, including an examination of the environment in which learning, engagement, and interest development occur (or do not occur) is paramount to the discussion of the relationship between interest and engagement. Changes to the environment and teaching techniques may serve as valuable and impactful grounds for reengaging, capturing interest, and supporting the learning of students with Attention-Deficit/Hyperactivity Disorder.

Statement of the Problem

The widespread and probable struggles of students diagnosed with ADHD underscore a need to engage these students in school in order to improve their behavioral, emotional, and academic relationship with school. ‘Engagement’ refers to a person’s or group’s involvement in a particular context (Renninger & Hidi, 2016) and is productive when accompanied by interest; a person whose interest is developing is a person who is meaningfully engaged (Renninger & Hidi, 2016, p. 75). Both interest and engagement exist in and react to the context (Renninger & Hidi, 2016). This fact emphasizes the important role of the environment in supporting development of engagement and interest. Therefore, integrating a discussion of the environment into the interplay between engagement and interest for students with an ADHD diagnosis may be especially important because, if these students are considerably less engaged in school and if barriers to interest development contribute to this lack of engagement, changes to the environment may prove the most fruitful place for intervention. However, many professionals remain at a loss when it comes to engaging students with ADHD in school and learning. Targeting their engagement by supporting interest development may prove a productive and meaningful avenue to creating lasting engagement in school and learning. Therefore, investigating the relationship between engagement and interest in students with an ADHD

diagnosis is an important first step to understanding the connection and to beginning a discussion of effective interventions.

Chapter 2: Literature Review

Engagement, interest development, and the impact of symptoms of Attention-Deficit/Hyperactivity Disorder are all complex and multifaceted concepts. Researching these complicated and important ideas requires determining through which theoretical lens to study them. In the following sections, diagnosis and effective interventions for ADHD, interest, engagement, and the interplay of these concepts is discussed. Renninger and Hidi's (2016) model of the role of interest and its relationship to engagement provides an entrée into the relationships between interest and engagement and a potential lens through which to understand the struggles of students with ADHD to engage in school.

Attention-Deficit/Hyperactivity Disorder

Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most common reasons for referral of children to mental health services (Cantwell, 1996 in Reiber & McLaughlin, 2004). The prevalence of the diagnosis has implications for clinicians and researchers and emphasizes how important it is for professionals to be familiar with the diagnosis and effective interventions for this disorder. In addition to struggles in the classroom, the implications of the disorder are more widespread. In the long term, ADHD is associated with significant risk of educational failure, interpersonal problems, mental illness, and delinquency (Sonuga-Barke, et al., 2013).

Definition and diagnosis. According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), ADHD is “a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development” (American Psychiatric Association,

2013, p. 59). Behavioral manifestations of Attention-Deficit/Hyperactivity Disorder, from which diagnoses are made, fall into three categories: inattention, hyperactivity, and impulsivity.

Inattention may manifest behaviorally through difficulties maintaining focus, such as wandering off task, lacking persistence, difficulty sustaining focus, or being disorganized. Hyperactivity can be seen through behaviors such as excessive motor activity when it is not appropriate, excessive fidgeting, tapping, or talkativeness. Impulsivity manifests through hasty actions that occur in the moment without forethought and that have high potential for harm to the individual (American Psychiatric Association, 2013). The behaviors must be analyzed in order to determine if they are age appropriate because many of these behaviors are appropriate and even likely at young ages and to be expected to a certain degree within a certain time frame. The behaviors likely indicate a disorder if they are not in line with the developmental trajectory of a child or if they are problematic to the child's academic performance.

The DSM-5 lists specific behaviors that fall into the above categories. Some of these behaviors include: "often fails to give close attention to details," "forgetfulness," "often talks excessively," and "often blurts out an answer" (American Psychiatric Association, 2013, p. 59). In order to diagnose, behaviors and symptoms have to show persistence over six months. They also have to be inconsistent with the child's developmental level. That is, the behavior or symptom should persist in the child after it has lessened or desisted in other children of the same age. For example, a child with ADHD may show an "inability to sustain attention and to persist in responding to tasks or play activities for as long as other children of the same age" (Mash & Barkley, 2007, p. 61). In addition, the symptoms have to be shown to have a direct negative impact on social and academic functioning. Stress in interpersonal relationships, especially

between a child with ADHD and his or her parents, is likely to be “considerably higher than stress levels reported by parents of children in control groups” (Mash & Barkley, 2007, p. 63).

There are genetic, physiological, and environmental risk factors for ADHD (American Psychiatric Association, 2013); indeed, it is “usually a chronic disorder with problems presumably having a biological basis” (Mash & Barkley, 2007, p. 62). This is further exemplified by the statistic that ADHD is more frequently diagnosed in males by approximately a two to one ratio (American Psychiatric Association, 2013).

ADHD diagnostic patterns. When discussing ADHD, it is important to address a trend in diagnosis of ADHD. Interestingly, although Black, Latino, and Native American children are more likely to be referred to special education (e.g. Losen, Hodson, Ee, & Martinez, 2014; Waitoller, Artiles, & Cheney, 2010; Donovan & Cross, 2002; Coutinho & Oswald, 2000) and to receive punishment in school (e.g. Gregory, Skiba, & Noguera, 2010; Krezmien, Leone, & Achilles, 2006; Wallace, Goodkind, Wallace, & Bachman, 2008; McIntosh, Girvan, Horner, & Smolkowski, 2014), Black, Latino, and Native American children are actually less likely to be diagnosed with ADHD than their White peers (Coker et al., 2014; Baglivio, et al., 2017; Moody, 2016). In fact, Black and Latino males are approximately 40 % less likely to be diagnosed with ADHD than White males (Baglivio, et al., 2017). “The under-diagnosis of ADHD in Black children and the over-punishment of Black children reflect a long-standing racial inequality that has been systemically reinforced in America for the last several hundred years” (Moody, 2016). Black and Latino males that *are* diagnosed with ADHD are also less likely than their White peers to receive treatment or use medication to manage their symptoms of ADHD (Baglivio, et al., 2017; Coker, et al., 2016).

The disparity between rates of ADHD diagnosis between Black or Latino children and White children is likely due to both underdiagnosis or undertreatment of Black and Latino children and overdiagnosis or overtreatment of White children (Coker, et al., 2014). This can be partially explained by the fact that Black and Latino children experience multiple disparities in medical and oral health, access to care, and use of services (Flores & Tomany-Kroman, 2008). Non-White children are more likely to be uninsured than White children (Flores & Tomany-Kroman, 2008) and more likely to have more sporadic (and less regular) access to medical care (Flores & Tomany-Kroman, 2008). For example, Flores & Tomany-Kroman (2008) reported that, compared with White children, Native American, Black, and Latino children, were much more likely to have inconsistent medical care. In fact, Native American children had 4 times the odds, Black and Latino children had approximately double the odds, and multiracial children had 1.4 times the odds of lacking regular access to medical care. Native American, Black, and Latino children were also significantly more likely than White children to have problems accessing specialty care, which diagnosis of ADHD may require (Flores & Tomany-Kroman, 2008).

Moody (2016) discusses five other potential explanations for why Black children are underdiagnosed with ADHD. First, he notes that there are racial biases in schools and in the judicial system that consistently disfavor Black children (Rudd, 2014), which lead to Black children receiving harsher and more frequent punishments. Second, he notes a lack of awareness and information about ADHD in the Black community (Ahmann, 2013) and states that Black parents may be less familiar with ADHD and its causes, as well as the behavioral impacts ADHD can have. Third, Moody discusses the impact of a lack of social networks in which ADHD and learning disorders are prevalent and a source of discussion (Horn et al., 2004). He states that, in some ways, ADHD is still very much a “White middle-class issue” (p. 156) and so,

Black parents may believe their children have behavioral issues that can be solved at home with punishment, rather than ADHD. Fourth, Moody (2016) discusses cultural misconceptions of students' behavior among teachers, administrators, and healthcare providers as well as social stigma attached to behavioral disorders (Davidson and Ford 2001). Specifically, Moody notes that Black parents were more likely to view diagnoses for ADHD and other disorders as socially stigmatizing than White parents and to, especially, fear that taking medication to manage symptoms of ADHD would lead to later drug abuse.

Role of the brain. Neuropsychological and psychophysiological research has found substantial evidence of the underlying brain and nervous system origins and corollaries of ADHD. The executive functioning difficulties often associated with ADHD are known to be mediated by the prefrontal cortex and its networks with the basal ganglia and cerebellum (Barkley, 2006). Individuals with damage to these parts of the brain exhibit behaviors similar to the symptoms of ADHD – difficulties sustaining attention, inhibiting behavior, regulating emotion and motivation, and organizing behavior across time (Fuster, 1997; Grattan & Eslinger, 1991). Psychophysiological research has shown that individuals with ADHD have reduced arousal to stimulation, different sensitivity to reinforcement, increased slow-wave or theta activity (which is associated with drowsiness and poor focus), and decreased beta or fast-wave activity (which is associated with decreased concentration and persistence) (Barkley, 2006).

There is also evidence for the role of dopamine and norepinephrine neurotransmitters, which contribute to altered sensitivity to rewards, in explaining symptoms of ADHD. Dysregulated dopaminergic and noradrenergic neurotransmission have been widely implicated in the pathophysiology of ADHD (Del Campo et al., 2011). Dopamine and noradrenaline play a critical role in executive functions based in the prefrontal-cortex, which are often reported to be

suboptimal in ADHD patients (Del Campo et al., 2011). These neurotransmitters, therefore, are a key target for medications to manage symptoms of ADHD (Barkley, 2006). Many ADHD medications are stimulants (dopamine reuptake inhibitors and agonists), which assist in regulating dopamine and decrease symptoms of ADHD such as inattention and poor focus.

Interventions to improve academic functioning of students with ADHD. Clinicians and educators are extremely likely to work with children with ADHD and need to advocate for their needs as well as organize and support intervention efforts. Behavioral interventions can improve academic, behavioral, and emotional functioning for all students and may be especially beneficial for students with ADHD. Students with ADHD may especially struggle to engage in school and so incorporating consideration of their interest development and school engagement may be a productive mechanism through which to improve their engagement.

The most effective interventions for Attention-Deficit/Hyperactivity Disorder (ADHD) can be divided into three categories: medication, psychosocial interventions, and a combination of the two (Pelham et al., 2016; Sibley et al., 2014; Reiber, 2004). Effective psychosocial interventions can be divided further into three categories: behavioral classroom management, behavioral parent training, and behavioral peer interventions. All three social interventions are grounded in behaviorist theory.

Medication. The most common treatment for ADHD has been the prescription of psychostimulant medication (Barkley, 2006; DuPaul & Eckert, 1997). Stimulants (methylphenidate and amphetamines) are often the first treatment prescribed. Indeed, prescription of medication in the treatment of ADHD is extremely prevalent; more than ninety percent of all children diagnosed with ADHD will receive some form of medication as a treatment regimen (Vaughan, Roberts, & Needelman, 2009). Stimulants have been found to

enhance the sustained attention, impulse control, interpersonal behavior, and academic productivity of seventy to eighty percent of children with ADHD (DuPaul & Eckert, 1997). They have been found to diminish task-irrelevant activity (especially in structured settings) and generally decrease disruptive behaviors in social situations (Mash & Barkley, 2007).

However, despite medication's seemingly great success, using it alone is not supported as best practice. First, although it improves behavior for many students, it still leaves at least ten to twenty-five percent struggling (Mash & Barkley, 2007). Second, medications have side effects and children's responses to the medications are variable (Mash & Barkley, 2007). Third, while medications may seem to quickly address problematic behaviors, intervening solely through medication has not been shown to lead to long-term improvements in functioning (DuPaul & Eckert, 1997). Fourth, some impairments associated with ADHD, such as academic impairment, are not adequately addressed by medications alone (Fabiano et al., 2007 in Schultz et al., 2011). Indeed, some behaviors can be treated more effectively through psychosocial interventions (Langberg et al., 2010 in Schultz et al., 2011). The most effective of these psychosocial interventions are applications of behaviorist theory.

Psychosocial. In a behaviorist approach to learning, typically "behavior of an organism" is shaped through a "particular type of consequence called a *reinforcement*" (Skinner, 1954, p. 87). Skinner's theory of operant conditioning describes the shaping that occurs through repeated pairing of an antecedent, a behavior, and a consequence. Behavior, then, is modified through manipulation of consequences. Behaviors that a school professional or parent wants to see repeated or fortified are rewarded through the earning of a rewarding consequence, such as technology privileges. Behaviors that professionals would like to see diminish are followed by punishing consequences. For example, punishing consequences might be the removal of

something the student finds valuable, such as time with friends. The principles of behaviorist theory can be used effectively in classrooms as well as by and with parents and peers to support students with ADHD and to shape their behavior.

Behavioral classroom management, behavioral parent coaching, and behavioral peer interventions are the most effective psychosocial interventions and they are based in behaviorist theory (Barkley, 2006; Schultz et al., 2011). The strategies are effective across the tiers of Response to Intervention (RTI) (Tresco et al., 2010). That is, they can be used at the universal, selected, and targeted levels. For example, there are many suggestions for teacher-implemented interventions that can be applied at the universal level and that scaffold learning for all students – not only students with ADHD. “Classroom behavior management strategies include praising positive behavior, ignoring mild negative behavior, providing specific instructions, creating explicit classroom rules and routines, and providing appropriate reprimands and prompts for behavior” (Schultz et al., 2011). These effective techniques fit well into a system of school-wide positive behavior support (SWPBS), which is a comprehensive system that is behaviorally-based and designed to prevent and change problem behaviors (Sugai, G. & Horner, R., 2006).

Behavioral classroom management. The most effective interventions combine a system of positive reinforcement with a penalty system (Reiber & McLaughlin, 2004). Within a classroom, this takes the form of contingency management procedures, which make explicit and repeatedly employ the relationship between behavioral responses and their consequences (Reiber & McLaughlin, 2004).

