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Self-control Depletion, Frustration Tolerance, Irritability, and Engagement in Risky Behaviors in College Students With and Without Adhd Risk

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Abstract

Background: ADHD prevalence rates in college students are increasing, with approximately 8.7% of college students reporting current ADHD diagnoses. College students with ADHD often have poor self-control, low frustration tolerance, and associated irritability. These associated features of ADHD are, in turn, associated with engagement in risky behaviors and social impairments.

Method: The present study used the Self-Control Strength Model as a theoretical framework to experimentally examine (a) relationships between ADHD symptoms, frustration tolerance, irritability, and self-control resource depletion and (b) associations between these variables, social functioning, and engagement in risky behaviors. College student participants (n=247) completed state and trait baseline measures, including a measure of current ADHD symptoms, and were randomized into depletion and non-depletion groups before completing two experimental tasks: the Stroop Color-Word Task (Stroop) to deplete self-control resources, and a computerized version of the Paced Auditory Serial Addition Task (PASAT-C) designed to induce frustration and measure frustration tolerance. Following the experimental tasks, participants completed additional state measures to determine the effects of the tasks.

Results: Linear and logistic regressions analyzed the associations between ADHD symptoms, depletion status, frustration tolerance, state irritability, and several functional outcomes. The Stroop failed to significantly deplete the self-control resources of participants in the depletion condition; thus, depletion status was not associated with either irritability or frustration tolerance. In the total sample, ADHD symptoms were associated positively with state irritability. Additionally, the interaction between ADHD symptoms and frustration tolerance was associated positively with state irritability, positively with positive social relationships, negatively with engaging in various types of non-suicidal self-injurious behaviors, and positively associated with state desire to engage in condom-less sex; however, associations were greatly driven by ADHD symptoms. Frustration tolerance was associated positively with a state desire to consume alcohol.

Discussion: Given the failure of the Stroop task in the depletion condition, the Strength Model of Self-Control cannot be fully analyzed. However, the present experimental study results provide some support for previous findings on the positive associations between ADHD symptoms, state irritability, and several functional outcomes.

Keywords: ADHD, Self-Control Resource Depletion, Frustration Tolerance, Risky Behaviors, Social Functioning

Self-Control Depletion, Frustration Tolerance, Irritability, and Engagement in Risky Behaviors in College Students with and without ADHD Risk

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Attention-deficit/hyperactivity disorder (ADHD) is characterized by a pervasive pattern of inattention, hyperactivity, and/or impulsivity that interferes with functioning. ADHD is increasingly prevalent in college students (8.7-9.5%) (*American College Health Association National College Health Assessment*, 2018; Wood et al., 2021) and associated with social impairment (Sacchetti & Lefler, 2017), lower GPA (Anastopoulos et al., 2018), and comorbid mental health disorders (Anastopoulos et al., 2018), especially anxiety and depression (Katzman et al., 2017).

Although not part of the diagnostic criteria, a near ubiquitous associated feature of ADHD is deficient emotion regulation (Barkley, 2010). Distress tolerance, or the ability to tolerate negative or aversive emotional states, is a common coping strategy which subserves emotion regulation (Conway et al., 2020). A frequent example of distress tolerance is the ability to tolerate frustration. Poor frustration tolerance is common in individuals with ADHD (Seymour et al., 2019; Surman et al., 2013) and is characteristically associated with irritability (Seymour et al., 2020; Skirrow et al., 2014). Tolerating frustration requires effortful acts of emotion regulation (Heatherton & Wagner, 2011) which can negatively impact the capacity to emotionally self-regulate in other domains (Hagger et al., 2010) and is often associated with functional impairments, *especially social*, beyond those imparted by ADHD symptoms (Cleminshaw et al., 2020; Surman et al., 2015). Furthermore, low frustration tolerance is associated with increased engagement in risky behaviors in college students (e.g., problematic substance use, condom-less sex, non-suicidal self-injury) (Loya et al., 2019; Marengo et al., 2019; Peterson et al., 2019; Shoham et al., 2019). Thus, better understanding frustration

tolerance, accompanying irritability, and the impact upon social functioning and engagement in risky behaviors in ADHD is a clinically significant topic.

While several research studies have considered ADHD, frustration tolerance, irritability, social functioning, and/or engagement in risky behaviors all but one of those investigations have been conducted on children/adolescents, relied exclusively on self-report measures and/or lacked theoretical underpinnings. The present study sought to incrementally contribute to the literature by resolving these existing gaps. Using the Self-Control Strength Model (Baumeister et al., 2007) as a theoretical framework, the overall objective of present study is to expand upon existing literature on college students with ADHD by experimentally investigating associations between self-control resource depletion, frustration tolerance, and irritability. Additionally, the present study considered associations between frustration tolerance, irritability, and other functional outcomes for which college students with ADHD are at elevated risk including social impairments (Sacchetti & Lefler, 2017) and risky behaviors demonstrated to be related negatively with self-control (Shoham et al., 2019).

ADHD

ADHD background and etiological theory. ADHD is a neurodevelopmental disorder characterized by a pervasive pattern of inattention, hyperactivity, and/or impulsivity that interferes with functioning and development (American Psychiatric Association, 2013). Several of these symptoms must be present before age 12, and there is great heterogeneity in ADHD presentation due to the wide variety of possible symptom combinations that may lead to a diagnosis. ADHD symptoms are associated with significant impairment in several domains including educational, motivational, social, and emotional functioning, among other areas (de Schipper et al., 2015). Though ADHD was previously thought to dissipate in adolescence (Hill & Schoener, 1996), its persistence into adulthood has been empirically supported (Wilens,

Biederman, & Spencer, 2002). At least one-third of children diagnosed with ADHD retain the diagnosis into adulthood (Mannuzza & Klein, 2000; Wender et al., 2006).

Current ADHD research supports a variety of theories regarding the etiology (Barkley, 1997; Sonuga-Barke, 2002). The variety of theories is likely representative of the heterogeneity of ADHD; ADHD is a multidimensional disorder, and the substantial etiological literature cites many likely pathways to ADHD (Scassellati et al., 2012; von Rhein et al., 2015). One widely acknowledged etiological factor, genetic transmission, plays a significant role in ADHD, with genetic factors accounting for 76% of the etiology of ADHD (Biederman & Faraone, 2005). Effective pharmacological treatments for ADHD (e.g., methylphenidate, atomoxetine, amphetamine) target the dopamine and norepinephrine systems, which implicate these systems in the etiology of ADHD symptoms (Dougherty et al., 1999; Dresel et al., 2000; Sharma & Couture, 2014). Cognitive theories of ADHD propose a relationship with insufficient frontostriatal brain activation (Sharma & Couture, 2014). These hypoactivation patterns negatively affect executive, attentional, and energetic functioning including emotion regulation (Sergeant, 2005).

There are likely complex interactions between these underlying biological factors and environmental variables to lead to ADHD (Sonuga-Barke & Halperin, 2010). One comprehensive biopsychosocial model is the triple pathway model (Sonuga-Barke et al., 2010). The three pathways of this model (Inhibitory Control, Delay Aversion, Temporal Processing) have been shown to represent independent neuropsychological pathways. Varying degrees of deficits in these three domains account for the heterogeneity of ADHD (Sonuga-Barke et al., 2010). Of relevance to the present study are the Inhibitory Control and Delay Aversion pathways.

In the triple pathway model, the characteristic impulsivity and inattention in those with ADHD is indicative of inhibitory deficits caused by mesocortical dopaminergic hypoactivity. These deficits lead to executive dysfunction which is expressed behaviorally as impulsivity and inattention and difficulties engaging in goal-directed behavior. Delay aversion, or the desire to access reward/reinforcement immediately, is a result of mesolimbic dopaminergic hypoactivity. Efforts to access proximal reinforcement and minimize the delay of reward lead to impulsivity, inattention, and hyperactivity (Sagvolden et al., 2005; Sonuga-Barke et al., 2010). Importantly, the triple pathway model predicts that not all individuals with ADHD will have impairments in all pathways yet those who do will be more functionally impaired (Sonuga-Barke et al., 2010).

ADHD in college students. Young adults with ADHD are less likely than their peers without ADHD to graduate from high school (Fleming et al., 2015) and to enroll in post-secondary education (Barkley et al., 2010). Despite lower college attendance rates and potential underdiagnosis, the prevalence rate of ADHD in college students is growing steadily. ADHD prevalence is currently estimated to be 8.7-9.5% in college students (*American College Health Association National College Health Assessment*, 2018; Wood et al., 2021), and this number increases to 9.7% when specifically considering college freshmen at private universities like Syracuse University (Stolzenberg et al., 2019).

In the transition to college, emerging adults with ADHD need to learn quickly to be autonomous in their decision making and develop new adaptive skills that may have not been needed in high school (Schaefer et al., 2017, 2018). As a result of challenges with both, students with ADHD often experience impairments in college including lower grade point averages and poorer social functioning (Lefler et al., 2016; Rabiner et al., 2008). Additionally, ADHD in college students is associated with comorbid mental health disorders (Anastopoulos et al., 2018), especially anxiety and depression (Anastopoulos et al., 2018; Coduti et al., 2016; Mochrie et al.,

2020; Nelson & Liebel, 2018; Rabiner et al., 2008) which develop in response to these collegiate impairments (Rabiner et al., 2008).

Social functioning in college students with ADHD. Children with ADHD have fewer friends and greater conflict with peers than children without ADHD (Cleminshaw et al., 2020; Surman et al., 2015). Additionally, children with ADHD are less well-liked and more socially rejected by peers than those without ADHD (Hoza, 2007), generally tending to have problematic peer relationships (Blachman & Hinshaw, 2002; Hoza, 2007; Normand et al., 2011).

Thus, by the time of college enrollment, many emerging adults with ADHD have developmental histories of social impairments. These social impairments often persist into young adulthood; ADHD symptoms are positively associated with social impairments in college students (Sacchetti & Lefler, 2017). The majority of college students with ADHD experience similar social difficulties to children with ADHD, such as having fewer friends and difficulty maintaining friendships (Bagwell et al., 2001; Sibley et al., 2010). Similar to children with ADHD (Aduen et al., 2018), these social dysfluencies in college students are thought to be performance-related and not knowledge-related (Fleming & McMahon, 2012). In other words, college students with ADHD know what behaviors are / are not socially skilled. However, despite having this knowledge, adults with ADHD have difficulties deploying their knowledge (Friedman et al., 2003) secondary to inhibitory control deficits and/or delay aversion (Sonuga-Barke et al., 2010).

Surprisingly, very little extant research has considered the extent to which frustration tolerance may impact performance of these socially skilled behaviors. Positing that there may be associations is supported by the "double deficit" literature. While not specific to ADHD, it is well accepted that those with weaker inhibitory control (as is present in ADHD) (Willcutt et al., 2005) are particularly impacted by the presence of strong emotions, like frustration (Gardner &

Steinberg, 2005). The present research study aims to fill this void in the literature by considering associations between experimentally induced frustration and self-report of social functioning.

Risky behaviors in college students with ADHD. Problematic substance use peaks in the early 20s (Littlefield et al., 2009). College students with ADHD are more likely to use marijuana and non-marijuana illicit substances and to experience both alcohol-related problems and alcohol-use disorders (Rooney et al., 2012, 2015) compared to college students without ADHD. Additionally, college students with ADHD are more likely to engage in risky sexual behaviors (e.g., condom-less sex) (Huggins et al., 2015; Van Eck et al., 2015). ADHD symptoms (e.g., impulsivity) (Balázs et al., 2018; Meza et al., 2016; Swanson et al., 2014) and poor frustration tolerance (Peterson et al., 2019) are independently associated with an increased risk of non-suicidal self-injurious behaviors (NSSI). The detrimental effects of these risky behaviors signal the importance of further examination in this population (Balázs et al., 2018; Bierhoff et al., 2019; Margherio et al., 2020; Owens & Hinshaw, 2020).

ADHD and Emotion Regulation

Although not part of the diagnostic criteria, a near ubiquitous associated feature of ADHD is deficient emotion regulation (Barkley, 2010; Hirsch et al., 2018). Emotion regulation overlaps considerably with the executive function of inhibitory control (Diamond, 2013) and refers to monitoring, evaluating and modifying one's emotions to accomplish goals (Thompson, 1994). Improved emotion regulation has also been associated with improvement in core ADHD symptoms (Surman et al., 2013), suggestive of a bidirectional relationship. A deficiency in emotion regulation is characterized by emotional impulsivity, weak expressive suppression, and mood lability (Barkley, 2010; Surman et al., 2013). Dysfunctional or deficient emotion regulation in those with ADHD contributes significantly to impairment in several domains

including social functioning (Flannery et al., 2016) and engagement in risky behaviors (Van Eck et al., 2017).

Distress tolerance. Distress tolerance, or the ability to tolerate negative or aversive emotional states, is a common coping strategy which subserves emotion regulation (Conway et al., 2020; Vujanovic & Zegel, 2020). Skills to increase distress tolerance are commonly included in interventions as a means of reducing ADHD symptoms and associated affective impairments (Matthies & Philipsen, 2014). Low distress tolerance often has detrimental effects which exacerbate the symptoms of ADHD and associated features (e.g., problematic substance use) (Leyro et al., 2010). Deficient emotion regulation in individuals with ADHD may increase impulsivity (Pedersen et al., 2019). One domain of impulsivity which is particularly linked to deficient emotion regulation in ADHD is negative urgency (Pedersen et al., 2019), or the tendency to act impulsively when experiencing negative affect like frustration (Egan et al., 2017).

A frequent example of distress tolerance is the ability to tolerate frustration. Tolerating frustration requires effortful acts of emotion regulation (Heatherton & Wagner, 2011), which can negatively impact the capacity to emotionally self-regulate in other domains (Hagger et al., 2010).

Frustration tolerance and irritability. While frustration is a normative affective response to blocked goal attainment, the commonly poor frustration tolerance in individuals with ADHD (Seymour et al., 2019; Surman et al., 2013) is characteristically associated with high levels of irritability (Seymour et al., 2020; Seymour & Miller, 2017; Skirrow et al., 2014).

Additionally, when frustrated, individuals with ADHD have greater levels of irritability, greater likelihood of quitting a frustrating task, greater focus on negative aspects of a task, and less constructive patterns of emotional coping (Melnick & Hinshaw, 2000; Seymour et al., 2016;

Walcott & Landau, 2004; Wheeler Maedgen & Carlson, 2000). Poor frustration tolerance and associated higher irritability is often associated with functional impairments, especially social, beyond those imparted by ADHD symptoms (Cleminshaw et al., 2020; Surman et al., 2015).

While several research studies have considered ADHD, frustration tolerance, irritability, and social functioning concurrently, all but one of those investigations have been conducted on children/adolescents, relied exclusively on self-report measures, and/or lacked theoretical underpinnings. The dearth of research in this area with college students with ADHD suggests that there is a need for further investigation.

The only previous adult study to experimentally investigate ADHD, frustration tolerance, irritability, and social functioning found that college students with ADHD were more likely to experience poor self-control than those without ADHD and that communications with romantic relationship partners were negatively impacted by an experimental self-control resource manipulation (Wymbs, 2018). This study did not consider engagement in risky behaviors or social functioning more broadly and focused only on romantic relationship communication patterns. Similar to the current study, this previous study used the Self-Control Strength Model as a theoretical foundation.

ADHD and Self-Control

Poor self-control has detrimental functional effects on adults with ADHD (Schwörer et al., 2020). Situational factors, or temporary external conditions (e.g., fatigue after a day at school), can negatively impact the ability to exhibit self-control and frequently precedes social conflicts in those with and without ADHD (DeWall et al., 2011; Wymbs, 2018).