Within contingency management, there are many options that are evidence-based (Pelham & Fabiano, 2008). Teacher-implemented reward programs, such as token economies and point systems, make explicit the rewards for certain behaviors and motivate students to

control their behavior in the effort to earn a tangible, desirable reward (Pelham & Fabiano, 2008). A token economy is a version of a simple reward/consequence system: students are presented with tokens that can be lost or earned, paired with teacher praise, and are contingent upon specified desirable and undesirable behaviors (Reiber & McLaughlin, 2004). Effectively and appropriately used time-outs, in which a student is prevented from participating in a desirable activity is another effective implementation of behaviorist theory (Pelham & Fabiano, 2008). Students with ADHD may also benefit from a daily report card system, in which the student is an active participant in creating an individualized behavior plan that rewards positive behaviors and makes explicit target behaviors (Pelham & Fabiano, 2008). In contingency management systems, behaviors are improved through explicit pairings of a behavior and a consequence (either reward or punishment). As students with ADHD often struggle with maintaining attention, the intervals between behavior and consequence should be efficient and predictable; “students with ADHD require frequent and intermittent feedback while working on assignments” (Reiber & McLaughlin, 2004). Students should be aware of what behaviors are desirable and what the consequences of their behavior will be. Classroom behavioral interventions may be especially impactful because ADHD can be interfering with learning in the classroom setting and these interventions target the behaviors in the problematic setting, which decreases the need for the child to generalize skills.

Behavioral parent coaching. The “functioning of adult caregivers is crucially important...because intervention for ADHD is heavily dependent on the adult caregiver” (Mash & Barkley, 2007). Unfortunately, but perhaps not unexpectedly, ADHD is associated with significantly increased parenting stress (Lee et al., 2012). Indeed, parents of children with ADHD report “significantly greater stress in their parental roles and higher levels of depression”

than parents of children without ADHD (Mash & Barley, 2007, p. 71). Patterns of interaction and communication between parents and children with ADHD can be stressful and detrimental to the relationship and to the child's progress.

Behavioral parent coaching uses many of the principles and ideas from behavioral classroom management interventions and applies them at home. It is designed to stop the stressful patterns of parent-child interaction; these interventions reinforce behavioral classroom management and improve parent-child relationships (Lee et al., 2012). Similar to behavioral classroom management interventions, behavioral parent coaching “emphasizes social contingencies in which the parent provides positive reinforcement for the child's prosocial behavior and ignores or punishes negative behavior by nonphysical discipline techniques” (Lee et al., 2012). For example, parent coaching includes making explicit the relationship between behaviors and their consequences, removing desirable privileges as a consequence, and using appropriately set-up time-outs. Coupling these practices outside of school with their use *in* school contextualizes and reinforces the learning for children with ADHD. That is, behavioral interventions' effectiveness can be expanded and built upon when continued outside of the classroom. Behavioral parent coaching not only improves the child's behavior and increases the parent's confidence in their ability to manage child behaviors, it also improves parental perception of children with ADHD (Daley et al., 2014; Lee et al., 2012). This in and of itself can have a positive impact on a child's trajectory.

Behavioral peer interventions. Behavioral peer interventions are important because “peer relations of children with ADHD are typically problematic” (Mash & Barkley, 2007, p. 72). The relations involve more “rejection and fewer close friendships” (p. 72) and children with ADHD

exhibit more “negative behavior” and are less “socially involved” during conversations (Mash & Barkley, 2007).

Behavioral peer interventions that target peer relationships and functioning in recreational settings are more effective than former models of social skills training groups, which met weekly and were clinic-based (Pelham & Fabiano, 2008). These groups usually focused on discussion and role-playing while social skills training is conducted daily and in brief segments (Pelham & Fabiano, 2008). These more effective models also contextualize the knowledge by applying it during coached recreational activities; they are often integrated into teaching sports skills and team membership skills – in addition to traditional social skills (Pelham & Fabiano, 2008). In these effective models, contingency management systems are implemented during coached recreational activities and skills are reinforced by follow-up with home rewards from parents (Pelham & Fabiano, 2008).

In summary, interventions for students with ADHD target both their environments and their neuropsychology in order to improve their ability to focus and learn in school. Implied in these interventions is the tenet that students’ environments can be altered to increase the chance that lessons will be learned by students. If this is so, then it is necessary to examine the components that contribute to engagement in learning in order to better understand how the process of engaging students can function well and how it can break down. One important and understudied contributor to academic engagement is the concept of “interest” and how it develops in students.

Interest in Learning

A question that continues to puzzle educators is how to secure the attention of all students. Students with ADHD are often especially challenging to captivate. Some students

present as uninterested in learning or school; however, many parents and educators state that they've observed students with ADHD to be able to maintain engagement in activities or subjects in which they are interested. What does 'interest' mean, and how can educators harness the power of interest to motivate students to engage in learning? Can interest be developed by external powers or is it a trait that cannot be influenced by external stimuli?

Defining interest. For Renninger and Hidi (2016), interest is both the psychological state of a person while engaging with some type of context and also the cognitive and affective motivational predisposition to reengage with content in that context over time. It therefore encompasses the context and the thoughts, feelings, and behaviors of the individual.

The psychological state of interest is characterized by focused attention, increased cognitive and affective functioning, and persistent effort (Ainley, Hidi & Dagmar, 2002). If the psychological state of interest is generated, or triggered repeatedly, it may support the development of interest as a motivational variable (Renninger & Hidi, 2016). That is, interest can change cognitive and affective processes related to a subject; these changes in processes can lead to changes in behavior. When interest in something develops into a motivational variable, it can be a powerful tool that facilitates learning and growth.

Interest is a continuum and develops through phases. Different environmental supports are needed to trigger and maintain the psychological state of interest depending upon the level, or phase, of interest. For example, what is necessary to awaken an interest may not be the same supports that are needed to sustain it. There are two types of interest: situational and individual. Situational interest is triggered by the environment and involves an affective reason and focused attention (Hidi, 2006). Research shows that situational interest has two phases: in the first phase, interest is triggered, and in the second phase, it is maintained (Harackiewicz, Barron, Tauer,

Carter, & Elliot, 2000; Mitchell, 1993). Individual interest develops over time and is a reasonably durable predisposition to attend to objects, events, and ideas and to reengage with particular content (Hidi, 2006). Individual interest is correlated with positive feelings and increased value and knowledge (Krapp, 1999, 2000; Renninger, 1992, 2000; Renninger, Ewen, & Lasher, 2002). Individual interests energize and motivate thoughts and actions in a goal-directed way (Alexander, 1997).

So, 'interest' can be both a motivational variable and a psychological state that occurs during interactions between persons and contents, and is characterized by increased attention, concentration, and affect (Hidi, 2006). The term "interest" also captures changes in behavior, especially the increased likelihood to reengage with certain content.

Studying interest. How to measure and study interest is a challenge for researchers. Individuals with well-developed interests can be studied by observing their repeated engagement with the content to determine the depth of their engagement and the frequency with which they reengage with a particular content or subject (Renninger & Hidi, 2016). However, in the case of students in school, this is not always possible. Expectations in school are relatively universal and do not often leave room for independent engagement with a subject or content. In addition, as will be discussed, interest is not a binary construct. That is, simply asking someone, "Are you interested in this?" will not sufficiently capture a measurement of interest. In the dataset used for the current study, interest was assessed using a single item, which was parent report. As is made clear in the literature, this is not the ideal way in which to assess interest in learning. Renninger and Hidi (2016) note that interest in learning can be assessed through various data sources, including facial expressions, neuroscientific techniques, ongoing observations, artifact analysis, class-enrollment and re-enrollment data, descriptive information about the context, descriptive

information about participant engagement, and self-report. Similar to school engagement, interest is best captured by a compilation of information collected through varying methods. However, interest is a relatively understudied concept and, as such, the methods through which to collect data on interest and interest development are limited.

The role of attention and curiosity in interest development. Renninger and Hidi (2016) note that the connection between interest and attention is one of the reasons that interest has such a strong correlation with learning. Indeed, this proposition has evidence from the field of neuroscience where scientists have found connections between interest, attention, and the reward mechanism in the brain (Renninger & Hidi, 2016). Panskepp (1998) connected interest with systems in the brain that seek information and objects – a foraging, exploration, investigation, curiosity, interest, and expectancy system. These activities and thoughts are energizing and can increase dopamine production, which is known to be an important neurochemical in the brain and which is connected to rewards and feelings of engagement and excitement (Panskepp, 1998). Further, neuroscience has found that intrinsic motivation, such as interest and curiosity, are strongly linked to the reward circuitry in the brain (Gottlieb, Oudeyer, Lopes, & Baranes, 2013; Kang, Hsu, Krajbich, Loewenstein, McClure, Wang, & Camerer, 2009; Gruber, Gelman, & Ranganath, 2014). The role of curiosity and its role in learning has implications for students who struggle with attending and focusing because their difficulties developing interest may interfere with their ability to learn.

Curiosity is a “positive emotional-motivational system” that is associated with recognition, pursuit, and self-regulation of novel and challenging opportunities (Kashdan, Rose, & Fincham, 2004). While some researchers use the terms ‘curiosity’ and ‘interest’ interchangeably, they should be conceptualized as two distinct constructs with distinct literature

bases (Renninger & Hidi, 2016; Markey & Lowenstein, 2014; Reeve, 1996). For example, Renninger & Hidi (2016) note that, while the psychological and physiological states of curiosity and interest have common elements, they should not be used interchangeably because they are triggered differently, and have different affective markers and durations. Curiosity involves attempts to satiate the desire to fill knowledge gaps through specific types of searches (Hidi & Berndorff, 1998), while interest can have several different triggers (Schank, 1979; Anderson, Shirley, Wilson, & Fielding, 1987; Hidi & Baird, 1986; 1987; Renninger & Bachrach, 2015). When curiosity is satisfied, it is marked by replacing an aversive psychological state with a positive one, while interest can be initiated by either a positive or negative affective state (Renninger & Hidi, 2016; Leslie, 2015). There are important conceptual differences between curiosity and interest. Nevertheless, curiosity plays a role in interest development to the extent that it is possible that when a curiosity is satiated, a triggering of interest may develop (Renninger & Hidi, 2016). Because of this, it is important not to blur the concepts and to see the distinction between them.

Renninger & Hidi's (2016) model of interest development assumes three premises: a) interest is a variable that can be supported to develop and deepen, regardless of a person's age or experience; b) in order for interest to develop, a person must make connections to the content of interest; and c) neuroscientific evidence supports the idea that people are hardwired to find pursuit of interest rewarding. These premises emphasize the connections between the environment and the individual's mechanisms in developing interest; that is, while humans are hardwired to find pursuing an interest rewarding, their environment plays an important role in supporting the development of an interest. Therefore, an individual whose environment is not supportive of a particular interest may not progress through the four phases of interest

development. These premises also have direct implications for interventions for students with ADHD in school.

The phases and model of interest development. Given the utility and necessity of developing interest in students, understanding the processes through which interest develops is useful. Renninger and Hidi (2016) provide an applicable and useful model: the four-phase model of interest development. This model describes the progression of interest and connects interest development to engagement and outcomes. In argument for prioritizing developing interest, Renninger and Hidi (2016) state interest is a powerful agent for learning; “triggering” of interest may produce engagement and the potential for optimal motivation. How do educators trigger a spark of interest in students and how do they feed the spark so it develops into a well-developed individual interest? These are important questions, because a well-developed individual interest empowers the learner, increases engagement, and increases perseverance, problem-solving, and reengagement (Renninger & Hidi, 2016).

Renninger & Hidi, in their 2016 model of interest development, propose that interest, when supported, develops through four phases: *triggered situational interest*, *maintained situational interest*, *emerging individual interest*, and *well-developed individual interest*. In the first phase, triggered situational interest, people’s interest may or may not lead to sustained engagement. Triggers of interest are usually external to an individual, and are maintained by a person’s prior experience, strengths, and needs. Triggers of interest can be facilitated by other people and by the environment (Dewey, 1902, 1913).

The second phase of interest development, *maintained situational interest*, occurs if triggered interest is sustained and the individual is supported in making connections between the interest and their own skills, knowledge, and prior experience (Renninger & Hidi, 2016). When

someone has maintained situational interest, they likely experience a positive affect related to their interest and they continue to develop their knowledge of and value for the content or object of interest. Most support, however, for the continuation of the development of the interest still comes from the environment (i.e. it is not yet internal).

In the third phase, *emerging individual interest*, individuals begin taking initiative by independently reflecting and reengaging, seeking answers, and identifying resources to enhance their knowledge (Renninger & Hidi, 2016). In this phase, an individual begins to “self-generate” interest, to self-regulate, and to prioritize further learning of the object of interest over other things. In this phase, they still require support to develop their skills and understanding.

In the fourth and final phase, *well-developed individual interest*, the learner is able to focus on the content of interest beyond information directly connected to their own questions about it. They have positive feelings and voluntarily reengage. They also have a long-range vision for their own participation and are better able to problem-solve. This final phase is also associated with personal meaning, value, and knowledge (Renninger, 1990).

This model and its four phases emphasize that interest is not static or a trait – it emerges situationally and can be developed or hindered by the environment and individuals (Renninger & Hidi, 2016). This emphasis on the role of the environment provides entrées into both how interest should be studied and how it can be shaped, developed, or truncated by the environment. If interest can be triggered, the question then becomes: does triggering interest contribute to student engagement in school? This question has particular implications for students with ADHD.

Neuroscientific support for differences in interest development in individuals with ADHD. Individuals who experience difficulty with attention or focus (like those with symptoms

of Attention-Deficit/Hyperactivity Disorder) may have a more difficult time progressing through the stages of interest development, in part due to differences in their dopamine circuitry in the brain. Neuropsychological research supports the hypothesis that the systems in the brain that use dopamine, which is involved in forming predictions about future outcomes and optimizing behavior through processing rewards, are different in children with an ADHD diagnosis than they are in children who do not show symptoms of ADHD (Swanson et al., 2007; Schultz et al., 1997; Casey & Durston, 2006; Nigg & Casey, 2005; Casey et al., 2006). The “dopamine hypothesis” posits that individuals with ADHD experience impaired signaling to their cognitive control systems, which may account for some of their difficulties controlling behavior and focusing (Swanson et al., 2007). So, activities that activate the reward mechanism in the brain, such as those that seek to fulfill interest and curiosity (Panskepp, 1998), may be wired differently for children with ADHD (Swanson et al., 2007), and may interrupt the development of interest.

The importance of interest cannot be understated, especially for students with ADHD. Educators must capture the child’s attention, generate interest, and then try to maintain it. Inherent within this challenge is opportunity. It is notable that parents and teachers report that it *is* possible to capture a child with ADHD’s interest. Barkley (2006) notes what many parents of children with ADHD report, that children show interest in and the ability to focus on video games (or other activities of interest) even when they do not exhibit the same skills with schoolwork. Interest can be sparked and it can be maintained through materials and activities. Some children come to school with interests already in place. For example, if a child is interested in sports, teachers and families can use that subject as a path to reading by providing sports columns, or a path to math by providing sports statistics. For some children, the teacher or parent may have to inspire or initiate an interest through exposure to new information. In both cases,

capturing interest requires knowing the child by careful observation and building interest organically by beginning with the child's situated content, rather than imposing an interest. Meeting a child where he or she is situated presents an area in which professionals can improve their skills. That is, it is important to acknowledge that interests change, so educators and professionals must be adaptable, flexible, and prepared with a multitude of possible materials and ideas. Educators must stay current and open to different sources and topics of interest. Interest opens the door and welcomes the student. However, the ultimate goal is school engagement, *real* absorption so that *real* learning occurs. In developing engagement, interest does not work alone. It is necessary for the student to walk through that door and enter with interests intact.

School Engagement

As mentioned previously, interest opens the door to learning and welcomes the student in. For learning to occur, the student must inhabit the room, make it his, act upon it, react to it, have an effect on it and in turn be affected by it. *That* is school engagement and the goal for those seeking to increase the efficacy of education. School engagement is the observable, behavioral manifestation of motivation. It is action, choice, and absorption in academic activities.

The term "school engagement" is used broadly and liberally in research and practice and is difficult to define. At the most basic level, school engagement is the extent to which students take part in educationally effective practices (Axelson & Flick, 2010). This definition encompasses the behavioral manifestations of school engagement and allows school engagement to be, to a certain extent, observable. However, researchers also report other facets of school engagement in addition to behavioral engagement: emotional and cognitive engagement (Fredricks et al., 2014). Emotional and cognitive school engagement, which are defined as

students' affective reactions to school and cognitive investment in learning, are more difficult to assess. The inclusion of emotional, cognitive, and behavioral activities in the definition of school engagement makes school engagement a fruitful and slippery goal.

School engagement is not a static goal: when engaged, the child may in fact self-inspire, self-initiate, so that engagement is not an end *per se*, but part of a cycle of learning. More things matter, so the child is exposed to more opportunities that lead to other tangentially related interests. School engagement is applied energy and attention. But for the student with ADHD, even if interested and motivated, there are still obstacles to engagement. For example, engagement requires focus over time, and for a child with ADHD, outside distractions as common as the noise of classmates chatting can interrupt focus and break engagement, especially if the task is a repetitive drill worksheet or an assignment that does not renew and refresh motivation and interest by moving the child to a different level.

As was the case with interest, school engagement is a challenge that presents opportunities to teachers. Providing materials that appeal to different senses and/or allow multi-modal approaches, for example, can encourage engagement. If a teacher does not assume that a child at school is automatically engaged, then that teacher will be more likely to consider engaging students as an important part of his or her role, rather than just conveying academic information. Administrators can support and encourage teachers by increasing instructional time and requiring less time spent on assessment. Administrators can advocate for curricula that are not standardized, because standardization can result in tasks that are too hard or too easy, too frustrating, boring, or discouraging which lead to disengagement, especially for children with ADHD. Teachers need to feel agency and autonomy, especially if they are crafting lessons inspired by their students' needs and specifically designed to engage their students. Teachers

know their students come to the classroom from a world outside where they are barraged by entertainments – such as games on screens – designed to captivate them; it's hard to compete with entertainment technology purposely designed to catch the child's interest and pull him in but not intended to teach. In the classroom, teachers should feel that they are taking advantage of educational technology, as well as taking advantage of the fact that they know their students better than any technology can. Teachers can connect cognitively and emotionally, while being more reactive to the environment in which they're asking the child to engage.

School engagement in action. Students can be engaged in many ways. These ways can be grouped into three categories: behavioral, cognitive, and emotional (Fredricks et al. 2004). Behaviorally engaged students meet behavioral expectations and do not tend to be disruptive. Students who are cognitively engaged are invested in their learning and increase effort when task difficulty increases. Emotionally engaged students experience positive emotions in relation to learning, such as enjoyment, or a sense of meaning (Fredricks et al. 2004). Fredricks, Blumenfeld, & Paris (2004) proposed a 'Model of Engagement' that includes behavioral, cognitive and emotional measures. In addition, Schaufeli, Salanova, González-romá, & Bakker (2002) in their 'Model of Engagement,' state that engagement as a construct is "changeable and malleable."

Risk factors to school engagement. For all children, there are many demographic and other factors that are correlated with increased risk for disengagement, that is, factors that are associated with decreased school engagement. At the individual level, highly correlated factors include: poor self-esteem (Régner & Loose, 2006; Schmader et al., 2001; Lamb et al., 2004); low intelligence (Moss & Dannemiller, 2001; Lamb et al., 2004); psychological and psychiatric problems (Ogilvie et al., 2018; Reid et al., 2004); physical ill health and disability (McCoy &

Banks, 2012; Law, Petrenchik, King, & Hurley, 2007); poor academic performance (Green et al., 2012; Skinner, Kindermann, Connell, & Wellborn, 2009); repeating a grade (Pierson, Connell, & Levin, 1992); specific learning problems and disabilities (Friedman, Cancelli, & Yoshida, 1988); behavioral problems (Abikoff et al., 2002; Greenwood et al., 2002; Wehby, Symons, & Shores, 1995); and frequent or chronic school nonattendance (Finn, Rock, & Murphy, 1997). At the family level, highly correlated factors include: large family size (Perez et al., 2009; Grissmer, Kirby, Berends, & Williamson, 1994; Luthar, 1991; Sameroff, Seifer, Baldwin, & Baldwin, 1993; Seifer, Sameroff, Baldwin, & Baldwin, 1992); family dysfunction (conflict and abuse) (Stanard et al., 2010); family break up and formation of new families (Anthony & Amato, 2014); high family mobility (Gruman et al., 2008); separation from family (Suarez-Orozco et al., 2010); parental illness; (Chen & Fish, 2013), and low Socioeconomic Status (SES) (Finn, 1989; Finn & Cox, 1992; Lee & Smith, 1993, 1994). Highly correlated social factors include: gender (being male) (Kessels et al., 2014; Driessen, & Van Langen, 2013); non-Anglo race or ethnicity (Johnson et al., 2001; Steinberg et al., 1996); and neighborhood and regional characteristics (Byrd & Chavous, 2009). For the child with ADHD, these risk factors often coexist with ADHD. But even when they do not, ADHD remains a tremendous – perhaps the greatest – risk factor correlated with failing to reach engagement and stay engaged.

Impact of underdiagnosis of ADHD on school engagement and interest. What is the impact of underdiagnosis of Black and Latino children on their school engagement and interest? First, there is evidence that students in Special Education have lower school engagement than their peers in regular education classrooms (McCoy & Banks, 2012; Nicholls, Mckenzie, & Shufro, 1994). This can be attributed to a variety of factors, including greater risk of negative teacher-student relations (Murray & Greenberg, 2001; McCoy & Banks, 2012), less social

acceptance by peers (Larrivee & Horne 1991; Koster et al., 2007) and increased social rejection and bullying (Asher and Coie 1990; Pijl et al. 2010; Ollendick et al. 1992), and less connection to and perceived meaningfulness of assignments (Nicholls, Mckenzie, & Shufro, 1994). Since Black and Latino children are disproportionately referred to Special Education (e.g. Losen, Hodson, Ee, & Martinez, 2014; Waitoller, Artiles, & Cheney, 2010; Donovan & Cross, 2002; Coutinho & Oswald, 2000), it can be hypothesized that overall rates of school engagement of Black and Latino students may appear lower than school engagement of White children due to their disproportionate placement in these Special Education settings. However, it will be important keep in mind the confounding variable of classroom placement when examining rates of school engagement. Second, there is also evidence that Black and Latino students who are more likely to drop out of school, which is one (but by no means the only) measure of school engagement (Holt, Bry, & Johnson, 2008; Kaufman, Alt, & Chapman, 2004; Chapman et al., 2011). Differences in school engagement between students who are members of ethnic minorities and White students can be partially explained by differences in academic motivation. A review of research on motivation to engage in academic activities in ethnic minority students found no consistent trend for which students are “more” motivated (Isik et al., 2018). Studies have found evidence of higher academic motivation among ethnic minority students (Choi, Bempechat, & Ginsburg, 1994; Gillen-O’Neel, Ruble, & Fuligni, 2011; Goodenow & Grady, 1993; McInerney, 2008; Sentell, 2012; Strage, 1999; Van Houtte & Stevens, 2010; Young, Johnson, Hawthorne, & Pugh, 2011); however, other studies (and some of the same studies) found evidence of higher academic motivation among White students (Hill et al., 2004; Hill & Wang, 2015; Sentell, 2012; Strage, 1999; Van Houtte & Stevens, 2010; Young et al., 2011). Isik

et al. (2018) note that this discrepancy in findings may be due to differing definitions and measures of motivation.

Despite no consistent evidence of a specific trend in degree of school engagement, the factors identified by the research that facilitate ethnic minority student motivation to engage are consistent with factors that facilitate school engagement for *all* students. Some these factors include well-being (good mental and physical health), self-efficacy, confidence, effort, positive beliefs and values about education, positive emotions related to learning, and study skills (Isik et al., 2018). Some factors that are more unique to students from ethnic minorities include acculturation (Ramos & Sanchez, 1995), Anglo (majority) orientation (Flores et al., 2008), minority acculturation (Lew et al., 1998), ethnic (identity) centrality (Perreira et al., 2010), racial/ethnic identity (Shin, 2011), ethnic pride (Warner, 2008), othergroup orientation (Guzmán et al., 2005), ethnic affirmation and belonging (Perreira et al., 2010), and Africentric values (Shin, 2011).

The specific impact of underdiagnosis of ADHD for Black and Latino students on school engagement and interest does not appear to have been previously studied. However, it is hypothesized that experiencing symptoms of ADHD without receiving a diagnosis and the increased support a diagnosis should bring would decrease school engagement and interest in learning. Interventions designed to address ADHD symptoms (both behavioral and medication) should also increase student engagement and interest in learning and so, it is hypothesized, that failing to be diagnosed (and therefore receive specific targeted treatment) would negatively impact school engagement and interest in learning. The current study seeks to determine the relationship between race, ADHD diagnosis status, interest in learning, and school engagement. Specifically, it seeks to determine, in the current dataset, if Black students are more or less likely

to be diagnosed with ADHD than their non-Black peers, if interest in learning impacts the relationship between diagnosis status and school engagement.

Interplay of Interest, School Engagement, and the Impact of ADHD

As stated above, neurological evidence (e.g. Fuster, 1997; Grattan & Eslinger, 1991; Del Campo et al., 2011; Barkley, 2006) indicates that, for a child diagnosed with ADHD, the reward circuitry in their brain may work differently than it does for children without symptoms of ADHD. ADHD impacts the interplay of interest, and school engagement. The three factors are intertwined and can therefore influence one another. For example, interest can be refreshed and re-inspired by school engagement when a child is able to move deeper and advance to a different level of a task. However, because the three factors are intertwined, the disruption of one can negatively impact the other two: school engagement can be jeopardized or lost when interest flags due to overexposure, or when a task becomes boring or too easy.

How does ADHD potentially interrupt the development of interest and school engagement? The most emphasized symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD) include inattention and/or hyperactivity that impair cognitive, behavioral, and interpersonal functioning (Volkow et al., 2016; Ferguson, 2000). There is also evidence that for individuals with ADHD, there is dysfunction in reward and motivation as well which contributes to their other symptoms and academic functioning (Haenliën & Caul, 1987; Johansen et al., 2009; Volkow et al., 2016). Previous studies have also examined the relationship between ADHD and academic engagement. However, there does not appear to be research specific to the development of interest in individuals with ADHD; it is hypothesized that symptoms of ADHD would interrupt the process of interest development. For individuals with ADHD, it is hypothesized that, due to difficulties sustaining attention and difficulties taking advantage of

opportunities to pique and develop interest, they may struggle to develop interest in the same way that their peers without ADHD do. This struggle to ignite and develop interest may be one contributing factor to their academic performance struggles and to their struggles controlling their behavior. If the neurological reward circuitry works differently for individuals with ADHD, then it is likely that they may struggle to sustain attention long enough to progress through the stages of interest development. In many cases, educators and the learning environment are not well-aligned with the needs of students with ADHD and so it may be that activities or subjects that pique and sustain the interest of students without ADHD are not sufficient or tailored in such a way as to have the same effect for the students with ADHD.

It is hypothesized that since school engagement and attention play a role in developing interest (Renninger & Hidi, 2016), individuals with ADHD may struggle to develop interest. Indeed, the neurological evidence that the reward circuitry works differently in individuals with ADHD means that their ability to sustain attention and control impulses is impeded (Barkley, 2006). Interest is an intrinsic reward and, as such, is strongly linked to this reward circuitry (Gottlieb, Oudeyer, Lopes, & Baranes, 2013; Kang, Hsu, Krajbich, Loewenstein, McClure, Wang, & Camerer, 2009; Gruber, Gelman, & Ranganath, 2014). The struggles with interest development that individuals with ADHD experience due to their differences and interruptions in the functioning of this circuitry, may impact their motivation for engagement in learning. The connections between interest development and school engagement in individuals with ADHD does not appear, at the time of this review, to have been explicitly examined by researchers.