The Self-Control Strength Model. The Self-Control Strength Model has been used to explain these temporary situational factors which can reduce self-control abilities. The Self-Control Strength Model considers the ability to exert self-control to be a limited resource which

can be exhausted (Baumeister et al., 2007; Hagger et al., 2010). This model proposes that engaging in an effortful task (e.g., a college student with ADHD studying for an Organic Chemistry test) will result in performance decrements on a subsequent task that requires emotional self-control (e.g., a college student with ADHD inhibiting frustration and irritability when a friend does not agree with an opinion).

Self-control resource depletion describes a state in which the likelihood of inhibiting frustration decreases secondary to antecedent exertion, temporarily diminishing an individual's finite amount of self-control (Hagger et al., 2010). Importantly, men and women experience comparable self-control depletion levels (Stucke & Baumeister, 2006).

Depletion has been induced in a controlled experimental setting in a variety of ways in individuals with ADHD (Wymbs, 2018) and without ADHD (Christiansen et al., 2012; DeWall et al., 2007; Muraven et al., 2002; Stucke & Baumeister, 2006; Watkins et al., 2015). Results demonstrate that depletion predicts a wide range of risky behaviors (e.g., excessive alcohol consumption, cannabis use, NSSI) (Christiansen et al., 2012; Muraven et al., 2002) in which college students with ADHD often engage, especially when stressed or frustrated (Egan et al., 2017; Fitzgerald & Curtis, 2017; Garcia et al., 2020). Although the associations between depletion and risky behaviors have been well studied in the general population, the extent to which these findings apply to college students with ADHD is unknown.

College students with ADHD may be more likely to experience self-control resource depletion than those without ADHD (Wymbs, 2018). Additionally, individuals with ADHD have more conflictual social relationships than those without ADHD (Robbins, 2005), and the depletion of self-control resources negatively impacts social communication and relationships in individuals with ADHD (Wymbs, 2018). Finally, the high prevalence of concurrent academic stressors and social impairments reported by college students with ADHD (Bagwell et al., 2001;

Fleming & McMahon, 2012; Lefler et al., 2016; Rabiner et al., 2008; Sacchetti & Lefler, 2017) also supports using the Self-Control Strength Model to further understand social impairments experienced by college students with ADHD (Fleming & McMahon, 2012; Weyandt & DuPaul, 2008). Studying for an Organic Chemistry test may well negatively impact subsequent social interactions for college students with ADHD more so than their non-ADHD peers.

Summary of Significance and Innovation

Characterized by high prevalence, associated functional impairments (especially academic and social), psychiatric comorbidities, negative long-term consequences, and persistence into adulthood, ADHD presents a significant public health problem (Akinbami et al., 2011; Biederman et al., 2002; Biederman & Faraone, 2005; de Schipper et al., 2015; Kessler et al., 2005; Killeen et al., 2011; Michielsen et al., 2015). Exemplifying these public health concerns and need for further empirical attention, college students with ADHD are more likely to engage in a wide variety of risky behaviors that have the potential for potential negative consequences (Balázs et al., 2018; Huggins et al., 2015; Rooney et al., 2012, 2015; Van Eck et al., 2015).

Using the Self-Control Strength Model as a theoretical framework, the overall objective of present study is to expand upon existing literature on college students with ADHD by experimentally investigating associations between self-control resource depletion, frustration tolerance, and irritability. Additionally, the present study will consider associations between depletion status, frustration tolerance, irritability, and worrisome functional outcomes for which college students with ADHD are at elevated risk including social functional deficits (Sacchetti & Lefler, 2017) and engagement in risky behaviors secondary to poor self-control (Shoham et al., 2019).

Hypotheses

Hypothesis 1: Total ADHD symptoms will be associated with observed frustration tolerance and reported irritability, and self-control resource depletion will intensify this difference. Specifically, those with higher reported ADHD symptoms will have lower frustration tolerance and higher irritability, and these associations will be more pronounced in the experimental (depletion) condition compared to the control (non-depletion) condition.

Hypothesis 2a: In the total sample, higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower self-reported state irritability.

Hypothesis 2b: In the total sample, higher abilities to tolerate frustration, regardless of depletion status, will be associated with higher self-reported social functioning.

Hypothesis 2c: In the total sample, higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower levels of self-reported hazardous alcohol consumption.

Hypothesis 2d: In the total sample, higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower levels of self-reported hazardous cannabis use.

Hypothesis 2e: In the total sample, higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower levels of self-reported engagement in risky sexual behaviors.

Hypothesis 2f: In the total sample, higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower levels of self-reported non-suicidal self-injurious behaviors.

Hypothesis 2g: In the total sample, higher abilities to tolerate frustration, regardless of depletion status, will be associated with (1) higher levels of reported tendency toward positive

response to dissatisfaction in close relationships and (2) lower levels of tendency toward negative response to dissatisfaction in close relationships.

Hypothesis 2h: In the total sample, higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower levels of reported state desire to engage in potentially high-risk behaviors (i.e., alcohol consumption, cannabis consumption, condom-less sex).

Hypothesis 3: ADHD symptoms will moderate the above associations.

Method

Study Overview

All eligible participants who consented to participate completed a virtual, remote, experimental study. Participation required the use of either a desktop or a laptop computer without a touchscreen, due to the nature of the experimental tasks (Stroop Color-Word Task; Paced Auditory Serial Addition Task – Computerized Version). Participants transitioned automatically between the Syracuse University SONA research participation system, Qualtrics, and Inquisit Web® (Millisecond Software). Following consent, participants completed state and trait baseline measures, including a measure of current ADHD symptoms, and were randomized into depletion and non-depletion groups before completing the two experimental tasks: the Stroop Color-Word Task (Stroop) to deplete self-control resources, and a computerized version of the Paced Auditory Serial Addition Task (PASAT-C) designed to induce frustration and measure frustration tolerance. Following the experimental tasks, participants completed additional state measures to determine the effects of the tasks and were debriefed.

To increase experimental control, mild deception was used in the current study recruitment. Participants were advertised a study with the primary goal of examining how

visuospatial skills may relate to friendships. Because deception was used, participants were debriefed upon study completion. The debriefing form outlined the true study purpose and procedures and provided participants with contact information for the research team to ask questions or to withdraw provided data. No participants contacted the research team regarding study deception following study completion.

Participants

Participants included 247 undergraduate students recruited from Syracuse University (SU) psychology courses. Of the 410 participants who initially consented to the study (excluding 20 students who participated more than once), 350 (85.4%) completed the entire study protocol. Of these 350 participants, 34 (9.7%) used a device with a touch screen (i.e., cellular phone, tablet), 26 (7.4%) failed at least one of the attention checks, and four (1.1%) used a stimulant medication on the day of protocol completion and thus were excluded from the sample. An additional 39 participants were excluded from analyses due to a high proportion of incorrect responses on the Stroop task (n=4), a Stroop response time <250 ms or >3000 ms (n=3) or reported decreased frustration following the Stroop and PASAT-C tasks (n=32). Please see Figure 1 for the participant elimination procedure.

The overall sample (n=247) was 25.6% male and 59.1% White/Caucasian, 24.3% Asian or Asian American, 6.1% Black or African American, and 0.8% Native American or Alaskan Native. Six participants (2.4%) were not represented by the racial categories provided, and 5 participants (2.0%) preferred not to provide information regarding race. In the overall sample, 12.1% of participants identified as Hispanic or Latinx and 4.0% preferred not to provide information regarding ethnicity. The mean age of the participants was 19.87 years (SD=1.31). The overall sample was 36.8% 1st year/Freshmen, 25.5% 2nd year/Sophomore, 20.2% 3rd

year/Junior, and 16.6% 4th year/Senior. Twenty-three participants (9.3%) reported ever being diagnosed with ADHD. See Table 1 for complete participant demographic data.

Inclusion/exclusion criteria. Recruitment was conducted through SU's SONA research participation system and five additional undergraduate psychology courses. Participants were enrolled in one or more of several courses, including PSY 205, PSY 252, PSY 274, PSY 335, PSY 442, and PSY 446. To participate in the study, those interested were required to be a) enrolled full-time as an SU undergraduate student; b) between 18 and 25 years old; and c) currently enrolled in a qualifying psychology course. No gender, ethnic or racial group was excluded from recruitment.

Participants recruited from PSY 205 completed a SONA prescreening to ensure eligibility to participate. Participants from all other courses completed a prescreening survey at the beginning of study protocol. Because an included measure, the Stroop Color-Word task, requires the ability to recognize colors, colorblindness was an exclusionary criterion. Additionally, all measures used were presented in English. Thus, inadequate command of the English language was also an exclusionary criterion. Potential participants with a history of psychosis, schizophrenia, bipolar disorder, autism spectrum disorder, or history of closed head injury were excluded as these may have interfered with protocol completion. Given the extensive psychiatric comorbidity of ADHD, the present study did not screen out comorbid conditions beyond those noted above.

Participants were asked about their use of medication for the treatment of ADHD. Because stimulant medication decreases impulsive behavior and increases sustained attention in individuals with ADHD (White et al., 2007), participants were asked not to take stimulant medication for 12 hours prior to competing the experimental study to eliminate ADHD medication as a potential confound. Participants were asked to report on their day-of-testing

stimulant medication status. Participants (*n*=4) who did not refrain from use of stimulant medication used to treat ADHD for 12 hours prior to completing the study were excluded from analyses.

Procedures

All study procedures were approved by the university's Institutional Review Board (IRB). All eligible participants who consented to participate transitioned automatically between SONA (PSY 205), Qualtrics, and Inquisit Web® to complete the study measures and the experimental tasks. Participants were required to use either a desktop or a laptop computer; no tablets, phones, or computers with a touchscreen were permitted. The Inquisit Web® platform allows experimenters to specify the type of device permitted using customizable script. This script was used to dictate acceptable devices, and it recorded the use of unacceptable devices. Participants were notified of this requirement during the informed consent process.

Participants were required to complete all measures and tasks in one session on Qualtrics and Inquisit Web®. Inquisit Web® provides each user with unique login information to record data, and any session left idle for 30 minutes was automatically terminated. Participants were given one week from the date of sign-up to complete the study measures. Participants completing the study to fulfill the PSY 205 research requirement received one SONA credit. Participants recruited through all other psychology courses were compensated with extra credit ranging from 1-4% of their total course grade. Participants who left the study vacant and attempted to return to the study were required to start from the beginning upon their return.

Prior to beginning the study measures, all participants completed online informed consent procedures. To mask the true aim of the study, participants received an introduction to the study that included mild deception. Participants were told that to goal of the present study was to

examine how visuospatial skills may relate to friendships. Upon completion of the study, participants were shown a debriefing message alerting them to the true aim of the study.

The study procedures and timeline are detailed in Figure 2. As noted in Figure 2, following informed consent, yet before completing the depletion (or non-depletion) cognitive task (Stroop) and the subsequent frustration tolerance task (PASAT-C), baseline self-report measures were administered. Baseline self-report measures queried ADHD symptoms, trait emotion regulation, trait negative urgency and lack of perseverance, trait frustration tolerance, social functioning, alcohol / cannabis use, sexual risk-taking behaviors, engagement in NSSI, state negative affect, and state irritability. After completing the pre-depletion self-report measures on Qualtrics, participants were randomly assigned to either complete a depleting task or to complete a non-depleting task on Inquisit Web® (see below for task descriptions). Participants were automatically directed from Qualtrics to Inquisit Web® to complete the experimental tasks. Following completion of these two cognitive tasks, participants were directed back to Qualtrics to complete the post-depletion self-report measures.

Immediately following the Stroop, participants completed a brief manipulation check consisting of three questions meant to gauge effort, perceived difficulty, and fatigue related to the Stroop (Figure 2). This brief Stroop manipulation check has been used in self-control resource depletion studies with significant differences noted between depleted / non-depleted conditions on all three items (Dang et al., 2017; Hagger et al., 2016). Following the brief manipulation check, participants completed the Paced Auditory Serial Addition Task (PASAT-C) to measure frustration tolerance.

Following the Stroop and PASAT-C, participants completed the state negative affect and state irritability measures for a second time. Additionally, participants completed measures of state desire to engage in risk-taking behaviors (i.e., alcohol/cannabis consumption, condom-less

sex) and engage in certain social relationship problem-solving methods. Participants provided sociodemographic data at the end of the study in an effort to make ADHD symptoms the most salient individual difference variable. Following all measure and task completion, participants were debriefed and compensated (1 SONA credit; 1-4% course extra credit). See Figure 2 for complete study procedures and timeline.

Experimental Measures

Please see Table 3 for complete information regarding assessment protocol including instrument, construct measured, and variable(s) used in the present study.

Self-control resource depletion induction.

Web-Stroop Color and Word Test (Stroop). A web-based version of the Stroop test (Stroop Color Word test with Keyboard Responding) was completed by all participants. The Stroop task (implemented on Inquisit Web®) is a common method of studying selective attention and response inhibition (Linnman et al., 2006). In this task, the participant is instructed to identify the color a word is printed in while simultaneously overriding the prepotent response to read the name of the word. In computerized Stroop tests, congruent color words as well as incongruent color words are presented one at a time, and reaction time for each item can be recorded. Participants were required to use designated keys (D=red, F=green, J=blue, K=black) on their keyboard to select a color and automatically proceeded to the next trial.

In the depletion condition, participants completed a complex Stroop task in which most trials were incongruent (256 trials, 75% incongruent, four different colors). In the control condition, all trials (256) were congruent and far lower in complexity. This trial number and presentation method has been used in past self-control resource depletion induction research (Dang et al., 2017; Kelly et al., 2015). Performance was recorded in Inquisit Web® and automatically saved.

The Stroop effect can be obtained by the use of Internet administration. Results from the computerized Stroop are comparable to results on the paper Stroop task (Penner et al., 2012). The computerized Stroop task has high test-retest reliability (DiBonaventura et al., 2010; Linnman et al., 2006). Importantly, a study examining the Stroop effect in individuals with and without ADHD showed identical interference effects for both populations (Schwartz & Verhaeghen, 2008).

Stroop Manipulation Check. To assess the depleting quality of the Stroop task, participants completed a three-item manipulation check meant to gauge perceived effort ("How much effort did you put into the color-naming task?"), difficulty ("How difficult did you find the color-naming task?"), and fatigue ("How tired do you feel after doing the color-naming task?") on a 7-point Likert scale (Dang et al., 2017; Hagger et al., 2016). Each domain of the manipulation check was individually analyzed for differences between the depletion and non-depletion conditions. These items have been used successfully to assess between-group differences (Dang et al., 2017). Successful depletion was operationalized as between group differences on all three items.

Immediately following the Stroop task and brief manipulation check, participants completed a frustration induction and tolerance cognitive task.

Frustration induction and tolerance.

Paced Auditory Serial Addition Task (PASAT-C). Frustration was induced and tolerance was assessed with the Paced Auditory Serial Addition Task-Computerized Version (PASAT-C; Lejuez et al., 2003). The PASAT (Gronwall & Sampson, 1974) is a visual and/or auditory serial addition task. Administration in the present study involved visually presenting participants with random series of digits from 1 to 9; participants were instructed to continuously sum the two most recently presented digits. The second digit was added to the first, the third to the second,

etc. A correct response must be made before presentation of the next stimulus in order to receive a correct response score. The PASAT demonstrates good psychometric properties such as high levels of construct validity (Gratz et al., 2006), internal consistency (α = .81 - .90), and test-retest reliability (α = .90 - .97) and reasonable levels of convergent validity as a measure of attention/concentration (% agreement: 75%) (Crawford et al., 1998; McHugh et al., 2011; Tombaugh, 2006). Importantly, the PASAT is weakly correlated with arithmetic skills (r = .28) (Gronwall & Sampson, 1974; Gronwall & Wrightson, 1981), and it is assumed that randomization equally distributed participants of varying arithmetic abilities between conditions.