Purpose of the Study

Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most common diagnoses of school-aged children, with approximately seven percent of the student population carrying the

diagnosis (Thomas et al., 2015). Research shows that students diagnosed with ADHD can experience widespread academic and behavioral challenges in school and in their post-school life (Barkley, 2006; DuPaul & Stoner, 2003; Frazier et al., 2007; Barkley, Murphy, & Fischer, 2008; Junod et al., 2006; Hinshaw, 1992; Rapport, Scanlan, & Denney, 1999). Given the importance of increasing these students' engagement in school (Junod et al., 2006; Greenwood, 1996; Greenwood, Delquadri, & Hall, 1984; Greenwood, Horton, & Utley, 2002; Greenwood, Terry, Marquis, & Walker, 1994), the standard question of how to increase *all* students' engagement becomes more complicated and even more relevant. Since the concept of increasing engagement is so broad, and given the school engagement challenges of students with ADHD, it may be fruitful to focus on interest development, which (like school engagement) can be targeted through environmental changes and supports (Renninger & Hidi, 2016).

The focus of the current study is to examine the relationship between school engagement, interest in learning, and an ADHD diagnosis. To the best of this researcher's knowledge, the role of interest in school engagement for students with an ADHD diagnosis has not been examined. It is proposed that, students with an ADHD diagnosis will exhibit less perceived interest and engagement in learning and school than students without ADHD. Therefore, the current research attempts to examine the following questions:

Research question #1. How much do demographic characteristics explain school engagement? Which of the characteristics uniquely predict school engagement? As previous research has demonstrated, demographic factors such as sex (Kessels et al., 2014; Driessen, & Van Langen, 2013), race and household language (Johnson et al., 2001; Steinberg et al., 1996), are correlated with school engagement. In addition, demographic variables such as learning disabilities or developmental delay (Friedman, Cancelli, & Yoshida, 1988; Moss & Dannemiller,

2001; Lamb et al., 2004), lower socio-economic status (Finn, 1989; Finn & Cox, 1992; Lee & Smith, 1993, 1994), and safety of neighborhood (Byrd & Chavous, 2009) are negatively correlated with school engagement. It is hypothesized that these demographic will be correlated with the measures of school engagement.

Research question #2. Do diagnoses correlated with academic outcomes (developmental delay, Autism Spectrum Disorder, intellectual disability) predict school engagement? There is some research that suggests students with developmental delay, Autism Spectrum Disorder (ASD), and intellectual disabilities have, in general, lower levels of school engagement than non-diagnosed peers (Kemp & Carter, 2006; Hume & Reynold, 2010). However, the research comparing individuals with these disorders to neuro-typical peers is limited and suffers from a lack of a clear definition of school engagement. It is hypothesized that retaining a diagnosis of developmental delay, Autism Spectrum Disorder, or intellectual disability will be negatively related to the school engagement variables.

Research question #3. Does ADHD status predict school engagement above and beyond other demographic characteristics (grade, sex, race, socio-economic status, and safety of neighborhood) and other diagnoses (developmental delay, Autism Spectrum Disorder, intellectual disability)? It is hypothesized that retaining a diagnosis of ADHD will be a strong predictor of school engagement (Junod et al., 2006; DuPaul & Stoner, 2003; DuPaul et al., 2008; Purdie et al., 2002; Martin, 2012), possibly more so than known demographic and risk factors.

Research question #4. Does interest in learning predict school engagement after controlling for demographic and diagnoses variables and ADHD status? Based on previous research, it is hypothesized that interest in learning will be a predictor of school engagement

(Fredricks, Blumenfield, & Paris, 2004; Epstein & McPartland, 1976; Skinner & Belmont, 1993) after controlling for demographic characteristics and risk factors.

Research question #5. Controlling for demographic and diagnoses variables, *does* interest in learning moderate the effect of ADHD status on school engagement? In other words, does interest in learning serve as a protective factor of school engagement for children with ADHD? It is hypothesized that interest in learning will significantly moderate the effect of ADHD on school engagement. Due to the relationship between ADHD and school engagement (Junod et al., 2006); DuPaul & Stoner, 2003; DuPaul et al., 2008; Purdie et al., 2002; Martin, 2012) and between school engagement and interest (Fredricks, Blumenfield, & Paris, 2004; Epstein & McPartland, 1976; Skinner & Belmont, 1993), it is likely that children with an ADHD diagnosis and a high level of interest, will be more engaged than students without a high level of interest in learning. Although there is little previous research on the relationship between interest and school engagement, it is hypothesized that since school engagement, and attention play a role in developing interest (Renninger & Hidi, 2016), individuals with ADHD may have lower rates of interest overall but that for those with a high level of interest in learning, this interest in learning will moderate the effect of an ADHD diagnosis on school engagement. Previous research on the positive correlation between interest in learning and school engagement (Fredricks, Blumenfield, & Paris, 2004; Epstein & McPartland, 1976; Skinner & Belmont, 1993), suggests that interest in learning should serve as a protective factor for school engagement for all students, including those with an ADHD diagnosis.

Research question #6. Controlling for demographic and diagnoses risk factors, does identifying as Black moderate the effect of ADHD and interest in learning on the school engagement variables? First, due to the discussed trend of underdiagnosis of ADHD in Black

children (Coker et al., 2014; Baglivio, et al., 2017; Moody, 2016), it is predicted that race will moderate the effect of ADHD diagnosis status on school engagement. Second, although there is a dearth of research on interest in learning and race, it is predicted that race will not moderate the effect of interest in learning on school engagement. Finally, it is predicted that the interaction of race and interest in learning will moderate the effect of ADHD diagnosis status on school engagement.

Chapter 3: Methods

Study Overview

The present study was a secondary data analysis using a portion of the data collected in the 2011-2012 National Survey of Children's Health, which is a public dataset. The initial study was a phone survey with parents of children ages 0 to 17 years. The following section describes the original study and participants, along with the sample, measures, and procedures used for this secondary analysis. Finally, this section will also include a description of the analyses.

Participants

This study includes children from across the United States and the District of Columbia. A random-digit-dial sample of households with children under age 18 years, comprising both landline and cell- phone numbers, was constructed for each of the 50 states and District of Columbia. Households were screened for children who lived or stayed in the household. If one or more children were identified, the interview was conducted for one randomly selected child. Respondents were parents or guardians familiar with the child's health and health care (Bramlett et al., 2017).

For the purposes of this study, the data was triaged by the researcher to only include respondents who provided answers to the desired questionnaire items for a total of $N = 49,796$ parents responding to questions about one of their children.

This study included a diverse demographic sampling. According to the Data Resource Center for Child and Adolescent Health website, the respondent population was 23.7 percent Hispanic, 52.5 percent White non-Hispanic, 13.5 percent Black non-Hispanic, and 10.3 percent Other non-Hispanic (www.childhealthdata.org). 51.2 percent of the sampled population was male and 48.8 percent was female.

Respondents were parents of children under age 18 years, whose phone number was called using a random-digit-dial sample of households. Respondents were asked questions from the 2011-2012 National Survey of Children's Health, which was estimated to take about 27 minutes per respondent. Data was collected between February 28, 2011 and June 25, 2012 (CDC, National Center for Health Statistics, State and Local Area Integrated Telephone Survey).

Procedures

Data collection, which occurred in 2011-2012, resulted in a total of 98,019 interviews, which indicated 190,846 age eligible children living in the households. Interviews were completed for 95,689 of these sampled children and partially completed for 2,330. Interviews were considered partially complete if the interview was completed through the end of Section 6 (for households with children under age 6 years) or Section 7 (for households with children aged 6–17 years). The researchers' target was 1,800 completed interviews per U.S. state. The target number of completed interviews was exceeded in every state and D.C. (Bramlett et al., 2017).

The questionnaire was read to respondents over the phone by individuals working for the data collection contractor National Opinion Research Center (NORC) and its subcontractor. Interviewer training was conducted by NORC staff at production centers located in Chicago, Illinois, and Las Vegas, Nevada. The use of multiple sites ensured continuous coverage in all time zones across the United States (Bramlett et al., 2017). When contacting a household, interviewers asked to speak to a parent or guardian living in the household who knew about the health and health care of the child(ren) in the household. The respondent's relationship to the child was collected in two questions. The respondent was the parent of the child (mother or father, of any type) for 93.1% of sampled children (Bramlett et al., 2017). Once an informed respondent was on the phone, the respondent was informed of his or her rights as a survey

participant. Verbal consent for study participation was then obtained and documented. The consent script informed respondents of the voluntary nature of the survey, assured them that their responses would be kept confidential, and informed them that there was no penalty for not answering questions. Respondents were also told that the interview might be recorded and monitored by a supervisor for quality purposes. The National Survey of Children's Health (NCHS) Research Ethics Review Board and the NORC Institutional Review Board approved all study procedures and modifications. Participants were provided assurance of confidentiality and told that participation in surveys conducted by NCHS is voluntary, and all individually identifiable information collected is confidential (Bramlett et al., 2017).

Measures

Some items from the 2011-2012 National Survey of Children's Health (NSCH) were selected for the current study. The original questionnaire was designed to collect and assess broad data on the physical and emotional health of children ages 0-17 years of age. Special emphasis was placed on factors that relate to the well-being of children, including medical, homes, family interactions, parental health, school and after-school experiences, and safe neighborhoods. A subset of the panel assembled questions to several domains. Questionnaire items identified for inclusion were then assessed through reviews by outside experts and selected members of the community of potential data users. Upon final approval by the Maternal and Child Health Bureau, these questions were pretested in 2002 and fielded in 2003 as the first National Survey of Children's Health (Bramlett et al., 2017). Of note to the current research, the NSCH included "flourishing items," which were included to provide information on childhood well-being and resilience. These "flourishing items" include the following questions: (1) child shows interest and curiosity in learning new things, (2) child stays calm and in control when

faced with a challenge, (3) child finishes tasks and follows through with plans. In the original study, these questions were loaded onto a “flourishing” item in the data. However, due to the current research focus on the relationship between interest in learning and school engagement, only the sub-question that pertains to interest in learning (child shows interest and curiosity in learning new things) was included in the analyses.

The NSCH survey was developed through a panel consisting of selected state and federal maternal and child health program directors, representatives of family organizations, child health services researchers, and survey design experts who met to discuss content domains. The original survey included numerous demographic variables and risk factors. The specific demographic, risk factor variables, and measures of topics of interest in learning follow.

Demographic variables and risk factors. For the purpose of this study the following content areas were representative of the demographic variables: grade (7th grade or above vs. below 7th grade), sex (male vs. female), race (Black vs. not Black), ethnicity (Hispanic vs. not Hispanic), socioeconomic status (Free and Reduced Lunch eligible vs. not eligible), and perceived safety of neighborhood (mostly or always feel safe vs. never, rarely, sometimes feel safe). Grade was collected through a single item and binary coded as seventh grade or above vs. below seventh grade. Sex was collected through a single question and both dummy and effect coded in the data. Similarly, race was binary coded to be Black vs. all other races. Ethnicity received a binary code of: Hispanic vs. non-Hispanic. Socioeconomic status was captured through the binary of meeting eligibility requirements for Free and Reduced Lunch vs. not eligible. The cut-off was determined using Federal requirements, where families at 185% or higher the poverty level receiving Free and Reduced Lunch eligibility (Child Nutrition Programs--Income Eligibility Guidelines, 2011). Safety of neighborhood was assessed through a

single item and coded as binary with those reporting they always or mostly felt safe in their neighborhood vs. those who reported they never, rarely, or sometimes feel safe in their neighborhood. The binary division between the original categories was determined through examination of the skew of the distribution. Due to the sample's skew towards high feelings of safety (that is, there was a large proportion of the sample that reported their neighborhood 'always' or 'usually' felt safe), the division was made to include 'never,' 'rarely,' or 'sometimes' in one category and 'always' and 'usually' in the other category.

In addition to demographic information, disorders that may impact school engagement were included. These variables included: presence of developmental delay, intellectual disability, or Autism Spectrum Disorder (ASD). Presence of developmental delay was collected through the following question: does child have current DD diagnosis? It was originally coded as a binary where 0 = No and 1 = Yes and then dummy and effect coded for the current research analyses. Similarly, presence of intellectual disability was collected through the following question: does child have current ID diagnosis? It was coded as a binary in the same way as developmental delay. Finally, presence of Autism Spectrum Disorder diagnosis was collected through the following question: does child have current ASD diagnosis? It was coded as a binary in the same way as the previous disorders.

Attention-Deficit/Hyperactivity Disorder. The 2011-2012 National Survey of Children's Health captured a child's ADHD status through two questions, one of which will be used in the current study. The original study assessed ADHD status through the following questions: (1) "Has a doctor or other health care provider ever told you that [sampled child] had Attention Deficit Disorder or Attention-Deficit/Hyperactivity Disorder, that is, ADD or ADHD?" (2) "Does [sampled child] currently have ADHD?" The questions used to assess ADHD status

were developed to determine whether the sampled child had acute or chronic physical, mental, behavioral, learning, or developmental conditions and, when present, the impact of these conditions upon the child's life (Blumberg et al., 2007). The question of current ADHD status, which was also binary, (Does [sampled child] currently have ADHD?) was chosen for the current research due to the researcher's focus on current functioning and the relationship between current diagnosis status and current school engagement.

Interest in learning. The 2011-2012 NSCH measured the participants' interest in learning through one question, which was a sub-question of the survey's "flourishing items," which were included to capture information on the children's well-being and resilience (2011/12 NSCH: Child Health Indicator and Subgroups SPSS Codebook). For the current study, the following question was used to capture interest in learning: "Child shows interest and curiosity in learning new things." Item responses were provided using a Likert-scale format, where 1 = never; 2 = rarely; 3 = sometimes; 4 = usually; and 5 = always. For the purposes of analyses, this question was entered into the dataset as a binary with those stating their child usually (4) or always (5) shows interest in one category and those stating their child never (1), rarely (2), or sometimes (3) shows interest in learning as the other binary category. This division was made in between the same categories as was used to make the division for the neighborhood safety binary categories. In the case of interest in learning, the sample was, again, skewed towards the responses indicating high levels of interest. In order to be consistent with previous binary divisions and due to the skew, the binary categories were created to include the same answer choices as were used for the neighborhood safety question.