The computerized version of the PASAT (PASAT-C; Lejuez et al., 2003) was designed to measure frustration tolerance, and consisted of three difficulty levels ranging from low (Level 1) to high (Level 3) and lasting 3 minutes, 5 minutes, and 10 minutes (maximum), respectively. This task has been shown to induce frustration among clinical and nonclinical samples (Bornovalova et al., 2008; Gratz et al., 2006; Lavender et al., 2017; Lejuez et al., 2003) and to adequately measure frustration tolerance (Winward et al., 2014). The PASAT-C can be administered using one of two formats; one in which participants select their response by using the cursor on a computer, and one in which participants provide their response verbally. The present study used cursor response, and the digits were presented at the center of a circle formed by response options (the numbers 1-18).

During administration of the PASAT-C, Level 1 automatically transitions to Level 2 without warning, which is followed by the presentation of an instructional trial for Level 3 (Lejuez et al., 2003). During Level 1 digits are presented every 3 seconds. Digit presentation is reduced to every 2 seconds during Level 2 and every 1.5 seconds during Level 3. Participants are provided corrective feedback in the form of an aversive error sound following each error. To ensure that participants who made errors heard the error sound at a similar volume, all

participants were instructed to set their computer's volume to 75% of its maximum volume. Participants were not provided an opportunity to terminate the PASAT-C in Levels 1 and 2. However, participants were instructed during Level 3 that they had the option to terminate the procedure (Quit button presented on the screen in Level 3). The participant was not told that the task automatically terminated at 10 minutes (Daughters et al., 2005; Daughters et al., 2005; Lejuez et al., 2003). Consistent with the precedent in the field (Lejuez et al., 2003), frustration tolerance using the PASAT-C was indexed as time in milliseconds until task termination of level 3.

PASAT-C Manipulation Check. Change scores from the Positive and Negative Affect Scale (PANAS) were calculated and used as a manipulation check to gauge the level of frustration induced by the PASAT-C. Pre-PANAS scores were subtracted from post-PANAS scores, and participants with difference scores below 0 (*n*=32; reported *less* negative affect following the PASAT-C) were excluded from analyses.

Self-Report Measures

Self-report measures of ADHD symptoms, trait emotion regulation, trait impulsivity (negative urgency, lack of perseverance), trait frustration tolerance, state irritability, state affect, social functioning, alcohol use, cannabis use, unprotected sex, non-suicidal self-injurious behaviors, and standard demographic information were collected. Bivariate correlations are reported for all study self-report measures (See Tables 3 and 4).

Attention Checks. Participants were presented with attention check questions at three points in the survey: Two during the pre-(depletion) induction surveys and one during the survey following the frustration tolerance task. The purpose of these questions was to "catch" participants who were not dedicating their full attention to the survey questions and the answers

that they provided. Only those participants who passed all three attention checks were included in analyses.

ADHD history. The following three questions were asked at the end of the study protocol to assess if participants have a previous history of ADHD diagnosis and/or a history of taking ADHD medication: 1) Have you ever been diagnosed with a mental health condition (e.g., anxiety, depression, ADHD)? If yes, please describe which one(s). 2) Do you take any medications? If so, please list and say for what purpose. 3) If you have been prescribed a stimulant medication, have you taken this medication today? The first question was used to describe the sample. The third question was used to make determinations about using a participant's data in analyses.

Adult ADHD Self-Report Scale (ASRS-v1.1). The ASRS is an 18-item instrument derived from *DSM-IV* criteria for ADHD, consisting of inattention and hyperactivity / impulsivity subscales (Kessler et al., 2005). The ASRS was designed to measure the current manifestation of symptoms in individuals aged 18 and older (Gray et al., 2014). Ratings are based on the frequency of symptoms and measured on a 5-point Likert scale (0 *(never)* – 4 *(very often)*). Internal consistency is high ($\alpha = .88$), and there is good concurrent validity and acceptable agreement for individual items (% agreement: 43%–72%) (Adler et al., 2006). All participants, regardless of reported diagnosis, completed the ASRS about their current ADHD symptoms. In the present study, hyperactivity-impulsivity and inattention subscale scores were combined, and only the total ADHD symptom score was used for hypothesis testing. ASRS total scores can range from 0-72, with a score 24 on either subscale (thus, a total score of 48) indicating likely ADHD (Kessler, Adler, et al., 2005). Mean total scores for individuals with ADHD (49.45; $SD = 22.73$) and without ADHD (32.48; $SD = 16.66$) have been reported (Adler et al., 2019). Internal consistency for the ASRS in the present study is good ($\alpha = .88$).

Difficulties in Emotion Regulation Scale (DERS). The DERS is a 36-item measure used to assess trait emotion dysregulation (Gratz & Roemer, 2004). Participants are asked to respond on a 5-point Likert scale where 1 is *almost never (0-10%)* and 5 is *almost always (91-100%).* The 36 items are distributed across six factors: Nonacceptance of Emotional Responses; Difficulties Engaging in Goal-Directed Behavior; Impulse Control Difficulties; Lack of Emotional Awareness; Limited Access to Emotion Regulation Strategies; and Lack of Emotional Clarity. DERS internal consistency is high (α = .93) and all of the DERS subscales have adequate internal consistency (α > .80). The DERS also has good test–retest reliability, adequate construct validity, and adequate predictive validity (Gratz & Roemer, 2004).

In the present study, to reduce participant burden, participants completed only items on three DERS subscales: Difficulties Engaging in Goal-Directed Behavior, Impulse Control Difficulties, and Limited Access to Emotion Regulation Strategies. These three subscales were selected due to their higher sensitivity to an ADHD diagnosis (Barkley, 2010; Surman et al., 2013). This measure of trait emotion regulation was completed prior to the depletion and frustration tolerance tasks. These three DERS subscales were treated as separate and used in analyses to describe the sample. In the present study, total DERS internal consistency was excellent (α = .94) and all of the DERS subscales had good to excellent internal consistency (α = .87-.90).

Urgency, Premeditation, Perseverance, and Sensation Seeking Impulsivity Scale (UPPS). The UPPS (Whiteside & Lynam, 2001) is a 45-item self-report measure using a 4-point Likert scale where 1 is *strongly agree* and 4 is *strongly disagree*. This instrument is used to measure four distinct pathways to trait impulsivity: (lack of) Premeditation, (negative) Urgency, Sensation Seeking, and (lack of) Perseverance. The four scales have 11, 12, 12, and 10 items respectively. The inventory was derived through a factor-analytic method that included well

known impulsivity scales. Median intercorrelation is $r = .34$, suggesting that the scales measure overlapping yet distinct constructs (Whiteside et al., 2005). Whiteside and Lynam (2001) presented information on the internal consistency, as well as divergent and external validity of the UPPS.

In the present study, to reduce participant burden, participants completed only the UPPS Negative Urgency and Lack of Perseverance subscales prior to the depletion and frustration tolerance tasks. The *a priori* decision to focus on these two constructs is that each measures frustration intolerance (Negative Urgency) and general inability to remain engaged in a task (Lack of Perseverance) (Egan et al., 2017; Whiteside & Lynam, 2001). Moreover, Whiteside and Lynam (2005; 2001) identified Negative Urgency ($\alpha = .86 - .89$) and Lack of Perseverance ($\alpha = .82 - .83$) as being independent constructs. These two UPPS subscales were treated as separate and used in analyses to describe the sample.

UPPS modification. The 4-point Likert scale of the UPPS was restructured into a 6-point Likert scale with new anchors at 1 (*completely agree)* and 6 (*completely disagree).* The Likert response technique was originally developed as a 5-point rating scale anchored at *strongly agree* and *strongly disagree* (Likert, 1932). Modifications to this scale have been made over time, and formats used vary greatly in the number and nature of response options. Importantly, precision of measurement and reliability increase as the number of response categories increases (Shi et al., 2020). Internal consistency was excellent for Negative Urgency ($\alpha = .92$) and good for Lack of Perseverance ($\alpha = .86$) in the present study. These findings provide support for the restructuring of the Likert scale used for the UPPS.

Frustration Discomfort Scale (FDS). The FDS is a 28-item trait measure of beliefs that people may have when they are frustrated (Harrington, 2005). Items are rated on a 5-point Likert scale ranging from 1 (*absent*) to 5 (*very strong*), with higher scores indicating greater discomfort

with frustration/frustrating situations. Items load onto four factors: (1) discomfort intolerance, (2) entitlement, (3) emotional intolerance, and (4) achievement (Harrington, 2005). Harrington (2005) provides evidence of good internal reliability and discriminative validity. To reduce participant burden, the present study used only Factor 1, discomfort intolerance, which is comprised of seven items involving intolerance of difficulties and hassles. This decision was made due to the high face validity of these items to the construct of frustration tolerance. The FDS was used to describe the sample. Internal consistency was excellent for the FDS ($\alpha = .90$) in the present study.

Positive and negative affect schedule (PANAS). The PANAS is a 20-item self-report scale that assesses state positive (e.g., "enthusiastic" and "attentive") and negative (e.g., "upset" and "irritable") emotions (Watson et al., 1988). Because our study aim is to induce negative affect, participants only indicated their state negative affect on the 10 *negative affect* items. The PANAS shows good reliability ($\alpha = 0.86 – 0.90$ for positive and 0.84 – 0.87 for negative items). Previous studies have used the PANAS before and after mood inductions to assess affective state change (Dowd et al., 2010; Gratz et al., 2013; Randall & Cox, 2001). Accordingly, the PANAS was administered immediately before and after the depletion (or non-depletion) and frustration tolerance tasks to provide concurrent validity for the depletion and frustration tolerance manipulations.

Participants indicated on a scale of 0 *(not at all)* to 10 *(extremely)* the extent to which they were currently feeling the emotion indicated. Because our mood induction aimed to induce frustration, a slightly modified version of the original PANAS scale was used. "Frustrated," the main emotion variable of interest, replaced "afraid" because "scared" was already included in the measure, and there was limited justification for having two separate items related to fear. "Embarrassed" replaced "ashamed," as it is a less intense adjective for feeling regret, and "mad"

replaced “guilty,” as it has a closer relation to the main variable of interest (frustration). A modification of the PANAS similar to this has been done in several other published studies (Amstadter et al., 2012; Loya et al., 2019; Reynolds et al., 2013). Internal consistency was excellent for both the pre-PANAS (α = .91) and the post-PANAS (α = .91) in the present study.

Brief Irritability Test (BITe). The BITe (Holtzman et al., 2015) is a 5-item measure of state irritability. Items are rated on a 6-point Likert scale ranging from 1 *(never)* to 6 *(always)* and averaged together to create a mean irritability score. The scale demonstrates good internal consistency (α = .88) and good concurrent validity with two other widely-used measures of irritability, the Irritability Questionnaire (IRQ) (*r* = .80) and the Born-Steiner Irritability Scale (BSIS) (*r* = .86) (Born et al., 2008; Craig et al., 2008; Holtzman et al., 2015). Additionally, all 5 items are highly face valid and show minimal conceptual overlap with related constructs (e.g., frustration) used in this study (Holtzman et al., 2015). BITe questions are framed broadly (“have been”) yet in the present study were modified to ask about current (“am,” “are”) feelings of irritability. Participants completed this measure of irritability twice: prior to and following the depletion and frustration tolerance tasks. The post-pre BITe difference score is used in hypothesis testing (described below). Internal consistency was excellent for both the pre-BITe (α = .91) and the post-BITe (α = .92) in the present study.

Social Functioning.

The Impairment Rating Scale (IRS). The IRS is a 12-item self-report visual analogue measure developed as a rating scale for severity of ADHD-related impairment across the lifespan (Fabiano et al., 2006). Raters are asked to place an *X* on a line signifying one’s placement on a continuum of functioning. This line is divided into seven equally spaced segments for scoring, with scores ranging from 0 *(no problem)* to 6 *(extreme problem).* In the present study, participants were asked to use a slider ranging from 0 (*no problem*) to 10 (*extreme problem*). The

IRS is stable over one year and reliable between informants (r = .78). The IRS also demonstrates good concurrent, convergent, and discriminant validity and is effective in discriminating between individuals with and without ADHD (i.e., sensitivity > .65) (Fabiano et al., 2006). The one domain of social functioning was isolated for analyses in the present study and was the only IRS scale used in hypothesis testing (see below).

Two additional questions regarding positive "How positive are your relationships with friends?" and negative "How negative are your relationships with friends?" relationships with friends were added to the assessment of social functioning. The two questions used similar 11-point Likert scales.

The three social relationships items were used independently in hypothesis testing.

Exit, Voice, Loyalty, Neglect (EVLN). The EVLN is a 28-item trait measure of responses to dissatisfaction that describes a broad range of reactions to periodic decline in close relationships (Rusbult, 1993; Rusbult et al., 2013). The EVLN typology consists of four constructs/ responses. Exit describes any attempt being undertaken to escape from a dissatisfying situation; contrary to Exit, Voice refers to one's attempt to change a dissatisfying situation, rather than escaping from it; Loyalty reflects a passive response, with individuals hoping and waiting until conditions improve; Neglect, like Exit, is a destructive response, and is also considered as a passive reaction. Neglect involves those responses which passively do not allow conditions to improve.

EVLN items are rated on a 9-point Likert scale ranging from 1 (*I never do this*) to 9 (*I always do this*), with higher scores indicating greater tendency to respond either positively (Voice, Loyalty) or negatively (Exit, Neglect) to hypothetical dissatisfaction in close relationships. EVLN questions are open-ended and response options are broad. In the present study, EVLN items were modified to ask about current (*"at this moment"*), state-level response

to hypothetical dissatisfaction in close relationships. To reduce participant burden, the present study used only one item from each construct is used (Exit - *If things were going really poorly between us at this moment, I would do things to drive my friends away*; Voice - *If my friends and I had problems at this moment, I would discuss things with them*; Loyalty - *If my friends and I were angry with each other at this moment, I would give things some time to cool off on their own rather than take action*; Neglect - *If I was really angry at this moment, I would treat my friends badly (for example, by ignoring them or saying cruel things*). This decision was made due to the high face validity of these four items to the individual constructs. Similar to previous studies, these items were combined into two scales which have been shown to have acceptable internal reliability (Positive [$\alpha = .76$], Negative [$\alpha = .79$]) (VanderDrift et al., 2019). Internal consistency was poor for both the Positive ($\alpha = .32$) and Negative ($\alpha = .52$) scales in the present study.

Risky Behaviors.

Alcohol Use Disorders Identification Test-Consumption (AUDIT-C). The AUDIT is a 10-item questionnaire used to determine if a person's alcohol consumption may be harmful. The AUDIT includes 3 items assessing alcohol consumption, 3 items assessing alcohol dependence, and 4 items assessing alcohol related problems. The present study used a truncated version of the AUDIT, measuring only consumption. The AUDIT-C is comprised of the first three questions from the AUDIT. Participants are asked to respond on a scale from 0 *(never)* to 4 *(4 or more times a week)* regarding the frequency of consumption and/or the experience of symptoms related to problematic drinking. The maximum possible score is 12. Based on areas under the receiver operating characteristic curves (.94 and .91 in men and women, respectively), AUDIT-C scores of 7 (men)/5 (women) were used as cut-points for hazardous/non-hazardous use (Campbell & Maisto, 2018). Examination of the alpha coefficients show that there is high

reliability (α = .76), sensitivity (.73 - .86), and specificity (.89 - .91) towards an alcohol use disorder diagnosis (Barry et al., 2015; Bradley et al., 2007). Internal consistency is acceptable for the AUDIT-C (α = .79) in the present study. This dichotomized variable—hazardous/non-hazardous—was used in hypothesis testing (see below).

Cannabis Use Disorders Identification Test-Revised (CUDIT-R). The CUDIT is a 10-item questionnaire based upon the Alcohol Use Disorders Identification Test. It is used for screening cannabis abuse and dependency (Adamson & Sellman, 2003). The CUDIT includes three items assessing consumption, three items assessing dependence, and four items assessing consequences. The CUDIT-R was adapted from the original CUDIT and designed to be an improved brief measure of cannabis misuse; the resulting CUDIT-R measure is 8-items. Participants are asked to respond on a scale from 0 *(never)* to 4 *(4 or more times a week)* regarding the frequency of use and/or the experience of symptoms related to problematic cannabis use. The maximum possible score is 32, and a score of 8 is considered hazardous use for both men and women (Adamson, Kay-Lambkin, Baker, Lewin, Kelly, et al., 2010). Psychometric evaluation has shown internal consistency (α = .91) and test-retest reliability (r = .85 - .87) to be good, and sensitivity (.91) and specificity (.90) to be high (Adamson et al., 2010). Internal consistency is good for the CUDIT-R (α = .80) in the present study. The CUDIT-R total score was used to create a dichotomous variable—hazardous/non-hazardous—based on the above cut-off point. This dichotomized variable was used in hypothesis testing (see below).

Sexual Risk Survey (SRS). The SRS is a 23-item questionnaire developed to measure engagement in risky sexual behaviors during the previous six months among college students (Turchik & Garske, 2009). This instrument is used to measure five factors including Sexual Risk Taking with Uncommitted Partners (8 items), Risky Sex Acts (5 items), Impulsive Sexual Behaviors (5 items), Intent to Engage in Risky Sexual Behaviors (2 items), and Risky Anal Sex

Acts (3 items). For each item, frequency responses are recoded using a 0-4 scale, with a total possible score of 0 to 92. In the present study, the SRS total score is used in hypothesis testing. Overall internal reliability is high (α = .90), and subscale reliability is high as well (α = .90, .82, .79, .81, and .63 for subfactors listed above, respectively (Turchik et al., 2015). There is good test-retest reliability (α = .93) and evidence of convergent validity with lifetime number of sexual behavior partners (*r* = .58; (Turchik & Garske, 2009)). In the present study, SRS internal consistency was excellent (α = .92) and the first four SRS subscales had acceptable to excellent internal consistency (α = .75 - .90). Similar to past findings (Turchik et al., 2015), internal consistency for the Risky Anal Sex Acts subscale was questionable (α = .66).

Functional Assessment of Self-Mutilation (FASM). The FASM is a two-part assessment of the methods, frequency, and functions of self-reported non-suicidal self-injury (NSSI). Part one consists of a checklist of 11 NSSI behaviors plus the inclusion of a fill-in 'other' category. Participants are asked to respond about whether they have purposefully engaged in each behavior within the past year, the frequency of occurrence, and whether medical treatment was obtained. Part two is comprised of a checklist of 22 statements assessing motivations for NSSI, rated on a Likert scale ranging from 0 (*never*) to 3 (*often*) (Lloyd, 1997). The present study used only part one of the FASM to ask about occurrence and the number of different methods of NSSI behaviors.

The FASM has demonstrated adequate internal consistency (α = .65 - .66) (Lloyd-Richardson et al., 2007) and concurrent validity with measures of suicide ideation and past attempts (Guertin et al., 2001), as well as recent attempts, hopelessness, and depressive symptoms (Nock & Prinstein, 2005). Similar to past findings (Lloyd-Richardson et al., 2007), internal consistency for the FASM was questionable (α = .63) in the current study. The total number of endorsed methods of NSSI behaviors was summed and used in hypothesis testing, and

frequency was dichotomized into 'endorsed NSSI engagement' and 'no endorsed NSSI engagement' (see below).

***State Desire to Engage in Potentially High-Risk Behaviors*.** Three questions were asked following the two Inquisit Web® cognitive experimental tasks to assess state desire to engage in potentially high-risk behaviors (S-ERB). Questions asked about state desire to consume alcohol "*My urge to drink right now is*…", state desire to use cannabis "*My urge to consume marijuana / cannabis right now is*…", and state desire to engage in condom-less sex "*My urge to engage in condom-less sex right now is*…". The three questions all used an 11-point Likert scale ranging from 0 (*absent*) to 10 (*very strong*).

Demographics. Participants provided demographic data on race, ethnicity, gender, age, sexual orientation, and year in school. See Table 1 for demographics of the study sample.

Preliminary Analyses

Analyses were conducted in SPSS-26. Power analyses were conducted in G*Power 3.1.

Power analyses. *A priori* power estimates using effect sizes from previous research examining predictive factors (e.g., ADHD, frustration tolerance) of engagement in risky behaviors (Lejuez et al., 2003; Mitchell et al., 2019; Nock & Mendes, 2008) were calculated using G*Power. Based on a projected medium effect size, power of .80 and $\alpha = .05$, a sample size of 179 participants was needed to attain adequate statistical power for hypothesis 1. Using the same parameters, a sample size of 98 was needed to attain adequate statistical power for hypotheses 2 and 3. Thus, with a sample size of 247 participants, the present study was adequately powered.

Pre-Analytic Data Management

Depletion manipulation check. Past research on the use of the Color-Word Stroop Task in college students indicates an error rate of 0.68 errors per 24 items with a standard deviation of

0.96 errors (Spreen & Strauss, 1998). This error rate percentage was used as a manipulation check. The number of Stroop items in the present study is 256; at the above normative error rate, it is expected that participants will make 7.25 errors with a standard deviation of 10.24. Due to failure to adequately engage with the depletion task, four participants with a one standard deviation or greater error rate (≥17.49 errors; rounded up to 18) on the Stroop task were excluded from analyses.

Additionally, past research has used response/reaction time cutoffs of <250 ms and >3000 ms. Responses falling beyond these two anchor parameters are considered to be lapses of attention (Mitchell et al., 2019). Three participants fell outside of these parameters for response/reaction time and were excluded from analyses.

A one-way MANOVA was performed to compare the effect of depletion status on Stroop effort, difficulty, and fatigue. Results revealed that there was no statistically significant difference between the depletion and non-depletion conditions in perceived Stroop effort ($F(1,245) = .629$, $p = .428$) or fatigue ($F(1,245) = 3.34$, $p = .069$). There was a statistically significant difference in perceived difficulty of the Stroop task between the depletion and non-depletion conditions ($F(1,245) = 30.87$, $p < .001$, $\eta^2 = .112$). Thus, participant self-report on these manipulation check items suggests that the Stroop Color Word Test only partially achieved the desired depletion outcomes.

Normality. All variables were assessed for normality. Total ADHD symptoms, frustration tolerance (PASAT-C Level 3 persistence duration), state irritability (BITe change), and the interaction term for ADHD and frustration tolerance were mean-centered. Mean-centering resulted in normal to relatively normal distributions; mean-centered skewness and kurtosis values were between -2 and 2, indicating normal to relatively normal distributions (George & Mallery, 1999).

Covariate determination. Bivariate correlations between study measures were computed and significant ($r > .30$) sociodemographic and descriptive associations with outcome variables were used as covariates in hypothesis testing analyses. As demonstrated in Table 6, several bivariate associations reached significance. The following demographic and descriptive variables were used as covariates in the respective analyses: race (H2b, c, d, e, and g; H3b, c, d, e, and g), ethnicity (H2g; H3g), gender (H2b, d, f, and h; H3b, d, f, and h), sexual orientation (H2b and f; H3b and f), $DERS_{total}$ (H2a, b, d, f, g, and h; H3a, b, d, f, g, and h), $UPPS_{total}$, (H2b, c, d, e, f, and h; H3b, c, d, e, f, and h), and FDS_{total} (H2a, b, f, g, and h; H3a, b, f, g, and h). Regarding Hypothesis 1 testing, $DERS_{total}$ and FDS_{total} (covariates) were not used in analyses due to their considerable associations with ADHD (Hirsch et al., 2018; Seymour et al., 2019). Covarying for these constructs would also remove a significant portion of ADHD influence; when the covariate is an attribute of the disorder, it is problematic to "adjust" for differences in the covariate (Miller & Chapman, 2001). Please see Table 6 for complete study correlation bivariate associations.

Planned Analyses

Hypothesis 1: ADHD was treated as a continuous variable and depletion status was treated categorically (depletion/no depletion). Multiple hierarchical linear regressions were used to compare the main effects of ADHD symptoms and depletion status as well as their interaction effects on frustration tolerance (PASAT-C Level 3 persistence duration) and state irritability (BITe change scores). As has been done in other studies, time to termination of Level 3 served as the primary dependent variable to index frustration tolerance (Lejuez et al., 2003; Mitchell et al., 2019).

Hypotheses 2 and 3: Multiple hierarchical linear (n=10) and logistic (n=3) regressions were used to examine associations between frustration tolerance, state irritability, social

functioning, and engagement in risky behaviors in the total sample, and to test the moderation hypothesis that stronger associations were present in participants with higher reported ADHD symptoms. For Hypothesis 2, only blocks including covariates and frustration tolerance were interpreted. See Table 7 for all linear regression results and Table 8 for all logistic regression results.

Results

Randomization

Prior to considering hypotheses, descriptive statistics were conducted for both experimental conditions. Then, chi-square analyses and ANOVAs were used to determine if randomization was successful.

Depletion condition descriptive statistics. As demonstrated in Table 1, 127 participants were in the depletion condition. Regarding depletion condition demographics, the mean age was 19.82 (*SD*=1.27). This sample was 19.70% men and 83.50% heterosexual. The majority were White/Caucasian (61.50%) and were not Hispanic or Latinx (85.80%). This condition was 35.40% 1st Year/Freshman students and 11.80% reported a previous diagnosis of ADHD.

The mean ADHD symptom score was 33.16 (*SD*=10.39). The mean score was 15.05 (*SD*=4.75) for DERS-Goals, 12.41 (*SD*=4.86) for DERS-Impulse, and 19.35 (*SD*=7.44). for DERS-Strategies. The mean score was 18.78 (*SD*=6.23) for the FDS, 0.71 (*SD*=1.10) for BITe change score, and 3.44 (*SD*=6.23) for PANAS change score. The above means are consistent with past college student research (Dowd et al., 2010; Lewandowski et al., 2008; Lu et al., 2019; Mestre-Bach et al., 2021). The mean score was 44.93 (*SD*=11.20) for UPPS-Negative Urgency, 28.18 (*SD*=7.74) for UPPS-Perseverance. Both UPPS-Negative Urgency and UPPS-

Perseverance ratings are higher than previous studies have found (Egan et al., 2017), however there are no group differences (see Group Comparisons below).

Regarding outcome variables, the mean score was 1.98 (*SD*=1.95) for the IRS, 8.32 (*SD*=1.55) for positive relationships, and 1.37 (*SD*=1.22) for negative relationships. In the depletion condition, 66.10% of participants did not report hazardous alcohol consumption, 82.7% did not report hazardous cannabis use, and 44.90% never engaged in NSSI. The mean types of NSSI were 1.18 (*SD*= 1.44), mean score was 12.61 (*SD*=13.89) for the SRS, and the mean PASAT-C persistence duration was 6.63 minutes (*SD*= 4.51). The mean score was 6.72 (*SD*= 2.10) for the EVLN-Positive, 3.02 (*SD*= 1.49) for the EVLN-Negative, 1.16 (*SD*= 2.20) for the S-ERB (Alcohol), 1.34 (*SD*= 2.84) for the S-ERB (Cannabis), and 1.12 (*SD*= 2.25) for the S-ERB (Condom-less Sex). All but one of these ratings are consistent with past college student research (Balázs et al., 2018; Couture et al., 2020; O'Malley & Johnston, 2002). SRS ratings are lower than previous studies have found (Turchik & Garske, 2009), however there are no group differences (see Group Comparisons below).

Non-depletion condition descriptive statistics. As demonstrated in Table 1, 120 participants were in the non-depletion condition. Regarding non-depletion condition demographics, the mean age was 19.93 (*SD*=1.36). This sample was 31.90% men and 85.00% heterosexual. The majority were White/Caucasian (63.20%) and were not Hispanic or Latinx (81.70%). This condition was 38.30% 1st Year/Freshman students and 6.7% reported an ADHD diagnosis.

The mean ADHD symptom score was 31.78 (*SD*=11.24). The mean score was 14.65 (*SD*=5.00) for DERS-Goals, 12.53 (*SD*=4.88) for DERS-Impulse, and 19.53 (*SD*=7.19) for DERS-Strategies. The mean score was 19.25 (*SD*=5.50) for FDS, 0.71 (*SD*=1.12) for BITe change score, and 3.68 (*SD*=6.48) for PANAS change score. These findings are consistent with

past college student research (Dowd et al., 2010; Lewandowski et al., 2008; Lu et al., 2019; Mestre-Bach et al., 2021). The mean score was 46.42 (*SD*=11.75) for UPPS-Negative Urgency, 27.38 (*SD*=8.23) for UPPS-Perseverance. Both UPPS-Negative Urgency and UPPS-Perseverance ratings are higher than previous studies have found (Egan et al., 2017), however there are no group differences.

Regarding outcome variables, the mean score was 1.95 (*SD*=2.13) for the IRS, 8.07 (*SD*=1.17) for positive relationships, and 1.61 (*SD*=1.71) for negative relationships. In the non-depletion condition, 66.00% of participants did not report hazardous alcohol consumption, 83.30% did not report hazardous cannabis use, and 55.80% never engaged in NSSI. The mean types of NSSI were 0.91 (*SD*= 1.36), mean score was 12.73 (*SD*=13.26) for the SRS, and the mean PASAT-C persistence duration was 6.49 minutes (*SD*= 4.49). The mean score was 6.61 (*SD*= 2.09) for the EVLN-Positive, 3.32 (*SD*= 1.73) for the EVLN-Negative, 1.10 (*SD*= 1.99) for the S-ERB (Alcohol), 1.02 (*SD*= 2.45) for the S-ERB (Cannabis), and 1.47 (*SD*= 2.47) for the S-ERB (Condom-less Sex). All but one of these ratings are consistent with past college student research (Balázs et al., 2018; Couture et al., 2020; O'Malley & Johnston, 2002). SRS ratings are lower than previous studies have found (Turchik & Garske, 2009), however there are no group differences.

Group Comparisons. There was a significant difference in gender between the depletion and non-depletion groups. However, no other significant demographic differences were found between groups. Additionally, no significant group differences were found in outcome variables between the depletion and non-depletion groups, including PASAT-C persistence duration. This further supports that the Stroop Color Word Test did not achieve the expected depleting effect. See Table 1 for all demographics and group characteristics.

Ancillary Analyses

Descriptive statistics are presented for both low (</= 47) and high (>/=48) ADHD symptom groups. Chi-square analyses and ANOVAs were used to determine if randomization was successful.

Low ADHD symptom descriptive statistics. As demonstrated in Table 2 226 participants (91.4% of total sample) were in the low ADHD symptoms group. Regarding low ADHD group demographics, the mean age was 19.89 (*SD*=1.57). This subsample was 25.70% men and 84.50% heterosexual. The majority were White/Caucasian (60.60%) and were not Hispanic or Latinx (84.50%). This condition was 37.60% 1st Year/Freshman students and 7.50% reported ever receiving an ADHD diagnosis.

The mean score was 14.48 (*SD*=4.83) for DERS-Goals, 12.00 (*SD*=4.60) for DERS-Impulse, and 18.91 (*SD*=7.19) for DERS-Strategies. The mean score was 18.85 (*SD*=5.69) for the FDS, 0.72 (*SD*=1.06) for BITe change score, and 3.50 (*SD*=6.25) for PANAS change score. The mean score was 46.28 (*SD*=11.16) for UPPS-Negative Urgency and 27.61 (*SD*=7.89) for UPPS-Perseverance.