School engagement. The 2011-2012 NSCH measured the participants' school engagement in school through a "school engagement" composite indicator, which was

constructed of two sub-questions: (1) “Cares about doing well in school;” and (2) “Does all required homework.” Item responses were provided using a Likert-scale format, where 1 = never; 2 = rarely; 3 = sometimes; 4 = usually; and 5 = always. The school engagement indicator falls within the survey’s “flourishing items.”

The first question (cares about doing well in school) appears to measure the student’s motivation to engage in school and the second question (does all required homework) appears to measure a specific behavior related to engagement. As a first step, these two questions were analyzed for their correlation. The ‘cares about doing well in school’ and ‘homework’ variables are very strongly correlated with one another ($p < .001$). However, as school engagement is the outcome variable, in order to gain a more robust depiction, the two sub-questions were analyzed separately. For both questions, answers were divided into binary categories in order to facilitate the logistic regression. As for the neighborhood safety and interest items, the responses were divided into two categories based on the skew of the distribution and a goal to be consistent across items. Therefore, the answers were divided to include ‘never,’ ‘rarely,’ and ‘sometimes’ into one category and ‘always’ and ‘usually’ into the other category.

Data Analyses Plan

Data were analyzed in SPSS using multiple logistic regression with sequential predictor entry, with the same model used to predict each of the engagement indicators (recall that these were dichotomized versions of the original survey questions: *Cares about Doing Well in School*, and *Does all Required Homework*). Analytic survey weights were applied to all analyses using the method described in Stapleton & Thomas, 2008, p. 40). Survey weights were applied because, since the dataset used is publicly available, it does not include identifier variables. Therefore, in order to control for nonindependence and to ensure that the data was representative of

the population, survey weights were applied. Sequential predictor entry specifically allows for testing incremental improvement in model fit as predictor(s) are added to the model.

Specifically, each block of predictors corresponded to each research question, in order. For ease of results interpretation all predictors were effect coded such that the first category was coded +1 and the remaining category -1). Block 1 included grade (7-12 vs. younger); gender (male vs. female); free and reduced lunch status (FRL; yes vs. no); perceived neighborhood safety (yes safe vs. not); race (Black vs. else); and ethnicity (Hispanic vs. else). Block 2 predictors included diagnosis of developmental delay (DD; yes vs. no), autism spectrum disorder (ASD; yes vs. no), and intellectual disability (ID; yes vs. no). Block 3 added in diagnosis of attention deficit and hyperactivity disorder (ADHD; yes vs. no); Block 4 included interest in learning new ideas (mostly vs. else). Block 5 tested the 2-way interaction between ADHD and interest in learning new ideas, and Block 6 tested all 2-way interactions between race (Black vs. else) and ADHD and interest, as well as the 3-way interaction. The final model with all predictors was as follows:

$$\begin{aligned} \text{Logit(Engagement)} &= b_0 + b_1*\text{Grade7-12} + b_2*\text{Male} + b_3*\text{FRL} + b_4*\text{SafeNeighborhood} \\ &+ b_5*\text{Race:Black} + b_6*\text{Ethnicity:Hispanic} \\ &+ b_7*\text{DD} + b_8*\text{ASD} + b_9*\text{ID} \\ &+ b_{10}*\text{ADHD} + b_{11}*\text{Interest} \\ &+ b_{12}*\text{ADHD*Interest} + b_{13}*\text{Race*ADHD} + b_{14}*\text{Race*Interest} \\ &+ b_{15}*\text{Race*ADHD*Interest}. \end{aligned}$$

In the model above, the log-odds (logits) of achieving a (relatively) high level of school engagement is equal to the conditional mean (b_0), plus the unique effects of demographic variables ($b_1 - b_6$), comorbid diagnoses ($b_7 - b_9$), and ADHD status (b_{10}), interest in learning

new things (b_{11}), and 2- and 3-way interactions among ADHD status, interest in learning new things, and race ($b_{12} - b_{15}$).

Research Question 1. The first research question aimed to examine the associations between demographic characteristics the school engagement variables. This included the questions designed to assess school engagement (as the dependent variable) as well as 6 demographic variables (i.e., grade, sex, race, ethnicity, Free and Reduced Lunch eligibility status, and perceived safety of the neighborhood). Pearson's r correlations were conducted to examine the associations across variables. The demographic variables were entered into the Sequential Logistic Regression model in Block 1.

Research Question 2. The second research question aimed to examine the associations between disorders that may impact school engagement and the school engagement variables. This included the questions designed to assess school engagement (as the dependent variable) as well as 3 diagnosis variables (i.e., developmental delay, Autism Spectrum Disorder, and intellectual delay). Pearson's r correlations were conducted to examine the associations across variables. The diagnoses variables were entered into the Sequential Logistic Regression model in Block 2.

Research Question 3. The third research question sought to examine the unique contribution of ADHD diagnostic status on school engagement while controlling for demographic and comorbid diagnoses variables. Pearson's r correlations were conducted to examine the associations across variables. The ADHD diagnosis variable was entered into the Sequential Logistic Regression model in Block 3.

Research Question 4. The fourth research question sought to examine the unique contribution of interest in learning on school engagement while controlling for demographic,

comorbid diagnoses, and ADHD variables. Pearson's r correlations were conducted to examine the associations across variables. The interest in learning variable was entered into the Sequential Logistic Regression model in Block 4.

Research Question 5. The fourth research question examined if interest in learning moderates the relationship of ADHD status on school engagement, while controlling for demographic and diagnoses factor variables. A fifth Block was added to the model of the sequential logistic regression model to investigate the relationship between ADHD status and interest in learning on school engagement while controlling for demographic and diagnoses factor variables.

Research Question 6. The sixth research question examined if there was an interaction between being Black and having an ADHD diagnosis, between being Black and being interested in learning, and between being Black, having an ADHD diagnosis, and being interested in learning and whether these interactions had a relationship with school engagement. A sixth Block was added to the model of the sequential logistic regression model to investigate the relationship between being Black, ADHD diagnosis status, interest in learning on school engagement. The two two-way interactions (Black*ADHD and Black*interest) were entered into Block 6 along with the three-way interaction (Black*ADHD*interest).

Chapter 4: Results

Descriptives and Correlations

Weighted means, standard deviations, and zero-order correlations among all variables are given in Table 2. Due to the large sample size, all correlations were significant at an absolute value of 0.02 or greater.

As can be seen, the majority of children were relatively highly engaged in school and were interested in learning new things (over 85% of the sample). (Not surprisingly, both engagement items were modestly correlated with each other, $r = 0.48$, $p < 0.001$.) The sample was fairly equally dispersed in terms of grade level (grades 7-12 vs. 1-6) and gender (male vs. female), and the majority of parents perceived living in a safe neighborhood. Approximately a third of children received free-or-reduced lunch (FRL), and less than 20% were identified as Black or Hispanic. Diagnoses of developmental delay (DD), autism spectrum disorder (ASD) and intellectual disorder (ID) were rare (1% to 4%), as was diagnosis of attention deficit and hyperactivity disorder (11%).

Given the large sample size, nearly all of the variables were correlated with each other. The relatively larger correlations among the two outcomes and predictors included ADHD (negatively correlated with engagement) and interest in learning new things (positively correlated with engagement). Among the predictors themselves, the strongest relationships can be observed among comorbid diagnoses (all positively related; in other words, having one diagnoses indicates higher risk for another).

Regression Models

Cares about Doing Well in School. As shown in Table 3a, Block 1 predictors, which included demographic variables (grade, gender, FRL, safe neighborhood, race, and ethnicity),

reliably distinguished children whose parents reported that they cared about doing well in school (our first indicator of school engagement) from those who did not, accounting for approximately 8% of the variance in the outcome as shown in the Nagelgerke Pseudo- R^2 value (Research Question 1).

Block 2 (Table 3a), which tested Research Question 2, included comorbid disorders that have been shown previously to impact school engagement (DD, ASD, and ID), was found to significantly improve the fit of the model to the data above and beyond the demographic characteristics, $\chi^2_{\text{change}} p < 0.001$, accounting for approximately 2% more variance in the engagement outcome.

Block 3 (Table 3b), which tested Research Question 3 (effect of ADHD status on engagement), further improved the fit of the model to the data, $\chi^2_{\text{change}} p < 0.001$, explaining an additional 4% variance (approximately).

Block 4 (Table 3b), which tested the effect of interest in learning new things (above and beyond demographic and developmental disorder predictors; Research Question 4), also improved the fit of the model to the data, $\chi^2_{\text{change}} p < 0.001$, explaining 10% more of the variance (approximately).

Block 5 (Table 3c), which included the 2-way interaction among ADHD and interest in learning new things, only slightly improved the fit of the model to the data, $\chi^2_{\text{change}} p < 0.001$ (<1% additional variance explained; Research Question 5). Importantly, the interaction was significant and its meaning will be explored further shortly.

Finally, Block 6 (Table 3c), which tested potential disparities for Black children with respect to the effect of ADHD and interest in learning on school engagement (Research Question 6) was also significant, explaining included interactions between race (being Black), interest, and

ADHD, slightly improved the fit of the model to the data, $\chi^2_{\text{change}} p < 0.05$ (<1% additional variance explained). Importantly, the 3-way interaction among the variables was significant and will be explored below.

Results from the final model with all predictors included (Table 3c, Block 6) indicated that all the included demographic variables and diagnoses, except race (Black vs. else), were significant unique predictors of engagement. Children in older grade levels, who were male, received FRL, or had any disorder were reported by their parents to be less likely to be engaged than their counterparts. In contrast, children perceived to live in safe neighborhoods, who were of Hispanic ethnicity, and who were interested in learning new things were reported by their parents as being more likely to be engaged.

To assist in interpreting the results more clearly, all logit coefficient values were translated mathematically into predicted probabilities. On average (across all predictors), children in the sample had a 65% predicted probability of being engaged in terms of caring about doing well in school. Children in older grade levels were predicted to be 8% lower in engagement than younger peers (64% predicted probability). Males were predicted to be 20% lower than females in engagement (predicted probability of 54%). Children receiving FRL were 8% lower in engagement than those not receiving FRL (predicted probability of 61%). Children whose parents perceived that they lived in (relatively) safe neighborhoods were predicted to be 6% higher in engagement compared to those living in less safe places (68% predicted probability). Children who were identified by parents as Black were predicted to be similar to other race peers on engagement (predicted probability of 66% vs. 65%; not statistically significant). Children diagnosed with DD, ASD, or ID had much lower predicted probabilities of engagement compared to peers not diagnosed (61 vs. 69%, 60 vs. 70%, and 62 vs. 68%,

respectively). Children diagnosed with ADHD were far lower in predicted engagement (54%) compared to non-ADHD peers (75%). And, not surprisingly, children whose parents had reported their child having an interest in learning new things were far more engaged compared to peers (81% predicted probability vs. 45%).

Last but not least, to understand the nature of the two significant interactions (the 2-way interaction between ADHD and interest in learning new things, as well as the 3-way interaction among race, ADHD, and interest in learning new things), model-based predicted probabilities were computed and graphed. The 2-way interaction, shown in Figure 1, Panel A, revealed that the difference between children with ADHD and non-ADHD peers was larger for those children whose parents had reported having an interest in learning new things. Specifically, the difference between ADHD and non-ADHD children whose parents reported little or no interest in learning new things was 15% (38% vs. 53% predicted engagement), which was a smaller gap than the difference of 19% between ADHD and non-ADHD children whose parents had reported a relatively strong interest in learning new things (70% vs. 89% predicted engagement).

The 3-way interaction is illustrated using two 2-way interactions: one for children identified as Black and one for children not identified as Black (see Figure 2, Panels A and B, respectively). As can be seen, the only difference between children identified as Black (Panel A) and those not identified as Black (Panel B) is that the relationship between interest in learning new things and school engagement is weaker for ADHD children compared to non-ADHD children (11% difference for children whose parents reported a lack of interest, compared to a 21% difference for children whose parents did report their child having interest). For children who were not identified as black, the gaps between ADHD and non-ADHD children were similar for children with and without interest, at 18% and 17%, respectively.

Does all Required Homework. As shown in Table 4a, Block 1 predictors, which included demographic variables (grade, gender, FRL, safe neighborhood, race, and ethnicity), reliably distinguished children whose parents reported that the child does all their required homework (our second indicator of school engagement) from those who did not, accounting for approximately 12% of the variance in the outcome as shown in the Nagelgerke Pseudo- R^2 value (Research Question 1).

Block 2 (Table 4a), which tested Research Question 2, included comorbid disorders that have been shown previously to impact school engagement (DD, ASD, and ID), was found to significantly improve the fit of the model to the data above and beyond the demographic characteristics, $\chi^2_{\text{change}} p < 0.001$, accounting for approximately 1% more variance in the engagement outcome.

Block 3 (Table 4b), which tested Research Question 3 (effect of ADHD status on engagement), further improved the fit of the model to the data, $\chi^2_{\text{change}} p < 0.001$, explaining an additional 5% variance (approximately).

Block 4 (Table 4b), which tested the effect of interest in learning new things (above and beyond demographic and developmental disorder predictors; Research Question 4), also improved the fit of the model to the data, $\chi^2_{\text{change}} p < 0.001$, explaining 4% more of the variance (approximately).

Block 5 (Table 4c), which included the 2-way interaction among ADHD and interest in learning new things, only slightly improved the fit of the model to the data, $\chi^2_{\text{change}} p < 0.001$ (<1% additional variance explained; Research Question 5). Importantly, the interaction was significant and its meaning will be explored further shortly.

Finally, Block 6 (Table 4c), which tested potential disparities for Black children with respect to the effect of ADHD and interest in learning on school engagement (Research Question 6) was not significant, explaining included interactions between race (being Black), interest, and ADHD, did not significantly improve the fit of the model to the data. No interactions with race were significant.

Results from the final model with all predictors included (Table 4c, Block 6) indicated that all the included demographic variables and diagnoses, except ethnicity (Hispanic vs. else), were significant unique predictors of engagement. Children in older grade levels, who were male, received FRL, identified as Black, or had any disorder were reported by their parents to be less likely to be engaged than their counterparts. In contrast, children perceived to live in safe neighborhoods and who were interested in learning new things were reported by their parents as being more likely to be engaged.