Regarding outcome variables, the mean score was 1.85 (*SD*=1.95) for the IRS, 8.25 (*SD*=1.58) for positive relationships, and 1.44 (*SD*=1.45) for negative relationships. In the low ADHD symptoms group, 76.10% of participants did not report hazardous alcohol consumption, 85.00% did not report hazardous cannabis use, and 53.10% never engaged in NSSI. The mean types of NSSI were 0.95 (*SD*= 1.34), mean score was 11.90 (*SD*=13.19) for the SRS, and the mean PASAT-C persistence duration was 6.70 minutes (*SD*= 4.45). The mean score was 6.62 (*SD*= 2.11) for the EVLN-Positive, 3.09 (*SD*= 1.55) for the EVLN-Negative, 1.12 (*SD*= 2.13) for the S-ERB (Alcohol), 1.04 (*SD*= 2.47) for the S-ERB (Cannabis), and 1.21 (*SD*= 2.43) for the S-ERB (Condom-less Sex).

High ADHD symptom descriptive statistics. Twenty-one participants (8.5% of total sample) were in the high ADHD symptoms group. Regarding high ADHD symptom group demographics, the mean age was 19.71 (*SD*=1.01). This sample was 23.80% men and 81.00% heterosexual. The majority were White/Caucasian (81.00%) and were not Hispanic or Latinx (76.20%). This condition was 28.60% 1st Year/Freshman students and 28.6% reported ever receiving an ADHD diagnosis.

The mean score was 18.86 (*SD*=3.01) for DERS-Goals, 17.48 (*SD*=4.60) for DERS-Impulse, and 25.14 (*SD*=6.05) for DERS-Strategies. The mean score was 20.76 (*SD*=7.56) for FDS, 0.59 (*SD*=1.05) for BITe change score, and 4.14 (*SD*=7.38) for PANAS change score. The mean score was 38.86 (*SD*=12.84) for UPPS-Negative Urgency, 29.71 (*SD*=8.79) for UPPS-Perseverance.

Regarding outcome variables, the mean score was 3.19 (*SD*=2.60) for the IRS, 7.62 (*SD*=2.06) for positive relationships, and 1.95 (*SD*=1.72) for negative relationships. In the high ADHD symptoms group, 47.60% of participants did not report hazardous alcohol consumption, 61.90% did not report hazardous cannabis use, and 19.00% never engaged in NSSI. The mean types of NSSI were 2.10 (*SD*= 1.70), mean score was 20.86 (*SD*=15.06) for the SRS, and the mean PASAT-C persistence duration was 5.06 minutes (*SD*= 4.76). The mean score was 7.19 (*SD*= 1.91) for the EVLN-Positive, 3.95 (*SD*= 2.04) for the EVLN-Negative, 1.19 (*SD*= 1.66) for the S-ERB (Alcohol), 2.71 (*SD*= 3.95) for the S-ERB (Cannabis), and 2.14 (*SD*= 3.15) for the S-ERB (Condom-less Sex).

Hypothesis Testing

Hypothesis 1 - ADHD symptoms will be associated with state irritability and observed frustration tolerance, and self-control resource depletion will intensify this difference.

A hierarchical linear regression was carried out to test if total ADHD symptoms, depletion status, and the interaction between total ADHD symptoms and depletion status significantly predicted state irritability. The first block of the model examined the prediction of irritability from total ADHD symptoms and depletion status. Results for the first block of the model were significant, (R = .179, F (2,244) = 4.05, p = .019). Total ADHD symptoms (t = 2.84, β = .179, p = .005), but not depletion status (t = -.018, β = -.001, p = .986) was significantly associated with state irritability. The second block of the model examined the prediction of irritability from the interaction between total ADHD symptoms and depletion status. Results for the second block of the model were non-significant (R = .181, $R^{2\ change}$ = .001, F (1,243) = .187, p = .666). Please see Table 7 for linear regression results.

A hierarchical linear regression was carried out to test if total ADHD symptoms, depletion status, and the interaction between total ADHD symptoms and depletion status significantly predicted frustration tolerance (PASAT-C persistence duration). The first block of the model examined the prediction of frustration tolerance from total ADHD symptoms and depletion status. Results for the first block predicting frustration tolerance from total ADHD symptoms and depletion status were non-significant, R = .052, F (2,243) = .324, p = .724. The second block of the model examined the prediction of frustration tolerance from the interaction between total ADHD symptoms and depletion status. Results for the second block predicting frustration tolerance from the interaction between total ADHD symptoms and depletion status was non-significant, R = .052, $R^{2\ change}$ = .000, F (1, 242) = .019, p = .890. Please see Table 7 for linear regression results.

Hypothesis 1 summary: State irritability, but not frustration tolerance, is associated positively with ADHD symptoms. The interaction between ADHD symptoms and depletion was not associated with irritability or frustration tolerance; thus, Hypothesis 1 was partially supported.

ADHD symptoms are associated positively with irritability, yet this association was not more intensified as a function of depletion status.

Hypothesis 2 – Higher abilities to tolerate frustration will be significantly associated with functional outcomes.

Linear (*n*=10) and logistic (*n*=3) regressions were used for the testing of both H2 and H3. All regressions were hierarchical, and only blocks (1 and 2) containing covariates and frustration tolerance were used for H2 testing. Blocks containing total ADHD symptoms and the interaction between total ADHD symptoms and frustration tolerance were not considered for Hypothesis 2.

Hypothesis 2a - Higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower self-reported state irritability. A hierarchical linear regression was carried out to test if $DERS_{total}$, FDS_{total} (covariates), and frustration tolerance significantly predicted state irritability. The first block of the model examined the prediction of irritability from $DERS_{total}$ and FDS_{total}. Results for the first block of the model were significant, (R = .187, F (2,243) = 4.42, p = .013). The second block of the model examined the prediction of irritability from frustration tolerance. Results for the second block of the model were non-significant (R = .201, $R^{2\ change}$ =.005, F (1,242) = 1.38, p = .241). Frustration tolerance did not significantly predict state irritability. Please see Table 7 for linear regression results.

Hypothesis 2b - Higher abilities to tolerate frustration, regardless of depletion status, will be associated with higher self-reported social functioning. A hierarchical linear regression was carried out to test if gender, $DERS_{total}$, $UPPS_{total}$, FDS_{total} (covariates), and frustration tolerance significantly predicted IRS social impairment. The first block of the hierarchical regression examined the prediction of IRS social impairment from the covariates of gender, $DERS_{total}$, $UPPS_{total}$, and FDS_{total}. Results for the first block of the model were significant, (R = .403, F (4,241) = 11.66, p < .000). The second block of the model examined the

prediction of IRS social impairment from frustration tolerance. Results for the second block of the model were non-significant (R = .403, $R^{2\ change}$ = .000, F (1,240) = .117, p = .732). Frustration tolerance did not significantly predict IRS social impairment. Please see Table 7 for linear regression results.

Additional hierarchical linear regressions were carried out to test if frustration tolerance significantly predicted (1) positive relationships with friends and (2) negative relationships with friends.

A hierarchical linear regression was carried out to test if sexual orientation, race, $DERS_{total}$, FDS_{total} (covariates), and frustration tolerance significantly predicted positive relationships with friends. The first block of the hierarchical regression examined the prediction of positive relationships with friends from the covariates of sexual orientation, race, $DERS_{total}$, and FDS_{total}. Results for the first block of the model were significant, (R = .341, F (4,228) = 7.50, p< .000). The second block of the model examined the prediction of positive relationships with friends from frustration tolerance. Results for the second block of the model were non-significant (R = .341, $R^{2\ change}$ = .000, F (1,227) = .057, p = .812). Frustration tolerance did not significantly predict positive relationships with friends. Please see Table 7 for linear regression results.

A hierarchical linear regression was carried out to test if sexual orientation, $DERS_{total}$, $UPPS_{total}$ (covariates), and frustration tolerance significantly predicted negative relationships with friends. The first block of the hierarchical regression examined the prediction of negative relationships with friends from the covariates of sexual orientation, $DERS_{total}$, and $UPPS_{total}$. Results for the first block of the model were significant, (R = .325, F (3,241) = 9.51, p< .000). The second block of the model examined the prediction of negative relationships with friends from frustration tolerance. Results for the second block of the model were non-significant (R =

.325, $R^{2\ change}$ = .000, F (1,240) = .005, p = .944). Frustration tolerance did not significantly predict negative relationships with friends. Please see Table 7 for linear regression results.

Hypothesis 2b summary: Frustration tolerance was not significantly associated with self-reported social impairment, positive relationships with friends, or negative relationships with friends. Thus, hypothesis 2b was not supported.

Hypothesis 2c - Higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower levels of self-reported hazardous alcohol consumption.

A hierarchical logistic regression was carried out to test if race, $UPPS_{total}$ (covariates), and frustration tolerance significantly predicted hazardous alcohol consumption. The first block of the model examined the prediction of hazardous alcohol consumption from the covariates of race and $UPPS_{total}$. Results for the first block of the model were significant, (Wald $X^2(2) = 19.15$, $p < .000$). The second block of the model examined the prediction of hazardous alcohol consumption from frustration tolerance. Results for the second block of the model were non-significant (Wald $X^2(1) = .010$, $p = .922$). While the overall model was significant (Wald $X^2(3) = 19.16$, $p < .000$), frustration tolerance did not contribute significantly. Thus, hypothesis 2c was not supported; frustration tolerance was not significantly associated with self-reported hazardous alcohol consumption in the total sample. Please see Table 8 for logistic regression results.

Hypothesis 2d - Higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower levels of self-reported hazardous cannabis use.

A hierarchical logistic regression was carried out to test if race, gender, $DERS_{total}$, $UPPS_{total}$ (covariates), and frustration tolerance significantly predicted hazardous cannabis use. The first block of the model examined the prediction of hazardous cannabis use from the covariates of race, gender, $DERS_{total}$, and $UPPS_{total}$. Results for the first block of the model were significant, (Wald $X^2(4) = 31.13$, $p < .000$). The second block of the model examined the

prediction of hazardous cannabis use from frustration tolerance. Results for the second block of the model were non-significant (Wald $X^2(1) = .915$, $p = .339$). While the overall model was significant (Wald $X^2(5) = 32.05$, $p < .000$), frustration tolerance did not contribute significantly. Thus, hypothesis 2d was not supported; frustration tolerance was not significantly associated with self-reported hazardous cannabis use in the total sample. Please see Table 8 for logistic regression results.

Hypothesis 2e - Higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower levels of self-reported engagement in risky sexual behavior.

A hierarchical linear regression was carried out to test if race, $UPPS_{total}$ (covariates), and frustration tolerance significantly predicted engagement in risky sexual behavior. The first block of the model examined the prediction of engagement in risky sexual behavior from race and $UPPS_{total}$. Results for the first block of the model were significant, ($R = .319$, $F(2,228) = 12.90$, $p = .000$). The second block of the model examined the prediction of engagement in risky sexual behavior from frustration tolerance. Results for the second block of the model were non-significant ($R = .325$, $R^{2\ change} = .004$, $F(1,227) = 1.03$, $p = .312$). Frustration tolerance did not significantly engagement in risky sexual behavior. Please see Table 7 for linear regression results.

Hypothesis 2f - Higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower levels of self-reported engagement in NSSI.

Multiple hierarchical regressions were carried out to test if frustration tolerance significantly predicted (1) history of engaging in NSSI (dichotomous) and (2) number of different types of NSSI behaviors.

A hierarchical logistic regression was carried out to test if gender, $DERS_{total}$, $UPPS_{total}$, FDS_{total} (covariates), and frustration tolerance significantly predicted history of engaging in NSSI. Results for the first block of the model were significant, (Wald $X^2(4) = 25.76$, $p < .000$). The second block of the model examined the prediction of history of engaging in NSSI from frustration tolerance. Results for the second block of the model were non-significant (Wald $X^2(1) = .101$, $p = .751$). While the overall model was significant (Wald $X^2(5) = 25.86$, $p < .000$), frustration tolerance did not contribute significantly. Frustration tolerance was not significantly associated with predicted history of engaging in NSSI in the total sample. Please see Table 8 for logistic regression results.

A hierarchical linear regression was carried out to test if sexual orientation, $DERS_{total}$, $UPPS_{total}$, FDS_{total} (covariates) and frustration tolerance significantly predicted the use of different types of NSSI. The first block of the model examined the prediction of the use of different types of NSSI from the covariates of sexual orientation, $DERS_{total}$, $UPPS_{total}$, and FDS_{total}. Results for the first block of the model were significant, ($R = .407$, $F(4,240) = 11.94$, $p < .000$). The second block of the model examined the prediction of the use of different types of NSSI from frustration tolerance. Results for the second block of the model were non-significant ($R = .409$, $R^{2\ change} = .001$, $F\ (1,239) = .251$, $p = .617$). Frustration tolerance was not significantly associated with predicted use of different types of NSSI in the total sample. Please see Table 7 for linear regression results.

Hypothesis 2f summary: Hypothesis 2f was not supported; frustration tolerance failed to predict both history of engaging in NSSI and the number of different types of NSSI behaviors.

Hypothesis 2g - Higher abilities to tolerate frustration, regardless of depletion status, will be associated with state response to hypothetical dissatisfaction in close relationships.

Multiple hierarchical linear regressions were carried out to test if frustration tolerance significantly predicted state-level (1) positive response to hypothetical dissatisfaction in close relationships and/or (2) negative response to hypothetical dissatisfaction in close relationships.

The first hierarchical linear regression was carried out to test if race (covariate) and frustration tolerance significantly predicted positive response to hypothetical dissatisfaction in close relationships. The first block of the model examined positive response to hypothetical dissatisfaction in close relationships from the covariate of race. Results for the first block of the model were significant, (R = .145, F(1,231) = 4.99, p = .027). The second block of the model examined the prediction of positive response to hypothetical dissatisfaction in close relationships from frustration tolerance. Results for the second block of the model were non-significant (R = .150, $R^{2\ change}$ = .001, F(1,230) = .303, p = .582). Frustration tolerance was not significantly associated with positive response to hypothetical dissatisfaction in close relationships. Please see Table 7 for linear regression results.

A second hierarchical linear regression was carried out to test if race, ethnicity, $DERS_{total}$, FDS_{total} (covariates), and frustration tolerance significantly predicted negative response to hypothetical dissatisfaction in close relationships. The first block of the model examined negative response to hypothetical dissatisfaction in close relationships from the covariates of race, ethnicity, $DERS_{total}$, FDS_{total}. Results for the first block of the model were significant, (R = .394, F(4,226)= 10.40, p < .000). The second block of the model examined the prediction of negative response to hypothetical dissatisfaction in close relationships from frustration tolerance. Results for the second block of the model were non-significant (R = .410, $R^{2\ change}$ = .013, F (1,225) = 3.39, p = .067), however frustration tolerance did not contribute significantly to the model. Frustration tolerance was not significantly associated with positive response to

hypothetical dissatisfaction in close relationships in the total sample. Please see Table 7 for linear regression results.

Hypothesis 2g summary: Hypothesis 2g was not supported; frustration tolerance failed to predict both negative response to hypothetical dissatisfaction in close relationships and positive response to hypothetical dissatisfaction in close relationships

Hypothesis 2h - Higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower self-reported state desires to engage in potentially risky behaviors.

Multiple hierarchical linear regressions were carried out to test if frustration tolerance significantly predicted (1) state desire to consume alcohol, (2) state desire to use cannabis, and (3) state desire to engage in condom-less sex.

The first hierarchical linear regression was carried out to test if gender, $DERS_{total}$, FDS_{total} (covariates), and frustration tolerance significantly predicted state desire to consume alcohol. The first block of the model examined state desire to consume alcohol from the covariates of gender, $DERS_{total}$, and FDS_{total}. Results for the first block of the model were significant, (R = .305, $F(3,242) = 8.25$, p <.000). The second block of the model examined the prediction of state desire to consume alcohol from frustration tolerance. Results for the second block of the model were significant (R = .331, $R^{2\ change}$ = .017, F (1,241) = 4.54, p = .034). Frustration tolerance was significantly associated with state desire to consume alcohol.