To assist in interpreting the results more clearly, all logit coefficient values were translated mathematically into predicted probabilities. On average (across all predictors), children in the sample had a 64% predicted probability of being engaged in terms of doing all required homework. Children in older grade levels were predicted to be 23% lower in engagement than younger peers (52% predicted probability). Males were predicted to be 14% lower than females in engagement (predicted probability of 57%). Children receiving FRL were 12% lower in engagement than those not receiving FRL (predicted probability of 58%). Children whose parents perceived that they lived in (relatively) safe neighborhoods were predicted to be 10% higher in engagement compared to those living in less safe places (69% predicted probability). Children who were identified by parents as Black were predicted to be 10% lower than those not identified as Black (predicted probability 59%). Children identified as Hispanic

ethnicity were similar to other ethnicity peers on engagement (predicted probability of 65% vs. 64%; not statistically significant). Children diagnosed with DD, ASD, or ID had much lower predicted probabilities of engagement compared to peers not diagnosed (60 vs. 69%, 62 vs. 67%, and 61 vs. 67%, respectively). More interestingly, children diagnosed with ADHD were far lower in predicted engagement (51%) compared to non-ADHD peers (76%). And, not surprisingly, children whose parents had reported their child having an interest in learning new things were far more engaged compared to peers (76% predicted probability vs. 51%).

Last, but not least, to understand the nature of the significant interaction between ADHD and interest in learning new things, model-based predicted probabilities were computed and graphed. As shown in Figure 1, Panel B, the difference between children with ADHD and non-ADHD peers was larger for those children whose parents had reported having an interest in learning new things. Specifically, the difference between ADHD and non-ADHD children whose parents reported little or no interest in learning new things was 22% (40% vs. 62% predicted engagement), which was a smaller gap than the difference of 25% between ADHD and non-ADHD children whose parents had reported a relatively strong interest in learning new things (61% vs. 86% predicted engagement).

Chapter 5: Discussion

Overview of Findings

This current study contributes to our understanding of the relationship between interest, and engagement for all students and, specifically, for students with Attention-Deficit/Hyperactivity Disorder (ADHD). The findings support the hypothesis that interest in learning and school may serve as a protective factor for school engagement for children with ADHD. The study provides evidence, consistent with previous research, that children with ADHD's school engagement, in general, is lower than school engagement of children without an ADHD diagnosis (e.g. Junod et al., 2006; Purdie et al., 2002; Martin, 2012). Analyses found that there was a statistically significant difference in school engagement between children with an ADHD diagnosis and those without.

Evidence supporting previously proposed correlational relationships. Previous research has found relationships between certain demographic variables and risk factor variables and school engagement. The current research, in order to explore the unique relationship of an ADHD diagnosis with school engagement, and in order to investigate the role interest has in the relationship, first had to see how these demographic and risk factor variables related to school engagement for the utilized dataset. In order to investigate these relationships, the descriptive statistics and correlations were useful. In general, the current research supported previous findings that found relationships between demographic and risk factor variables and school engagement. Specifically, 6 demographic and 3 diagnosis risk factor variables (grade, gender, Free and Reduced Lunch eligibility status, perceived neighborhood safety, developmental delay diagnosis, Autism Spectrum Disorder diagnosis, intellectual disability diagnosis) were examined for their relationship to engagement. These variables were all suggested by previous research

to have relationships with school engagement. The current research found that the following variables were strongly correlated ($p < .001$) with both of the school engagement variables (cares about school and does all required homework): grade, gender, Free and Reduced Lunch eligibility status, perceived neighborhood safety, race, developmental delay diagnosis, Autism Spectrum Disorder diagnosis, and intellectual disability diagnosis. Ethnicity was only correlated strongly ($p < .001$) with cares about school; it was moderately correlated ($p < .05$) with completes all required homework.

The other important role the correlations played in the current research was noting the correlation between the two questions designed to assess school engagement. The families were asked two questions designed to capture engagement (child cares about doing well in school and child does all required homework). The original researchers combined the answers from these two questions into one engagement composite score. The correlation analyses indicated that the two sub-questions were highly correlated ($p < .001$) with one another ($p = 0.48$).

ADHD and engagement. Evidence for the relationship between demographic and diagnosis risk factor variables and school engagement was important in the argument for the important role of ADHD in school engagement because the researcher sought to control these demographic and diagnosis risk variables in order to understand the unique relationship between ADHD and school engagement. Adding ADHD to the regression model provides a statistically significant improvement in the explanatory value of the model. Previous research (Junod et al., 2006; DuPaul and Stoner, 2003; DuPaul et al., 2008; Purdie et al., 2002; Martin, 2012) indicated a relationship between ADHD status and school engagement, which was supported by the current research. However, the current study clarifies that ADHD predicts school engagement

over and above other demographic and diagnosis variables. This emphasizes the need for researchers and educators to think about these students when designing curricula or research.

Interest and engagement. Analyses also provided evidence for the important role of interest in learning in supporting school engagement. After determining that ADHD was correlated with school engagement, the question then became: what are malleable factors for school engagement that can be targeted situationally? That is, what can educators and clinicians target in order to increase school engagement, especially for children who tend to have lower school engagement, specifically, students with ADHD? One such hypothesized malleable factor for school engagement was interest in learning. The literature review suggested interest in learning may correlate with school engagement. The current research sought to determine if interest in learning predicts school engagement after controlling for demographic and diagnosis factors and for ADHD diagnosis status. Analyses indicate that interest in learning significantly increases the predictive capabilities of the model relative to other predictive factors (demographic and diagnosis factors and ADHD diagnosis status). That is, there was a statistically significant difference in school engagement relative to populations with varying levels of interest. The current study indicates that interest in learning is, indeed, correlated with school engagement and predictive of school engagement. The relationship is interesting because it has not been examined in the previous literature base and because interest in learning is a variable that clinicians and educators can target by learning about each child.

Race. The role of race (specifically, reporting one's race as Black), was of especial consideration in the analyses. Literature review indicated that, although Black, Latino, and Native American children are more likely to be referred for special education services (e.g. Losen, Hodson, Ee, & Martinez, 2014; Waitoller, Artiles, & Cheney, 2010; Donovan & Cross,

2002; Coutinho & Oswald, 2000) and to receive punishments in school for behavior (e.g. Gregory, Skiba, & Noguera, 2010; Krezmien, Leone, & Achilles, 2006; Wallace, Goodkind, Wallace, & Bachman, 2008; McIntosh, Girvan, Horner, & Smolkowski, 2014) than White children, research has noted that they are less likely to be diagnosed with ADHD (Coker et al., 2014; Baglivio, et al., 2017; Moody, 2016) than White children. The current research sought to examine if students identified as Black had different engagement levels compared to students not identified as Black, particularly for those who were also diagnosed with ADHD, and further, whether interest in learning moderated these relationships. Interestingly, children identified as Black were not found to differ from children with other racial identities on caring about doing well in school (i.e., no main effect), but were significantly lower on the second engagement indicator (does all required homework). That Black students have similar levels of caring about school as non-Black students is valuable information for clinicians and educators to keep in mind when working with Black students and, importantly, this suggests that completion of required schoolwork should not necessarily be taken as an indicator of the degree to which a student cares about doing well in school. This said, there were no interactions found between children identified as Black and other children with ADHD status or interest. Indeed, the only significant finding was that the gap between ADHD and non-ADHD children was larger for children identified as Black and whose parents rated them with higher interest in learning new things. In other words, interest is not as protective for Black children diagnosed with ADHD compared to peers. Future research should probe this issue more deeply.

ADHD, interest, and engagement. Finally and most fascinatingly, the current research sought to examine whether interest in learning moderates the effect of an ADHD diagnosis on school engagement. That is, the researcher hypothesized that interest in learning may serve as a

protective factor for school engagement for students with ADHD, whose school engagement was found to be lower overall. It is hypothesized that since motivation, engagement, and attention play a role in developing interest (Renninger & Hidi, 2016), individuals with ADHD may struggle to develop interest. If so, interest in learning would be an informative and potentially fruitful target for educators and clinicians. The analyses indicated that, although students with an ADHD diagnosis were generally less likely to be engaged in school, the gains in school engagement resulting from an increased level of interest in learning were not hampered by an ADHD diagnosis. That is, students with an ADHD diagnosis, who were, in general, less engaged in school, who were interested in learning were more likely to have a high level of school engagement. These results are depicted in Figures 2-3, which show the predicted levels of school engagement relative to measured interest in learning for students with and without ADHD. Interest in learning did not, necessarily, make students with an ADHD diagnosis “catch up” to the engagement level of their non-ADHD peers; *however*, being interested in learning was significantly predictive of increased school engagement. Students with an ADHD diagnosis who were interested in learning had school engagement levels that were significantly higher than engagement levels for students with low interest in learning. The graphs of the interactions show that interest in learning does not ameliorate the effect of having an ADHD diagnosis on school engagement – students both with and without interest in learning and who were diagnosed with ADHD were lower than their non-ADHD peers on both school engagement variables. However, students with ADHD with a high interest in learning had higher scores on the engagement variables than students without ADHD who had low levels of interest in learning. Therefore, while it cannot be said that interest in learning is a protective factor for school engagement, it can be stated that interest in learning is a malleable factor for school engagement and may be

especially important to target for students with ADHD because their levels of school engagement are lower overall.

Although determining *why* or *how* interest in learning increases school engagement for students with ADHD was not within the scope of the current research, previous literature reviews suggest several mechanisms that may partially explain the relationship. Neuroscientific research on the cognitive factors of individuals with ADHD has found that individuals with ADHD may have dysfunction of the reward and motivation mechanisms of the brain (Haenlien & Caul, 1987; Johansen et al., 2009; Volkow et al., 2016; Gottlieb, Oudeyer, Lopes, & Baranes, 2013; Kang, Hsu, Krajbich, Loewenstein, McClure, Wang, & Camerer, 2009; Gruber, Gelman, & Ranganath, 2014). These differences in reward circuitry often manifest behaviorally and cognitively as difficulties utilizing schedules or systems of rewards that function well for students who do not have ADHD. These rewards circuitries play a large role in the development of interest because they are strongly linked to interest and curiosity (Gottlieb, Oudeyer, Lopes, & Baranes, 2013; Kang, Hsu, Krajbich, Loewenstein, McClure, Wang, & Camerer, 2009; Gruber, Gelman, & Ranganath, 2014). So, the current study reminds researchers and educators that their students' engagement and motivation must be viewed contextually and determining what motivates, engages, or interests a student may be best learned through getting to know each student.

Practice Implications

School engagement has been a topic of research for many years (Fredricks, Blumenfeld, & Paris, 2004). Given its connections to learning outcomes, school engagement has also been a source of distress for educators and clinicians as they sought to determine ways to improve it. How do you capture and engage students who, research shows, are generally less engaged and motivated, such as students with ADHD? The current research suggests that targeting student

interest in learning may be a productive bridge to school engagement. According to Renninger and Hidi (2016), targeting interest efficaciously may depend on at what stage of development a student's interest is. Their model of interest development assumes three premises: a) interest is a variable that can be supported to develop and deepen, regardless of a person's age or experience; b) in order for interest to develop, a person must make connections to the content of interest; and c) neuroscientific evidence supports the idea that people are hardwired to find pursuit of interest rewarding. Students may need increased support during initial stages of interest development, which may look like conversations, connections to others, connections to resources, or explicit instruction. Understanding the connection between interest in learning and school engagement may also support teachers as they work to plan lessons and activities that are engaging and interesting to students. Knowing the impact of interest in learning and engagement should inspire educators and clinicians to consider these aspects of learning to be as important as any academic tenets. Clinicians and educators may need to thoughtfully differentiate instruction to trigger and maintain interest in learning. For example, connecting students to resources to support their development of interest, as well as honing rapport-building skills to better assess a child's interest, are recommended. In addition, practitioners who work with children should be very careful not to label a student as 'not interested' in learning or school because, fortuitously, each child is interested in learning about something and it is the job of clinicians, parents, and educators to seek out and foster these interests. The responsibility of engaging students in school and learning does not rest solely on the child but, instead, should be developed with the assistance of caring and attentive adults. That is, emphasizing and working to support development of interest in learning and school engagement should not be undervalued, nor

should it be thought to be less important than the academic value of lessons. In fact, it may be productive to target interest in learning and school engagement before focusing on academics.

The neuroscientific evidence for the differences in reward circuitry in individuals with ADHD should indicate to researchers and educators that development of supports for students with ADHD may need to be thoughtfully tailored to each student. The discussion of the manifestation of these reward circuitry differences is important. It is not to say that schedules of rewards and systems designed to motivate students do *not* work for students with ADHD; however, it does suggest that children with ADHD may need stronger incentives (Kollins, Lane, & Shapiro, 1997), may need more immediate rewards due to failure to be able to delay gratification, may not benefit from partial schedules of reinforcement, and may require more frequent small immediate rewards (Sonuga-Barke, 2003; Tripp & Wickens, 2008). These adaptations to systems which effective educators already employ may tap into a child's development of interest.

To this end, researchers, educators, and clinicians would be well advised to keep the path to school engagement through interest development in mind as they develop curricula and set up their classrooms. Students with ADHD are known to struggle with school engagement more than their non-ADHD peers and so focusing in their interest development may be especially important and impactful. In the end, the means to increased engagement through interest is definitely targetable by educators and clinicians and should empower them to listen to their students, value rapport-building, and not to think of time spent getting to know students as not related to their academic success. In fact, it may be that truly knowing a student with the aim of supporting their interest development, while simple in theory, may be one of the more efficacious and productive "interventions" teachers may not even be aware they are doing.

Limitations

Though this present study addressed an important gap in the current research literature by investigating the effects of interest in learning on school engagement for students with ADHD, multiple important limitations should be considered. First, the concepts of interest in learning and school engagement are extremely large, nebulous, and notoriously difficult to measure. They are challenging to measure objectively and difficult to observe, so self-report is often used. In the case of this study, the children's parents provided ratings for their children's interest in learning and engagement in school. Parent report is the only measure of these indicators in the current study. Ideally, parent report would be only one of multiple sources of data collected to measure these concepts. A self-report and observational data would also be factored in to better capture measurements of interest school engagement. In addition, how individuals define interest in learning and school engagement may differ greatly between households, schools, and individuals. What one parent considers 'interested' may be quite different from how another parent defines 'interested.' In addition, as discussed, Renninger and Hidi (2016) do not endorse measuring interest in learning through a question that asks individuals if they are interested in something. However, data and research that includes a measure of interest in learning is rare and the benefits of using an extremely large dataset in order to collect information on exceptionally nuanced concepts was determined to outweigh this limitation.

The 2011-2012 National Survey of Children's Health provided a rich and robust dataset for analysis. However, due to the current research being a secondary analysis, some of the constructs may not exactly map onto to the definitions of the constructs concluded from the literature review. Interest in learning was captured through one item on the survey in which parents were asked if their child showed interest and curiosity in learning new things. As

indicated by researchers, especially Renninger and Hidi (2006), interest is a large and complicated construct that is not static. Interest in learning develops through stages is much more complicated than simply showing interest. Much of interest occurs internally and may not be capturable by observations of behavior. Parent respondents to the questionnaire may not have assessed their children's interest in learning in the same way that a researcher studying interest development would have.

Similarly, the engagement questions appeared to be designed to capture both motivation to engage in school (cares about doing well in school) and the behavioral manifestation of this caring (does all required homework). However, the literature review indicates that both engagement and motivation are large concepts which are difficult to disentangle from one another. Assessing a student's pattern of homework completion is just one aspect of engagement; however, there are likely many other behaviors that would also indicate engagement or lack of engagement.

Future Directions

The limitations of the current research and the literature base indicate several potentially rewarding future directions for study. First, research that captures both interest in learning and school engagement by more in-depth and situative measures would deepen the research community's understanding of the role of interest in learning in school engagement for children with ADHD. Interest was captured by a single item and engagement was captured by a composite of two questions. Ideally, future research on interest in learning and school engagement would include self-report information, observational data, or more nuanced composites of the constructs of interest.

The current research was focused on determining if interest in learning is a malleable factor for school engagement for students with ADHD; it will now be helpful to turn to the question of *how* to increase interest in learning of students with ADHD, with specific attention to their stages of interest development. These studies may be in the form of experimental research on curricula or programs thought to increase interest in learning and/or school engagement. How do teachers who capture students' interest and engage them in school manage to do so? Research would greatly benefit from collecting data on these teachers to learn what they do well and to what extent they, perhaps unknowingly, tap into the students' development of interest.

Conclusions

Limitations notwithstanding, this study expands the current understanding of school engagement for students with ADHD by including a measure of interest in learning. The results of this study provide evidence that interest in learning is a malleable factor for school engagement for all students, and especially for those with ADHD. While future research using more nuanced representations of school engagement and interest in learning are needed to determine the directional relationship between interest in learning and school engagement, this study nevertheless provides new insights into a crucial challenge in education.

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Appendix A: Tables and Figures

Table 1.

Descriptive Statistics

Measure	ADHD <i>n</i> = 5,242		Non-ADHD <i>n</i> = 42,275	
	<i>Frequency</i>	<i>Percentage of Total</i>	<i>Frequency</i>	<i>Percentage of Total</i>
<i>Cares about Doing Well in School</i>				
Mostly	3,348	7.0%	37,349	78.6%
Rarely	1,894	4.0%	4,925	10.4%
<i>Does all Required Homework</i>				
Mostly	3,372	7.1%	37,783	79.5%
Rarely	1,870	3.9%	4,491	9.5%
<i>Grade</i>				
7th - 12th	2,826	5.9%	21,506	45.3%
Below 7th	2,416	5.1%	20,768	43.7%
<i>Gender</i>				
Male	3,627	7.6%	20,725	43.6%
Female	1,614	3.4%	21,550	45.4%
<i>FRL</i>				
Eligible	2,297	4.8%	14,539	30.6%
Not Eligible	2,945	6.2%	27,736	58.4%
<i>Feels Neighborhood is Safe</i>				
Mostly	4,466	9.4%	37,578	79.1%
Rarely	776	1.6%	4,696	9.9%
<i>Race</i>				
Black	934	2.0%	7,849	16.5%
Not Black	4,308	9.1%	34,426	72.4%
<i>Ethnicity</i>				
Hispanic	597	1.3%	6,977	14.7%
Not Hispanic	4,645	9.8%	35,297	74.3%
<i>DD</i>				
Diagnosed	790	1.7%	948	2.0%
Not Diagnosed	4,452	9.4%	41,327	87.0%
<i>ASD</i>				
Diagnosed	455	1.0%	585	1.2%
Not Diagnosed	4,787	10.1%	41,690	87.7%
<i>ID</i>				
Diagnosed	291	0.6%	310	0.7%
Not Diagnosed	4,951	10.4%	41,965	88.3%
<i>Interest</i>				
High	3,649	7.7%	37,000	77.9%
Low	1,593	3.4%	5,274	11.1%

Note. *N* = 47,517 students in grades 1-12. FRL = Free and Reduced Lunch Eligible; DD = Developmental Delay; ASD = Autism Spectrum Disorder; ID = Intellectual Disability; ADHD = Attention-Deficit/Hyperactivity Disorder. Survey weights applied to all analyses.

Table 2.

Descriptive Statistics and Correlations Among All Variables

Measure	<i>M</i>	<i>(SD)</i>	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
<i>Outcomes</i>														
1. Cares About Doing Well in School (Mostly)	0.86	(0.35)	--											
2. Does All Required Homework (Mostly)	0.87	(0.34)	.48	--										
<i>Block 1 Predictors</i>														
3. Grade: 7-12 (vs. 1-6)	0.51	(0.50)	-.09	-.16	--									
4. Gender: Male (vs. Female)	0.51	(0.50)	-.16	-.12	.00	--								
5. FRL (vs. Not)	0.35	(0.48)	-.08	-.11	-.04	.01	--							
6. Lives in Safe Neighborhood	0.88	(0.32)	.06	.09	.03	.03	-.22	--						
7. Race: Black (vs. Else)	0.18	(0.39)	-.03	-.09	-.01	-.03	.20	-.18	--					
8. Ethnicity: Hispanic (vs. Else)	0.16	(0.37)	.03	.01	-.05	.02	.19	-.12	-.13	--				
<i>Block 2 Predictors</i>														
9. DD (vs. Not)	0.04	(0.19)	-.14	-.12	-.02	.06	.06	-.04	.02	-.03	--			
10. ASD (vs. Not)	0.02	(0.15)	-.11	-.09	-.01	.10	-.01	-.01	-.01	.00	.40	--		
11. ID (vs. Not)	0.01	(0.11)	-.10	-.09	-.02	.03	.04	-.02	-.02	.00	.45	.26	--	
<i>Block 3 Predictors</i>														
12. ADHD (vs. Not)	0.11	(0.31)	-.22	-.23	.02	.13	.06	-.04	-.01	-.04	.21	.16	.14	--
<i>Block 4 Predictors</i>														
13. Interest in Learning New Things (Mostly)	0.86	(0.35)	.34	.26	-.13	-.06	-.06	.08	-.07	-.01	-.14	-.10	-.11	-.16

Note. *N* = 47,517 students in grades 1-12. FRL = Eligible for Free and Reduced Lunch; DD = Developmental Delay; ASD = Autism Spectrum Disorder; ID = Intellectual Disability; ADHD = Attention-Deficit/Hyperactivity Disorder. Survey weights applied to descriptive statistics and correlations (Pearson's *r* reported). All correlations at .02 magnitude are significant at the .05 level.

Table 3a.

Multiple Logistic Regression Results Predicting Whether Child Cares about Doing Well In School (Mostly), Blocks 1-2

	Block 1					Block 2					
	χ^2_{total}	Nagel	HR	b	OR	χ^2_{change}	χ^2_{total}	Nagel	HR	b	OR
<i>Model Fit</i>	2177 ***	.08	.86			622 ***	2799 ***	.10	.86		
<i>Coefficients</i>											
Intercept (Mean)				1.82 ***	6.18					0.83 ***	2.29
Grade: 7-12				-0.27 ***	0.76					-0.28 ***	0.76
Gender: Male				-0.51 ***	0.60					-0.48 ***	0.62
FRL				-0.23 ***	0.79					-0.22 ***	0.80
Lives in Safe Neighborhd				0.22 ***	1.25					0.21 ***	1.23
Race: Black				-0.02	0.98					-0.02	0.98
Ethnicity: Hispanic				0.19 ***	1.21					0.18 ***	1.19
DD										-0.43 ***	0.65
ASD										-0.37 ***	0.69
ID										-0.29 ***	0.75
ADHD											
Interest in Learning New											
ADHD*Interest											
Black*ADHD											
Black*Interest											
Black*ADHD*Interest											

Note. N = 49,796 students grades 1-12. Block 1 chi-square change test *df* = 6; Block 2 *df* = 3; Block 3 *df* = 1; Block 4 *df* = 1; Block 5 *df* = 1; Block 6 *df* = 3. FRL = Free and Reduced Lunch Eligible; DD = Developmental Delay; ASD = Autism Spectrum Disorder; ID = Intellectual Disability; ADHD = Attention-Deficit/Hyperactivity Disorder. All predictors effect-coded and survey weights applied to all analyses.

* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001.

Table 3b.

Multiple Logistic Regression Results Predicting Whether Child Cares about Doing Well In School (Mostly), Blocks 3-4

	Block 3						Block 4					
	χ^2 change	χ^2 total	Nagel	HR	b	OR	χ^2 change	χ^2 total	Nagel	HR	b	OR
<i>Model Fit</i>	998 ***	3797 ***	.14	.86			2981 ***	6778 ***	.24	.87		
<i>Coefficients</i>												
Intercept (Mean)					0.66 ***	1.93					0.62 ***	1.85
Grade: 7-12					-0.28 ***	0.76					-0.17 ***	0.84
Gender: Male					-0.44 ***	0.65					-0.45 ***	0.64
FRL					-0.19 ***	0.83					-0.19 ***	0.83
Lives in Safe Neighborhd					0.19 ***	1.21					0.12 ***	1.13
Race: Black					-0.04 *	0.96					0.03	1.03
Ethnicity: Hispanic					0.13 ***	1.14					0.17 ***	1.18
DD					-0.29 ***	0.75					-0.18 ***	0.84
ASD					-0.29 ***	0.75					-0.21 ***	0.81
ID					-0.23 ***	0.80					-0.14 *	0.87
ADHD					-0.57 ***	0.56					-0.48 ***	0.62
Interest in Learning New											0.89 ***	2.44
ADHD*Interest												
Black*ADHD												
Black*Interest												
Black*ADHD*Interest												

Note. N = 49,796 students grades 1-12. Block 1 chi-square change test *df* = 6; Block 2 *df* = 3; Block 3 *df* = 1; Block 4 *df* = 1; Block 5 *df* = 1; Block 6 *df* = 3. FRL = Free and Reduced Lunch Eligible; DD = Developmental Delay; ASD = Autism Spectrum Disorder; ID = Intellectual Disability; ADHD = Attention-Deficit/Hyperactivity Disorder. All predictors effect-coded and survey weights applied to all analyses.

* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001.

Table 3c.

Multiple Logistic Regression Results Predicting Whether Child Cares about Doing Well In School (Mostly), Blocks 5-6

	Block 5						Block 6					
	χ^2_{change}	χ^2_{total}	Nagel	HR	b	OR	χ^2_{change}	χ^2_{total}	Nagel	HR	b	OR
<i>Model Fit</i>	38 ***	6817 ***	.24	.87			11 *	6828 ***	.24	.87		
<i>Coefficients</i>												
Intercept (Mean)					0.63 ***	1.87					0.63 ***	1.87
Grade: 7-12					-0.17 ***	0.84					-0.17 ***	0.84
Gender: Male					-0.45 ***	0.64					-0.45 ***	0.64
FRL					-0.19 ***	0.83					-0.19 ***	0.83
Lives in Safe Neighborhd					0.12 ***	1.13					0.12 ***	1.13
Race: Black					0.03	1.03					0.02	1.02
Ethnicity: Hispanic					0.17 ***	1.18					0.17 ***	1.18
DD					-0.17 ***	0.84					-0.17 ***	0.84
ASD					-0.21 ***	0.81					-0.22 ***	0.81
ID					-0.14 **	0.87					-0.13 *	0.87
ADHD					-0.45 ***	0.64					-0.45 ***	0.64
Interest in Learning New					0.83 ***	2.29					0.82 ***	2.26
ADHD*Interest					-0.12 ***	0.89					-0.16 ***	0.86
Black*ADHD											0.00	1.00
Black*Interest											-0.02	0.99
Black*ADHD*Interest											-0.07 **	0.93

Note. N = 49,796 students grades 1-12. Block 1 chi-square change test *df* = 6; Block 2 *df* = 3; Block 3 *df* = 1; Block 4 *df* = 1; Block 5 *df* = 1; Block 6 *df* = 3. FRL = Free and Reduced Lunch Eligible; DD = Developmental Delay; ASD = Autism Spectrum Disorder; ID = Intellectual Disability; ADHD = Attention-Deficit/Hyperactivity Disorder. All predictors effect-coded and survey weights applied to all analyses.

* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001.

Table 4a.