The second hierarchical linear regression was carried out to test if gender, $DERS_{total}$, $UPPS_{total}$, FDS_{total} (covariates), and frustration tolerance significantly predicted state desire to use cannabis. The first block of the model examined state desire to use cannabis from the covariates of gender, $DERS_{total}$, $UPPS_{total}$, FDS_{total}. Results for the first block of the model were significant,

(R = .343, F(4,241)= 8.04, p <.000). The second block of the model examined the prediction of state desire to use cannabis from frustration tolerance. Results for the second block of the model were non-significant (R = .348, $R^{2\ change}$ = .004, F (1,240) = .994, p = .320). Frustration tolerance was not significantly associated with state desire to use cannabis. Please see Table 7 for linear regression results.

The third hierarchical linear regression was carried out to test if gender, $UPPS_{total}$, (covariates), and frustration tolerance significantly predicted state desire to engage in condom-less sex. The first block of the model examined state desire to engage in condom-less sex from the covariates of gender and $UPPS_{total}$. Results for the first block of the model were significant, (R = .290, F(2,243)= 11.17, p <.000). The second block of the model examined the prediction of state desire to engage in condom-less sex from frustration tolerance. Results for the second block of the model were non- significant (R = .290, $R^{2\ change}$ = .000, F (1,242) = .043, p = .835). Frustration tolerance was not significantly associated with state desire to engage in condom-less sex. Please see Table 7 for linear regression results.

Hypothesis 2h summary: Hypothesis 2h was partially supported; frustration tolerance predicted state desire to consume alcohol; however, it failed to predict state desire to use cannabis and state desire to engage in condom-less sex.

Hypothesis 3 – ADHD symptoms will moderate associations.

All above linear (n=10) and logistic (n=3) regressions were used for the testing of both H2 and H3. All regressions were hierarchical, and only blocks (3 and 4) containing total ADHD symptoms and the interaction between total ADHD symptoms and frustration tolerance were used.

Hypothesis 3a – ADHD symptoms will moderate associations between frustration tolerance and self-reported state irritability.

A hierarchical linear regression was carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and irritability. The third block of the model examined the prediction of irritability from total ADHD symptoms. Results for the third block of the model were non-significant (R = .224, $R^{2\ change}$ = .010, F(1,241) = 2.45, p = .119). The fourth block of the model examined the prediction of irritability from the interaction between frustration tolerance and ADHD symptoms. Results for the fourth block of the model were significant (R = .265, $R^{2\ change}$ = .020, F(1,240) = 5.14, p = .024). Total ADHD symptoms (t = 1.57, β = .120, p = .119) was not significantly associated with irritability in the total sample. However, the interaction between frustration tolerance and total ADHD symptoms was significantly associated with state irritability (t = 2.27, β = .144, p = .024).

Thus, hypothesis 3a was supported. Higher ADHD symptoms strengthened the association between frustration tolerance and state irritability. Please see Table 7 for linear regression results.

Hypothesis 3b - ADHD symptoms will moderate associations between frustration tolerance and self-reported social functioning.

A hierarchical linear regression was carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and impairment in relationships with friends. The third block of the model examined the prediction of impairment in social relationships with friends from total ADHD symptoms. Results for the third block of the model were non-significant (R = .410, $R^{2\ change}$ = .006, F(1,239) = 1.58, p = .210). The fourth block of the model examined impairment in relationships with friends from the interaction between frustration tolerance and ADHD symptoms. Results for the fourth block of the model were non-significant (R = .424, $R^{2\ change}$ = .011, F(1,238) = 3.30, p = .070). Neither total ADHD symptoms (t = 1.26, β = .091, p = .210) nor the interaction between frustration tolerance and total ADHD

symptoms (t = -1.82, β = -.109, p = .070) was significantly associated with self-reported social impairment. Please see Table 7 for linear regression results.

Additional linear regressions were carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and (1) positive relationships with friends and (2) negative relationships with friends. The first hierarchical linear regression was carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and positive relationships with friends. The third block of the model examined the prediction of positive relationships with friends from total ADHD symptoms. Results for the third block of the model were non-significant (R = .342, $R^{2\ change}$ = .000, F(1,226) = .027, p = .869). The fourth block of the model examined positive relationships with friends from the interaction between frustration tolerance and ADHD symptoms. Results for the fourth block of the model were significant (R = .383, $R^{2\ change}$ = .030, F(1,225) = 7.93, p = .005). Total ADHD symptoms (t = -.165, β = -.013, p = .869) was not significantly associated with positive relationships with friends in the total sample; however, the interaction between frustration tolerance and total ADHD symptoms was significantly positively associated with positive relationships with friends (t = 2.82, β = .178, p = .005). Please see Table 7 for linear regression results.

The second hierarchical linear regression was carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and negative relationships with friends. The third block of the model examined the prediction of negative relationships with friends from total ADHD symptoms. Results for the third block of the model were non-significant (R = .343, $R^{2\ change}$ = .012, F(1,239) = 3.24, p = .073). The fourth block of the model examined negative relationships with friends from the interaction between frustration tolerance and ADHD symptoms. Results for the fourth block of the model were non-significant (R = .356, $R^{2\ change}$ = .009, F(1,238) = 2.50, p .115). Neither total ADHD symptoms (t = 1.80, β = .134, p = .073) nor

the interaction between frustration tolerance and total ADHD symptoms (t = -1.58, β = -.097, p = .115) was significantly associated with negative relationships with friends in the total sample. Please see Table 7 for linear regression results.

Hypothesis 3b summary: The interaction between frustration tolerance and total ADHD symptoms was significantly positively associated with positive relationships with friends. The association between frustration tolerance and positive relationships was stronger in individuals with lower ADHD symptoms. However, interactions between frustration tolerance and total ADHD symptoms were not significantly associated with self-reported social impairments or negative relationships with friends. Thus, hypothesis 3b was partially supported.

Hypothesis 3c - ADHD symptoms will moderate associations between frustration tolerance and self-reported hazardous alcohol consumption.

A hierarchical logistic regression was carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and hazardous/non-hazardous alcohol consumption. The third block of the model examined the prediction of hazardous/non-hazardous alcohol consumption from total ADHD symptoms (Wald $X^2(1)$ = .287, p = .592). Results for the third block of the model were non-significant. The fourth block of the model examined the prediction of hazardous/non-hazardous alcohol consumption from the interaction between frustration tolerance and ADHD symptoms (Wald $X^2(1)$ = .082, p = .774). Results for the fourth block of the model were non-significant. Neither total ADHD symptoms nor the interaction between frustration tolerance and total ADHD symptoms was significantly associated with hazardous/non-hazardous alcohol consumption. Thus, hypothesis 3c was not supported. Please see Table 8 for logistic regression results.

Hypothesis 3d - ADHD symptoms will moderate associations between frustration tolerance and self-reported hazardous cannabis use.

A hierarchical logistic regression was carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and hazardous cannabis use. The third block of the model examined the prediction of hazardous cannabis use from total ADHD symptoms (Wald $X^2(1) = .614$, $p = .433$). Results for the third block of the model were non-significant. The fourth block of the model examined hazardous cannabis use from the interaction between frustration tolerance and ADHD symptoms (Wald $X^2(1) = .010$, $p = .921$). Results for the fourth block of the model were non-significant. The interaction between frustration tolerance and total ADHD symptoms was not significantly associated with hazardous cannabis use. Thus, hypothesis 3d was not supported. Please see Table 8 for logistic regression results.

Hypothesis 3e - ADHD symptoms will moderate associations between frustration tolerance and self-reported engagement in risky sexual behavior.

A hierarchical linear regression was carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and engagement in risky sexual behavior. The third block of the model examined the prediction of engagement in risky sexual behavior from total ADHD symptoms. Results for the third block of the model were non-significant ($R = .328$, $R^{2\ change} = .002$, $F(1,226) = .441$, $p = .507$). The fourth block of the model examined engagement in risky sexual behavior from the interaction between frustration tolerance and ADHD symptoms. Results for the fourth block of the model were non-significant ($R = .334$, $R^{2\ change} = .004$, $F(1,225) = 1.11$, $p = .294$). Neither total ADHD symptoms ($t = .664$, $\beta = .043$, $p = .507$) nor the interaction between frustration tolerance and total ADHD symptoms ($t = 1.05$, $\beta = .067$, $p = .294$) was significantly associated with negative relationships with friends in the total sample. Thus, hypothesis 3e was not supported. Please see Table 7 for linear regression results.

Hypothesis 3f - ADHD symptoms will moderate associations between frustration tolerance and self-reported engagement in NSSI.

Multiple hierarchical regressions were carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and (1) history of engaging in NSSI and (2) use of different types of NSSI.

A hierarchical logistic regression was carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and history of engaging in NSSI. The third block of the model examined history of engaging in NSSI from total ADHD symptoms ($X^2(1) = 15.93$, $p < .000$). Results for the third block of the model were significant. The fourth block of the model examined history of engaging in NSSI from the interaction between frustration tolerance and ADHD symptoms. Results for the third block of the model were significant (Wald $X^2(1) = 3.96$, $p = .047$); however, the interaction between frustration tolerance and total ADHD symptoms (Wald $X^2(1) = 3.67$, $p = .055$) did not contribute significantly to the model. Total ADHD symptoms, but not the interaction between frustration tolerance and total ADHD symptoms, was significantly associated with history of engaging in NSSI. Please see Table 8 for logistic regression results.

A hierarchical linear regression was carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and the number of different types of NSSI. The third block of the model examined the number of different types of NSSI from total ADHD symptoms. Results for the third block of the model were significant ($R = .466$, $R^{2\ change} = .051$, $F(1,238) = 15.38$, $p = .000$). The fourth block of the model examined the number of different types of NSSI from the interaction between frustration tolerance and ADHD symptoms. Results for the fourth block of the model were significant ($R = .481$, $R^{2\ change} = .014$, $F(1,237) = 4.44$, $p = .036$). Both total ADHD symptoms ($t = 3.92$, $\beta = .278$, $p < .000$) and the interaction between frustration tolerance and total ADHD symptoms were significantly associated with use

of different types of NSSI (t = -2.11, β = -.123, p = .036). Please see Table 7 for linear regression results.

The interaction between frustration tolerance and total ADHD symptoms was not significantly associated with history of engaging in NSSI; however, it was significantly negatively associated with the number of different types of NSSI behaviors. Those with lower frustration tolerance used more types of NSSI, and higher reported ADHD symptoms strengthened this relationship. Thus, hypothesis 3f was partially supported.

Hypothesis 3g – ADHD symptoms will moderate associations between frustration tolerance and state response to hypothetical dissatisfaction in close relationships.

Multiple hierarchical linear regressions were carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and state-level (1) positive response to hypothetical dissatisfaction in close relationships and (2) negative response to hypothetical dissatisfaction in close relationships.

The first hierarchical linear regression was carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and positive response to hypothetical dissatisfaction in close relationships. The third block of the model examined the prediction of positive response to hypothetical dissatisfaction in close relationships from total ADHD symptoms. Results for the third block of the model were non-significant (R = .160, $R^{2\ change}$ = .003, F(1,229) = .718, p = .398). The fourth block of the model examined positive response to hypothetical dissatisfaction in close relationships from the interaction between frustration tolerance and ADHD symptoms. Results for the fourth block of the model were non-significant (R = .160, $R^{2\ change}$ = .000, F(1,228) = .013, p = .908). Neither total ADHD symptoms nor the interaction between frustration tolerance and total ADHD symptoms was significantly associated

with positive response to hypothetical dissatisfaction in close relationships. Please see Table 7 for linear regression results.

The second hierarchical linear regression was carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and negative response to hypothetical dissatisfaction in close relationships. The third block of the model examined the prediction of negative response to hypothetical dissatisfaction in close relationships from total ADHD symptoms. Results for the third block of the model were non-significant (R = .414, $R^{2\ change}$ = .004, $F(1,224) = 1.03$, p = .312). The fourth block of the model examined negative response to hypothetical dissatisfaction in close relationships from the interaction between frustration tolerance and ADHD symptoms. Results for the fourth block of the model were non-significant (R = .422, $R^{2\ change}$ = .006, $F(1,223) = 1.76$, p = .186). Neither total ADHD symptoms nor the interaction between frustration tolerance and total ADHD symptoms was significantly associated with negative response to hypothetical dissatisfaction in close relationships (t = -1.32, β = -.082, p = .186). Please see Table 7 for linear regression results.

The interaction between frustration tolerance and total ADHD symptoms not significantly associated with either positive or negative response to hypothetical dissatisfaction in close relationships. Thus, hypothesis 3g was not supported.

Hypothesis 3h - ADHD symptoms will moderate associations between frustration tolerance and self-reported state desires to engage in potentially risky behaviors.

Multiple hierarchical linear regressions were carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and (1) state desire to consume alcohol, (2) state desire to use cannabis, and (3) state desire to engage in condom-less sex.

The first hierarchical linear regression was carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and state desire to consume alcohol.

The third block of the model examined the prediction of state desire to consume alcohol from total ADHD symptoms. Results for the third block of the model were non-significant (R = .338, $R^{2\ change}$ = .005, F(1,240) = 1.30, p = .255). The fourth block of the model examined state desire to consume alcohol from the interaction between frustration tolerance and ADHD symptoms. Results for the fourth block of the model were non-significant (R = .347, $R^{2\ change}$ = .006, F(1,239) = 1.59, p = .209). The interaction between frustration tolerance and total ADHD symptoms was not significantly associated with state desire to consume alcohol (t = 1.26, β = .078, p = .209). Please see Table 7 for linear regression results.

The second hierarchical linear regression was carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and state desire to use cannabis. The third block of the model examined the prediction of state desire to use cannabis from total ADHD symptoms. Results for the third block of the model were significant (R =.369, $R^{2\ change}$ = .015, F(1,239) = .474, p= .045). The fourth block of the model examined state desire to use cannabis from the interaction between frustration tolerance and ADHD symptoms. Results for the fourth block of the model were non-significant (R = .371, $R^{2\ change}$ = .002, F(1,238) = .474, p = .492). Total ADHD symptoms (t = 2.02, β = .149, p = .045), but not the interaction between frustration tolerance and total ADHD symptoms (t = .688, β = .042, p = .492) was significantly associated with state desire to use cannabis. Please see Table 7 for linear regression results.

The third hierarchical linear regression was carried out to test if total ADHD symptoms moderated the relationship between frustration tolerance and state desire to engage in condom-less sex. The third block of the model examined the prediction of state desire to engage in condom-less sex from total ADHD symptoms. Results for the third block of the model were non-significant (R = .294, $R^{2\ change}$ = .002, F(1,241) = .572, p = .450). The fourth block of the model examined state desire to engage in condom-less sex from the interaction between frustration

tolerance and ADHD symptoms. Results for the fourth block of the model were significant (R = .320, $R^{2\ change}$ = .016, $F(1,240) = 4.20$, p = .041). Total ADHD (t = .756, β = .048, p = .450) was not significantly associated with state desire to engage in condom-less sex in the total sample; however, the interaction between frustration tolerance and total ADHD symptoms was significantly (t = 2.05, β = .127, p = .041) associated with state desire to engage in condom-less sex. Please see Table 7 for linear regression results.

The interaction between frustration tolerance and total ADHD symptoms was not significantly associated with state desire to consume alcohol or state desire to use cannabis; however, it was significantly positively related with state desire to engage in condom-less sex. The association between frustration tolerance and state desire to engage in condom-less sex was stronger in individuals with higher ADHD symptoms. Thus, hypothesis 3h was partially supported.

Please see Table 9 for an overview of complete study hypothesis testing results.

Discussion

The present study used the Self-Control Strength Model as a theoretical framework for experimentally investigating associations between self-control resource depletion, frustration tolerance, and irritability in a college student population. Further, this study investigated the potential moderating role of ADHD symptoms (used as a proxy for ADHD) on associations between frustration tolerance and irritability as well as several concerning functional outcomes in college students for which college students with ADHD are at elevated risk (i.e., social functioning deficits, risky behaviors related negatively with self-control) (Sacchetti & Lefler, 2017; Shoham et al., 2019). This study was novel in its: a) research design using experimental depletion tasks in addition to self-report measures and b) consideration of ADHD, objective

frustration tolerance, state levels of irritability, and self-reported engagement in risky behaviors concurrently in a college population.