Multiple Logistic Regression Results Predicting Whether Child Does all Required Homework (Mostly), Blocks 1-2

	Block 1					Block 2					
	χ^2_{total}	Nagel	HR	b	OR	χ^2_{change}	χ^2_{total}	Nagel	HR	b	OR
<i>Model Fit</i>	3118 ***	.12	.87			477 ***	3595 ***	.13	.87		
<i>Coefficients</i>											
Intercept (Mean)				1.72 ***	5.57					0.83 ***	2.29
Grade: 7-12				-0.55 ***	0.57					-0.57 ***	0.57
Gender: Male				-0.39 ***	0.68					-0.36 ***	0.70
FRL				-0.30 ***	0.74					-0.29 ***	0.75
Lives in Safe Neighborhd				0.30 ***	1.34					0.28 ***	1.33
Race: Black				-0.20 ***	0.82					-0.21 ***	0.81
Ethnicity: Hispanic				0.08 ***	1.08					0.07 **	1.07
DD										-0.44 ***	0.64
ASD										-0.26 ***	0.77
ID										-0.26 ***	0.78
ADHD											
Interest in Learning New											
ADHD*Interest											
Black*ADHD											
Black*Interest											
Black*ADHD*Interest											

Note. N = 49,796 students grades 1-12. Block 1 chi-square change test *df* = 6; Block 2 *df* = 3; Block 3 *df* = 1; Block 4 *df* = 1; Block 5 *df* = 1; Block 6 *df* = 3. FRL = Free and Reduced Lunch Eligible; DD = Developmental Delay; ASD = Autism Spectrum Disorder; ID = Intellectual Disability; ADHD = Attention-Deficit/Hyperactivity Disorder. All predictors effect-coded and survey weights applied to all analyses.

* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001.

Table 4b.

Multiple Logistic Regression Results Predicting Whether Child Does all Required Homework (Mostly), Blocks 3-4

	Block 3						Block 4					
	χ^2_{change}	χ^2_{total}	Nagel	HR	b	OR	χ^2_{change}	χ^2_{total}	Nagel	HR	b	OR
<i>Model Fit</i>	1290 ***	4886 ***	.18	.87			1257 ***	6143 ***	.22	.87		
<i>Coefficients</i>												
Intercept (Mean)					0.64 ***	1.90					0.59 ***	1.81
Grade: 7-12					-0.58 ***	0.56					-0.52 ***	0.59
Gender: Male					-0.31 ***	0.73					-0.30 ***	0.74
FRL					-0.26 ***	0.77					-0.26 ***	0.77
Lives in Safe Neighborhd					0.26 ***	1.30					0.22 ***	1.25
Race: Black					-0.24 ***	0.78					-0.21 ***	0.81
Ethnicity: Hispanic					0.01	1.01					0.02	1.02
DD					-0.28 ***	0.76					-0.20 ***	0.82
ASD					-0.17 ***	0.84					-0.11 *	0.90
ID					-0.19 ***	0.83					-0.12 *	0.89
ADHD					-0.67 ***	0.51					-0.61 ***	0.55
Interest in Learning New											0.61 ***	1.83
ADHD*Interest												
Black*ADHD												
Black*Interest												
Black*ADHD*Interest												

Note. N = 49,796 students grades 1-12. Block 1 chi-square change test *df* = 6; Block 2 *df* = 3; Block 3 *df* = 1; Block 4 *df* = 1; Block 5 *df* = 1; Block 6 *df* = 3. FRL = Free and Reduced Lunch Eligible; DD = Developmental Delay; ASD = Autism Spectrum Disorder; ID = Intellectual Disability; ADHD = Attention-Deficit/Hyperactivity Disorder. All predictors effect-coded and survey weights applied to all analyses.

* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001.

Table 4c.

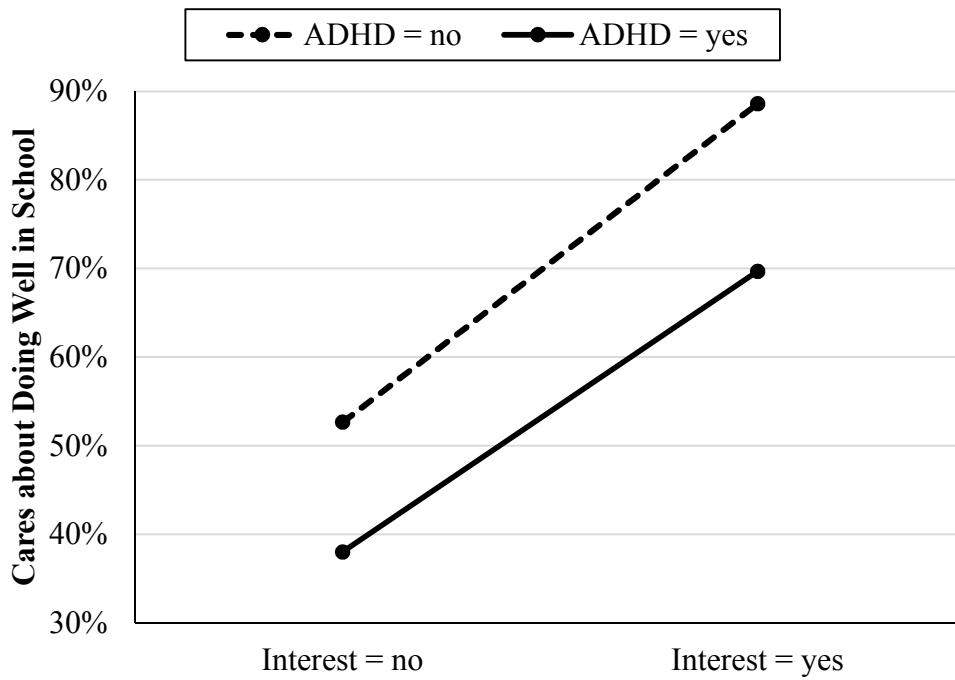
Multiple Logistic Regression Results Predicting Whether Child Does all Required Homework (Mostly), Blocks 5-6

	Block 5						Block 6					
	χ^2_{change}	χ^2_{total}	Nagel	HR	b	OR	χ^2_{change}	χ^2_{total}	Nagel	HR	b	OR
<i>Model Fit</i>	45 ***	6187 ***	.22	.87			3	6190 ***	.22	.87		
<i>Coefficients</i>												
Intercept (Mean)					0.60 ***	1.81					0.59 ***	1.80
Grade: 7-12					-0.52 ***	0.60					-0.52 ***	0.60
Gender: Male					-0.30 ***	0.74					-0.30 ***	0.74
FRL					-0.26 ***	0.77					-0.26 ***	0.77
Lives in Safe Neighborhd					0.22 ***	1.25					0.22 ***	1.25
Race: Black					-0.21 ***	0.81					-0.22 ***	0.80
Ethnicity: Hispanic					0.02	1.02					0.03	1.03
DD					-0.19 ***	0.83					-0.19 ***	0.83
ASD					-0.12 **	0.89					-0.12 **	0.89
ID					-0.13 *	0.88					-0.13 *	0.88
ADHD					-0.56 ***	0.57					-0.57 ***	0.57
Interest in Learning New					0.54 ***	1.72					0.56 ***	1.75
ADHD*Interest					-0.13 ***	0.88					-0.11 ***	0.89
Black*ADHD											-0.01	0.99
Black*Interest											0.04	1.04
Black*ADHD*Interest											0.02	1.02

Note. $N = 49,796$ students grades 1-12. Block 1 chi-square change test $df = 6$; Block 2 $df = 3$; Block 3 $df = 1$; Block 4 $df = 1$; Block 5 $df = 1$; Block 6 $df = 3$. FRL = Free and Reduced Lunch Eligible; DD = Developmental Delay; ASD = Autism Spectrum Disorder; ID = Intellectual Disability; ADHD = Attention-Deficit/Hyperactivity Disorder. All predictors effect-coded and survey weights applied to all analyses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Panel A



Panel B

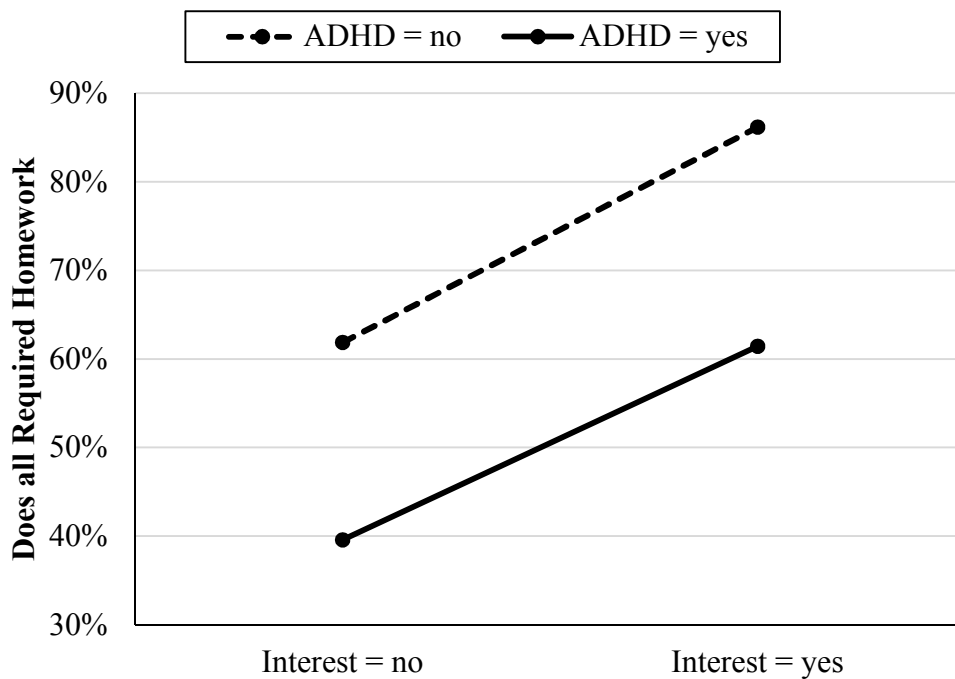
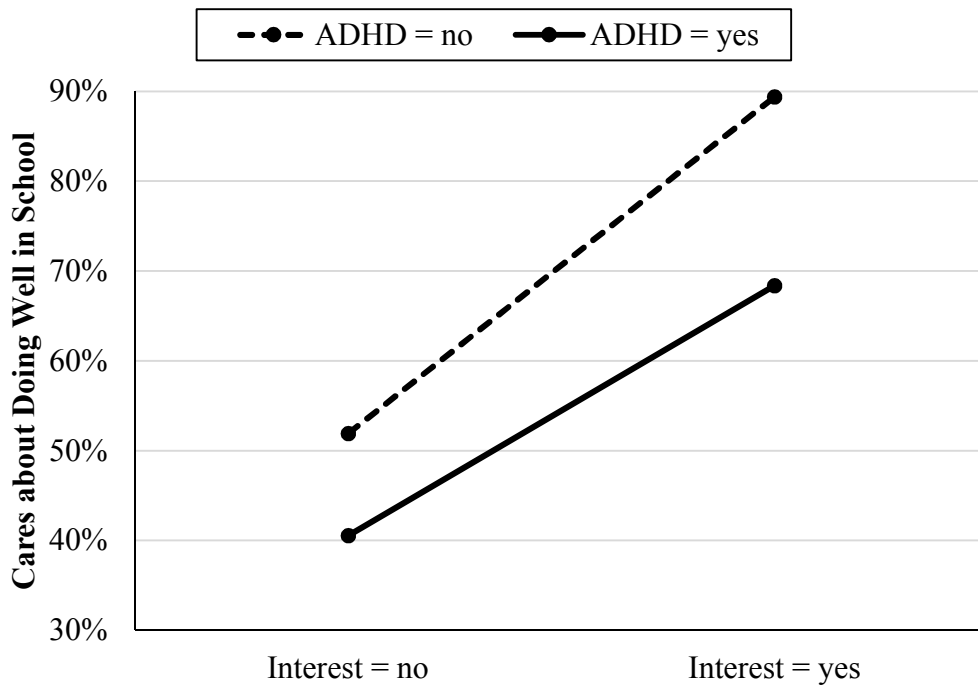


Figure 1.
Two-way Interaction between ADHD Status and Interest in Learning New Things for Engagement Outcomes: Cares about Doing Well in School (Panel A) and Does all Required Homework (Panel B)

Panel A



Panel B

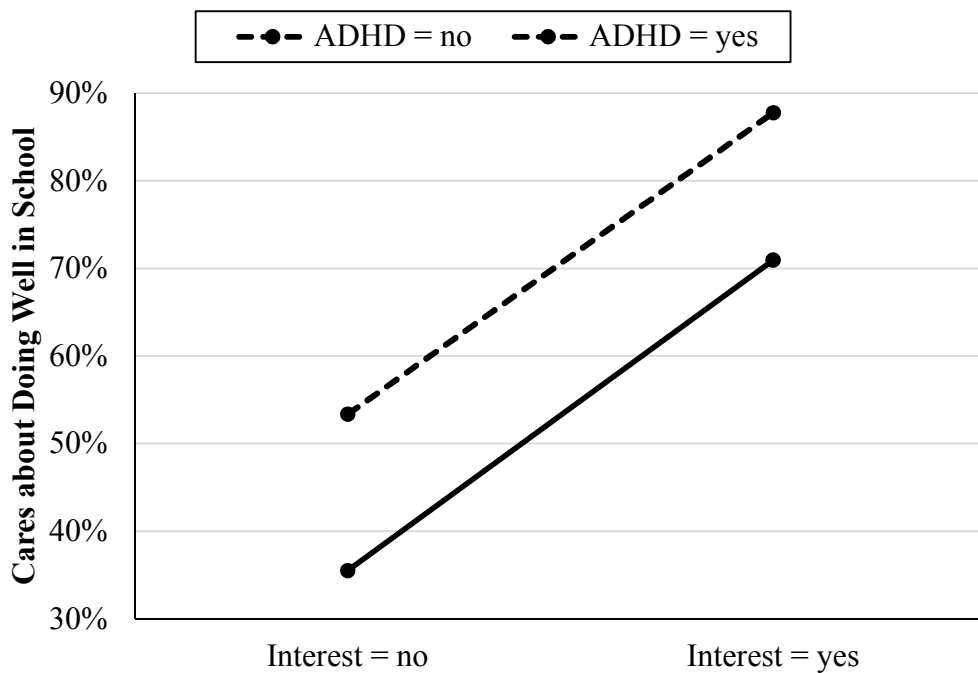


Figure 2.

Three-way Interaction among Race (Black), ADHD Status, and Interest in Learning New Things for One Engagement Outcome, Cares about Doing Well in School for Children Identified as Black (Panel A) and Children not Identified as Black (Panel B)