Supported Hypotheses

The primary significant findings from this study are (1) ADHD symptoms are associated with increased state irritability during a frustration tolerance task, (2) the relationship between frustration tolerance and state irritability is moderated by ADHD symptoms such that those with higher ADHD symptoms have stronger relationships between frustration tolerance and state irritability, (3) the relationship between frustration tolerance and positive relationships with friends is moderated by ADHD symptoms such that those with higher ADHD symptoms have stronger relationships between frustration tolerance and positive relationships with friends, (4) the relationship between frustration tolerance and the number of types of NSSI endorsed is moderated by ADHD symptoms such that those with higher ADHD symptoms have stronger relationships between frustration tolerance and the number of types of NSSI endorsed, (5) frustration tolerance significantly predicts state desire to consume alcohol, and (6) the relationship between frustration tolerance and state desire to engage in condom-less sex is moderated by ADHD symptoms such that those with higher ADHD symptoms have stronger relationships between frustration tolerance and state desire to engage in condom-less sex.

Frustration tolerance and irritability. The positive relationship between ADHD symptoms and state irritability is unsurprising; other studies have found that individuals with ADHD are more easily irritated than others (Eyre et al., 2017, 2019) and irritability is generally considered to be a prominent clinical target in ADHD treatment (Faraone et al., 2019). In fact, irritability is a core feature of emotion dysregulation in those with ADHD (Shaw et al., 2014). Our experimental results confirm these past findings and support the external validity of our findings.

A more novel finding is that irritability can be experimentally induced in college students with elevated ADHD symptoms. The topic of task persistence has been considered far less in the college student ADHD population and no experimental studies could be located which examined these associations. The present results indicate that even though they failed to persist on the PASAT-C as long as their peers, college students with higher ADHD symptoms reported increased irritability following the PASAT-C. It is well known that youth with ADHD fail to persist on frustrating tasks (Hoza et al., 2001; Seymour et al., 2019). College students with ADHD are considered a niche ADHD subpopulation (Antshel & Barkley, 2009) and generally have higher cognitive resources than their same age-peers with ADHD who do not attend college (Weyandt et al., 2017). Nonetheless, despite these likely developmental advances, college students with elevated ADHD symptoms (a) fail to persist and (b) their limited persistence may carry an emotional cost: irritability (Borges et al., 2017).

Frustration tolerance and positive peer relationships. An additional novel finding is that the relationship between frustration tolerance and positive relationships with friends is moderated by ADHD symptoms. Individuals with higher frustration tolerance and lower ADHD symptoms reported more positive relationships with friends. It is well known that individuals with ADHD have difficulty forming and maintaining friendships (Bagwell et al., 2001; Sibley et al., 2010) and often have fewer friends and experience greater conflict in their relationships than typically-developing peers from childhood (Cleminshaw et al., 2020; Hoza, 2007; Normand et al., 2011). Not surprisingly, the present findings support a negative independent association between ADHD symptoms and positive friendships. While not investigated much in the young adult ADHD literature, at least one other study has reported that self-reported abilities to tolerate frustration are positively associated with positive friendship relationships in adults with ADHD (Surman et al., 2013). These experimental results provide support for this previous finding.

Frustration tolerance and NSSI. An additional important and novel finding is that the relationship between frustration tolerance and number of types of NSSI used is moderated by ADHD symptoms. Individuals with lower frustration tolerance report engagement in more types of NSSI and this relationship is strengthened by ADHD symptoms. The inability to tolerate frustration (Anderson et al., 2018; Anestis et al., 2013; Peterson et al., 2019) and ADHD (Balázs et al., 2018; Meza et al., 2016; Swanson et al., 2014) have both been previously reported to be associated independently with engagement in NSSI. Additionally, ADHD symptoms (e.g., impulsivity) (Balázs et al., 2018) increase risk of more varied forms of NSSI (Meza et al., 2016; Swanson et al., 2014). The present experimental results extend the findings of these studies and indicate that ADHD symptoms moderates the relationship between low frustration tolerance and more varied NSSI methods.

One of the more prominent NSSI theories posits that NSSI functions as an experientially avoidant behavior, aimed at decreasing experiences of emotional distress (Hepp et al., 2020). While completely unexplored in ADHD, there are reasons to hypothesize that as a function of deficient emotion regulation and impulsivity (Moukhtarian et al., 2018), the experience of frustration in individuals with ADHD might increase risk for engaging in a larger number of types of NSSI.

Frustration tolerance and state engagement in condom-less sex. Finally, the relationship between frustration tolerance and state desire to engage in condom-less sex is moderated by ADHD symptoms. Individuals with lower frustration tolerance report stronger state desire to engage in condom-less sex and this relationship is strengthened by ADHD symptoms. It has been previously reported that college students with ADHD are more likely to engage in risky sexual behaviors (e.g., condom-less sex) (Huggins et al., 2015; Van Eck et al., 2015). College presents a uniquely challenging setting in which potentially risky sexual

behaviors are likely to increase (Lam & Lefkowitz, 2013), and ADHD symptoms (e.g., impulsivity) (Deckman & Nathan DeWall, 2011; Steel & Ferrari, 2013) and poor frustration tolerance (Marengo et al., 2019) are independently associated with an increased risk of engaging in potentially risky sexual behaviors.

Interestingly, neither frustration tolerance nor ADHD symptoms was associated with overall (lifetime) engagement in potentially risky sexual behaviors, indicating that the impulsivity characteristic of ADHD may influence sexual risk taking immediately following a frustrating event (Graziano et al., 2015). For example, negative urgency, or the tendency to act impulsively when experiencing negative affect like frustration (Egan et al., 2017) might be especially influential in decision making following a frustrating event. Negative urgency may lead to engaging in potentially risky sexual behavior, such as condom-less sex (Curry et al., 2018; Deckman & Nathan DeWall, 2011), without first considering the potential consequences (i.e., unintended pregnancy, sexually transmitted infections) (Cooper, 2002; Mair et al., 2016), putting those with ADHD at increased risk.

Unsupported Hypotheses

Although the above five findings lend partial support to several hypotheses, it is important to note that multiple other hypotheses were not supported. There are at least two possible explanations for the large number of null findings. First, it is possible that the frustration tolerance task (PASAT-C) did not produce significant frustration in the college student sample. The PASAT-C can reliably induce negative emotions (Bornovalova et al., 2008; Gratz et al., 2006; Lavender et al., 2017; Lejuez et al., 2003). However, use of persistence on the PASAT-C to measure frustration tolerance has resulted in inconsistent between-group findings (clinical v. control) (Eichen et al., 2017; Schloss & Haaga, 2011; Winward et al., 2014). Similarly, the associations between lab-based cognitive tasks and ecologically valid outcomes (e.g., hazardous

levels of alcohol consumption) is generally regarded to be weak in strength (Nikolas et al., 2019), suggesting that ecologically valid frustration may not be induced reliably by a cognitive task alone.

Second, the Stroop task failed to adequately deplete the participants. Thus, the Self-Control Strength Model (Baumeister et al., 2007) could not be tested. Despite some empirical support for the construct of self-control resource depletion (Dang et al., 2017; Wymbs, 2018), there remains significant controversy about this theory. The most consistent argument against self-control resource depletion is the low replicability of this effect (Carter & McCullough, 2014; Emmerling et al., 2017), possibly due to a failure to experimentally manipulate depletion. Because the present study methods were unable to effectively deplete self-control resources, no remarks about the theory itself can be made.

Clinical Implications

Overall, there were several findings with translational value that were consistent with previous research. The findings consistent with previous research suggests that ADHD symptoms are negatively associated with multiple functional outcomes in college students.

An additional novel finding of particular clinical importance is the positive association between ADHD symptoms and NSSI. High ADHD symptoms may contribute to increased risk of NSSI, and as the present study found, engagement in a greater variety of types of NSSI. Combined with greater levels of irritability, individuals with high ADHD symptoms may engage in less adaptive emotional coping (Seymour et al., 2016). It is of particular importance that clinicians target frustration tolerance and irritability management by teaching emotion regulation skills when working with college students with ADHD. Emotion dysregulation and ADHD symptoms (i.e., impulsivity) likely combine to result in the use of a broad range of NSSI,

potentially as an irritability reduction strategy in college students with ADHD (Anderson et al., 2018; Anestis et al., 2013).

Targeted clinical work including teaching emotion regulation skills is important is also important when considering other potentially risky behaviors. Another novel and clinically significant finding is the negative association between frustration tolerance and state desire to engage in condom-less sex, which was strengthened by ADHD symptoms. Similar to other potentially risky behaviors (e.g., engagement in NSSI), higher state desire to engage in condom-less sex may result from the potentially lower adaptive emotional coping in individuals with high ADHD symptoms (Brown et al., 2010; Bunford et al., 2015; Galéra et al., 2010). The combination of emotion dysregulation and ADHD symptoms may produce circumstances in which college students with ADHD use maladaptive coping strategies (Marengo et al., 2019; Wymbs et al., 2021).

Emotion dysregulation – and specifically *episodic* irritability – might be an important treatment target for college students with ADHD. Clinically, the combination of CBT and DBT has been demonstrated to improve emotion regulation and reduce irritability in adults with ADHD (Nasri et al., 2020). Mindfulness interventions may also assist in helping reduce episodic irritability in adults with ADHD (Mitchell et al., 2017).

Limitations

There are several limitations to the present study that support the need for further investigation of this topic. First, the depletion task chosen did not serve its intended purpose. The lack of a depleting effect of the Stroop task hampers the ability to truly investigate the effect of self-control resource depletion on both irritability and frustration tolerance. Depletion would be considered successful if there were significant group (depletion/non-depletion) differences in effort, difficulty, and fatigue questions immediately following the Stroop task (Dang et al., 2017)

as well as group differences in persistence on the PASAT-C. Unfortunately, most of these outcomes did not occur. The present study used 256 Stroop trials. Past studies using the Stroop with as many as 888 trials as a depleting task have had mixed results (Mangin et al., 2021). This indicates that even with significant modifications, the Stroop task may fail to be sufficiently depleting for college students.

An additional limitation of the present study was the use of experimental tasks via remote, unmonitored administration. This study design (necessitated during COVID-19) greatly limited experimental control over several factors (i.e., location of participant, environmental distractions, volume of computer during the PASAT-C frustration tolerance task, device screen size), any of which may have impacted outcomes. The remote execution of study protocol did not allow for participants' device settings to be monitored throughout the study, potentially resulting in device settings not being adjusted for study protocol to be successfully implemented (e.g., volume not turned up to 75%, etc.).

The present sample was mostly White females, which is generally consistent with demographics from the larger Psychology undergraduate population of this university. Replication in a larger, more diverse sample is necessary to increase generalizability. Additionally, it may be the case that the assessed functional outcomes are associated with other, unmeasured variables (e.g., depression, anxiety, sleep) (Gordon et al., 2017; Morales et al., 2018). Students were recruited without the restricting limitation of an ADHD diagnosis, allowing consideration of a broader range of ADHD symptoms. This permitted us to capture a sample of college students who may experience irritability and negative functional outcomes similar to those with diagnosed ADHD. Nonetheless, these results may not be generalizable to the population of college students with ADHD.

It is also important to note that the significant finding that lower frustration tolerance is associated with greater negative response to hypothetical dissatisfaction in a close relationship should be interpreted with caution due to the poor internal consistency of the truncated EVLN scales.

Finally, the use of self-report for all non-experimental measures is a limitation. The use of self-report may have resulted in the over-endorsement of desirable qualities and the under-endorsement of less desirable qualities. The lack of objective measures to assess ADHD symptoms, in particular, should be noted.

Directions for Future Research

The present study highlights the need for reconsidering the use of the Stroop Color-Word task for investigating self-control resource depletion. The present study was unable to test the Self-Control Strength Model due to the inability of the Stroop to achieve its anticipated outcomes. In addition to the above recommendation to replicate this study in a larger, more diverse sample, additional research on the utility of the tasks used in the present study is needed. Specifically, the use of separate or multiple depletion tasks may be necessary in studies investigating the Self-Control Strength Model (Dang, 2018). Alternatively, the low replicability of the self-control resource depletion effect (Carter & McCullough, 2014; Emmerling et al., 2017) raises questions about future studies successfully obtaining this effect experimentally. Significant controversy, specifically in the field of social psychology, about self-control being a depletable resource suggests that there may be better ways to explain the phenomena attributed to the depletion of self-control resources (Carter et al., 2015; Dang & Hagger, 2019; M. S. Hagger et al., 2016). Decrements in several variables examined in the present study (e.g., emotion regulation abilities) may lead to similar expected outcomes (e.g., quitting a frustrating task) and should be further studied.

Further, future research may benefit from assessing the role of personality traits in social relationships, engagement in risky behaviors as well as other functional outcomes (i.e., GPA) not considered in the current study. Likewise, because inattention and impulsivity are not the sole province of ADHD (American Psychiatric Association, 2013), it is possible reported ADHD symptoms were attributable to other disorders such as anxiety or depression.

The present study examined relatively superficial characteristics (i.e., positive, negative) of friendships. There may be additional friendship characteristics that could shed greater light on the associations between ADHD, frustration tolerance, and social impairment. For example, perceived closeness to friends, communication with friends, and quality of time spent with friends could be affected by levels of ADHD symptoms and frustration tolerance. Thus, future research that more thoroughly examines social relationships may also be helpful.

Finally, based on the finding that there was no difference in objective frustration tolerance (PASAT-C persistence duration) based on either depletion status or ADHD symptoms, and that 32 participants were excluded because of *reduced* frustration following the PASAT-C, it is possible that frustration in college students cannot be induced reliably using an experimental measure. Future research should consider the sole use of *in vivo*, relational frustration-induction tasks which have been used successfully in past research (Wymbs, 2018), using these tasks in conjunction with a computer-based cognitive experimental measure, or considering alternative options beyond the PASAT-C for use with college students.

Conclusions

The present study sought to incrementally contribute to the literature using the Self-Control Strength Model (Baumeister et al., 2007) as a theoretical framework. The overall objective of present study was to expand upon existing literature on college students with ADHD by experimentally investigating associations between self-control resource depletion, frustration

tolerance, and irritability. Additionally, the present study considered associations between frustration tolerance, irritability, and other functional outcomes for which college students with ADHD are at elevated risk.

The current study was unable to test the Self-Control Strength Model, as the Stroop Color Word Task failed to be depleting. These results indicate a need for further consideration of the utility of the Self-Control Strength Model and the use of the Stroop Color-Word task as a depleting task. ADHD symptoms was associated with state irritability during a frustration tolerance task. The relationship between frustration tolerance and state irritability was moderated by ADHD symptoms such that those with higher ADHD symptoms had stronger relationships between frustration tolerance and state irritability. The relationship between frustration tolerance and positive relationships with friends was moderated by ADHD symptoms. The association between frustration tolerance and positive relationships was stronger in individuals with lower ADHD symptoms. The relationship between frustration tolerance and the number of types of NSSI endorsed was moderated by ADHD symptoms. Those with lower frustration tolerance used more types of NSSI, and higher reported ADHD symptoms strengthened this relationship. Finally, the relationship between frustration tolerance and state desire to engage in condom-less sex is moderated by ADHD symptoms. The association between frustration tolerance and state desire to engage in condom-less sex was stronger in individuals with higher ADHD symptoms.

Table 1
Demographics and Depletion Group Characteristics

Variable	Depletion (n=127) *M (SD)*	*%*	Non-Depletion (n=120) *M (SD)*	*%*	*F*	η^2	X^2	Total (n=247) *M (SD)*	%
Age	19.82 (1.27)		19.93 (1.36)		.467	.808		19.87 (1.32)	
Gender		19.70% Men		31.90% Men			4.84***		25.60% Men
Sexual Orientation		83.50% Heterosexual		85.00% Heterosexual			6.28		84.20% Heterosexual
Race		61.50% White/ Caucasian		63.20% White/ Caucasian			2.36		62.40% White/ Caucasian
Ethnicity		85.80% Not Hispanic or Latinx		81.70% Not Hispanic or Latinx			1.99		83.80% Not Hispanic or Latinx
Year in School		35.40% 1st Year/Freshman		38.30% 1st Year/Freshman			5.05		36.80% 1st Year/Freshman
Diagnosed ADHD		88.20% No Diagnosed ADHD		93.30% No Diagnosed ADHD			1.93		90.70 % No Diagnosed ADHD
ASRS -v1.1	33.16 (10.39)		31.78 (11.24)		.997	.004		32.49 (10.81)	
DERS-Goals	15.05 (4.75)		14.65 (5.00)		.41	.002		14.85 (4.87)	
DERS-Impulse	12.41 (4.86)		12.53 (4.88)		.04	.000		12.47 (4.86)	
DERS-Strategies	19.35 (7.44)		19.53 (7.19)		.04	.00		19.44 (7.30)	
UPPS-Negative Urgency	44.93 (11.20)		46.42 (11.75)		1.04	.004		45.65 (11.47)	
UPPS-Perseverance	28.18 (7.74)		27.38 (8.23)		.629	.003		27.79 (7.78)	

FDS	18.78 (6.23)		19.25 (5.50)		.394	.002		19.01 (5.88)	
	Depletion (*n*=127)		Non-Depletion (*n*=120)					Total (*n*=247)	
Variable	*M (SD)*	*%*	*M (SD)*	*%*	*F*	η^2	X^2	*M (SD)*	%
IRS	1.98 (1.95)		1.95 (2.13)		.010	.000		1.96 (2.04)	
Positive Relationships	8.32 (1.55)		8.07 (1.71)		1.52	.006		8.20 (1.63)	
Negative Relationships	1.37 (1.22)		1.61 (1.71)		1.66	.007		1.49 (1.48)	
AUDIT		66.10 % No Problem		60.00 % No Problem			1.00		63.20 % No Problem
CUDIT		82.70 % No Problem		83.30 % No Problem			.019		83.00 % No Problem
SRS	12.61 (13.89)		12.73 (13.26)		.005	.000		12.67 (13.56)	
FASM-Engagement		44.90 % No History		55.80 % No History			2.96		50.20 % No History
FASM-Types	1.18 (1.44)		0.91 (1.36)		2.35	.010		1.05 (1.41)	
Stroop (Effort)	5.09 (1.30)		4.49 (1.57)		.629	.003		5.02 (1.43)	
Stroop (Difficulty)	3.99 (1.39)		3.01 (1.39)		30.87***	.112		3.51 (1.47)	
Stroop (Fatigue)	4.50 (1.58)		4.11 (1.75)		3.34	.013		4.31 (1.68)	
PASAT-C Persistence Duration [a]	6.63 (4.51)		6.49 (4.49)		.058	.000		6.56 (4.49)	
BITe Change	0.71 (1.10)		0.71 (1.02)		.51	.000		0.71 (1.06)	
PANAS Change	3.44 (6.23)		3.68 (6.48)		.084	.000		3.56 (6.34)	
EVLN -Positive	6.72 (2.10)		6.61 (2.09)		.189	.001		6.67 (2.09)	
EVLN -Negative	3.02 (1.49)		3.32 (1.73)		2.21	.009		3.16 (1.61)	
S-ERB (Alcohol)	1.16 (2.20)		1.10 (1.99)		.046	.000		1.13 (2.10)	

S-ERB (Cannabis)	1.34 (2.84)		1.02 (2.45)		.904	.004		1.18 (2.66)	
	Depletion (n=127)		Non-Depletion (n=120)					Total (n=247)	
Variable	*M (SD)*	*%*	*M (SD)*	*%*	*F*	η^2	X^2	*M (SD)*	%
S-ERB (Condom-less Sex)	1.12 (2.25)		1.47 (2.74)		1.20	.005		1.29 (2.50)	

Note. ASRS-v1.1, Adult ADHD Self-Report Scale; DERS, Difficulties in Emotion Regulation; UPPS, Urgency, Premeditation, Perseverance, and Sensation Seeking Impulsivity Scale; BITe, Brief Irritability Test; FDS; Frustration Discomfort Scale; IRS, The Impairment Rating Scale; AUDIT-C, Alcohol Use Disorders Identification Test-Consumption; CUDIT-R, Cannabis Use Disorders Identification Test-Revised; SRS, Sexual Risk Survey; FASM, Functional Assessment of Self-Mutilation; Stroop, Web-Stroop Color and Word Test; PASAT-C, Paced Auditory Serial Addition Task-Computerized Version; S-ERB, State desire to engage in potentially risky behaviors; EVLN, Exit-Voice-Loyalty-Neglect.

[a] PASAT-C persistence duration is in minutes and seconds.

Table 2
ADHD Group Characteristics

Variable	Low ADHD [a] (*n*=226) *M (SD)*	*%*	High ADHD [a] (*n*=21) *M (SD)*	*%*
Age	19.89 (1.57)		19.71 (1.01)	
Gender		25.70% Men		23.80% Men
Sexual Orientation		84.50% Heterosexual		81.00% Heterosexual
Race		60.60% White/ Caucasian		81.00% White/ Caucasian
Ethnicity		84.80% Not Hispanic or Latinx		76.20% Not Hispanic or Latinx
Year in School		37.60% 1st Year/Freshman		28.60% 1st Year/Freshman
Diagnosed ADHD		7.50% Diagnosed ADHD		28.60% Diagnosed ADHD
DERS-Goals	14.48 (4.83)		18.86 (3.01)	
DERS-Impulse	12.00 (4.60)		17.48 (4.60)	
DERS-Strategies	18.91 (7.19)		25.14 (6.05)	
UPPS-Negative Urgency	46.28 (11.16)		38.86 (12.84)	
UPPS-Perseverance	27.61 (7.89)		29.71 (8.79)	
FDS	18.85 (5.69)		20.76 (7.56)	
IRS	1.85 (1.95)		3.19 (2.60)	
Positive Relationships	8.25 (1.58)		7.62 (2.06)	
Negative Relationships	1.44 (1.45)		1.95 (1.72)	

Variable	Low ADHD (*n*=221) *M (SD)*	*%*	High ADHD (*n*=26) *M (SD)*	*%*
AUDIT		76.10 % No Problem		47.60 % No Problem
CUDIT		85.00 % No Problem		61.90 % No Problem
SRS	11.90 (13.19)		20.86 (15.06)	
FASM-Engagement		53.10 % No History		19.00 % No History
FASM-Types	0.95 (1.34)		2.10 (1.70)	
PASAT-C Persistence Duration [b]	6.70 (4.45)		5.06 (4.76)	
BITe Change	0.72 (1.06)		0.59 (1.05)	
PANAS Change	3.50 (6.25)		4.14 (7.38)	
EVLN -Positive	6.62 (2.11)		7.19 (1.91)	
EVLN -Negative	3.09 (1.55)		3.95 (2.04)	
S-ERB (Alcohol)	1.12 (2.13)		1.19 (1.66)	
S-ERB (Cannabis)	1.04 (2.47)		2.71 (3.95)	
S-ERB (Condom-less Sex)	1.21 (2.43)		2.14 (3.15)	

Note. DERS, Difficulties in Emotion Regulation; UPPS, Urgency, Premeditation, Perseverance, and Sensation Seeking Impulsivity Scale; BITe, Brief Irritability Test; FDS; Frustration Discomfort Scale; IRS, The Impairment Rating Scale; AUDIT-C, Alcohol Use Disorders Identification Test-Consumption; CUDIT-R, Cannabis Use Disorders Identification Test-Revised; SRS, Sexual Risk Survey; FASM, Functional Assessment of Self-Mutilation; Stroop, Web-Stroop Color and Word Test; PASAT-C, Paced Auditory Serial Addition Task-Computerized Version; S-ERB, State desire to engage in potentially risky behaviors; EVLN, Exit-Voice-Loyalty-Neglect.

[a] Low ADHD (</= 47 ASRS-v1.1 score); High ADHD (>/= 48 ASRS-v1.1 score).
[b] PASAT-C persistence duration is in minutes and seconds.

Table 3
Study Measures (Listed in Order of Administration)

Measure	Construct	State/Trait	Empirical Support	Purpose
ASRS-v1.1	ADHD Symptoms	-	Gray et al., 2014	Hypotheses 1,3
DERS	Emotion Regulation	Trait	Gratz & Roemer, 2004	Descriptive
UPPS	Impulsivity	Trait	Whiteside & Lynam, 2001	Descriptive
FDS	Frustration Tolerance	Trait	Harrington, 2005	Descriptive
PANAS [a]	Affect	State	Gratz et al., 2013	Concurrent validity
BITe [b]	Irritability	State	Holtzman et al., 2015	Hypotheses 1,2,3
IRS	Social Functioning	-	Fabiano et al., 2006	Hypotheses 2,3
AUDIT-C	Risky Behaviors (Alcohol Use)	-	Barry et al., 2015	Hypotheses 2,3
CUDIT-R	Risky Behaviors (Cannabis Use)	-	Adamson et al., 2010	Hypotheses 2,3
SRS	Risky Behaviors (Sexual Risk)	-	Turchik & Garske, 2009	Hypotheses 2,3
FASM	Risky Behaviors (NSSI)	-	Lloyd, 1997	Hypotheses 2,3
Stroop	Depletion	-	Dang et al., 2017	Hypotheses 1,2,3
PASAT-C	Frustration Tolerance	-	Lejuez et al., 2003	Hypotheses 1,2,3
S-ERB	Potentially Risky Behaviors	State	-	Hypotheses 2,3
EVLN	Social Problem Solving	State	Rusbult et al., 1986	Hypotheses 2,3

Note. ASRS-v1.1, Adult ADHD Self-Report Scale; DERS, Difficulties in Emotion Regulation; UPPS, Urgency, Premeditation, Perseverance, and Sensation Seeking Impulsivity Scale; BITe, Brief Irritability Test; FDS; Frustration Discomfort Scale; PANAS, Positive and negative affect schedule; IRS, The Impairment Rating Scale; AUDIT-C, Alcohol Use Disorders Identification Test-Consumption; CUDIT-R, Cannabis Use Disorders Identification Test-Revised; SRS, Sexual Risk Survey; FASM, Functional Assessment of Self-Mutilation; NSSI, Non-suicidal self-injurious behaviors; Stroop, Web-Stroop Color and Word Test; PASAT-C, Paced Auditory Serial Addition Task-Computerized Version; S-ERB, State desire to engage in potentially risky behaviors; EVLN, Exit-Voice-Loyalty-Neglect.

[a] The PANAS is used as a Pre/Post measure of Negative Affect.

[b] The BITe is used as Pre/Post measure of Irritability.

Table 4

Correlation Matrix of Descriptive Variables

	Variable	1	2	3	4	5	6	7	8	9	10
1	Depletion	1.00									
2	ASRS-v1.1	0.06	1.00								
3	DERS-Goals	0.04	.55**	1.00							
4	DERS-Impulse	-0.01	.50**	.60**	1.00						
5	DERS-Strategies	-0.01	.48**	.65**	.69**	1.00					
6	UPPS-Negative Urgency	-0.06	-.49**	-.43**	-.52**	-.46**	1.00				
7	UPPS-Perseverance	0.05	.36**	.36**	.38**	.33**	-.19**	1.00			
8	FDS	-0.04	.22**	.40**	.34**	.35**	-.27**	.36**	1.00		
9	PANAS change	-0.02	.14*	.18**	0.11	.18**	-0.04	0.09	.17**	1.00	
10	BITe change	0.01	.18**	.18**	0.08	.18**	-0.08	0.10	.13*	.73**	1.00

*Note: * p < 0.05, ** p < 0.01*

ASRS-v1.1, Adult ADHD Self-Report Scale; DERS, Difficulties in Emotion Regulation; UPPS, Urgency, Premeditation, Perseverance, and Sensation Seeking Impulsivity Scale; FDS, Frustration Discomfort Scale; PANAS, Positive and negative affect schedule; BITe, Brief Irritability Test.

[a] The PANAS is used as a Pre/Post measure of Negative Affect.

[b] The BITe is used as Pre/Post measure of Irritability.

Table 5
Correlation Matrix of Outcome Variables

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Depletion	1.00																
2	ASRS-v1.1	0.06	1.00															
3	IRS	0.01	.25**	1.00														
4	Positive Relationships	0.08	-.17**	-.53**	1.00													
5	Negative Relationships	-0.08	.25**	.54**	-.54**	1.00												
6	AUDIT-C	-0.08	.09	-0.03	0.06	0.01	1.00											
7	CUDIT-R	0.01	.13*	0.09	-0.06	0.08	0.17**	1.00										
8	SRS	0.00	0.12	0.12	0.03	0.01	.37**	.17**	1.00									
9	FASM-Engagement	0.11	.37**	.18**	-.15*	0.12	0.10	.15*	0.02	1.00								
10	FASM-Types	0.10	.41**	.22**	-.16*	.17**	0.09	.23**	0.06	.75**	1.00							
11	PASAT-C Persistence Duration	0.02	-0.05	-0.06	0.07	-0.01	0.03	0.01	0.01	-0.03	-0.06	1.00						
12	BITe Change	0.01	.18**	-0.03	-0.06	0.03	0.04	-0.06	0.07	.13*	0.10	-0.10	1.00					
13	S-ERB (Alcohol)	0.01	.14*	.27**	-0.09	.20**	.20**	0.11	0.11	.17**	.18**	0.09	0.08	1.00				
14	S-ERB (Cannabis)	0.06	.21**	.16*	-0.10	.23**	.18**	.64**	.16*	.25**	.26**	0.05	-0.06	.38**	1.00			
15	S-ERB (Condom-less Sex)	-0.07	0.08	.17**	-0.05	.21**	.23**	.15*	.30**	0.09	0.06	0.01	0.05	.34**	.33**	1.00		
16	EVLN - Positive	0.03	-0.05	-0.03	0.11	-0.09	0.77	0.06	0.12	0.01	-0.03	0.04	-.19**	0.00	0.05	0.03	1.00	
17	EVLN - Negative	-0.10	.18**	.35**	-.37**	.35**	-0.03	0.11	-0.03	.17**	.25**	-.16*	0.12	0.12	.17**	0.033	-.211**	1.00

*Note: * $p < 0.05$, ** $p < 0.01$*

ASRS-v1.1, Adult ADHD Self-Report Scale; IRS, The Impairment Rating Scale; AUDIT-C, Alcohol Use Disorders Identification Test-Consumption; CUDIT-R, Cannabis Use Disorders Identification Test-Revised; SRS, Sexual Risk Survey; FASM, Functional Assessment of Self-Mutilation; PASAT-C, Paced Auditory Serial Addition Task-Computerized Version; BITe, Brief Irritability Test; S-ERB, State desire to engage in potentially risky behaviors; EVLN, Exit-Voice-Loyalty-Neglect.

Table 6
Correlation Matrix of Outcome Measure Covariates

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Race	1.00																	
2	Ethnicity	0.07	1.00																
3	Gender	0.11	0.00	1.00															
4	Sexual Orientation	0.08	0.07	0.05	1.00														
5	BITe	-0.12	0.09	-0.01	0.04	1.00													
6	IRS	0.13	-0.08	-.16*	0.08	-0.03	1.00												
7	Positive Relationships	-.15*	0.01	0.11	-.13*	-0.06	-.53**	1.00											
8	Negative Relationships	0.03	-0.04	-0.09	.13*	0.03	.54**	-.54**	1.00										
9	AUDIT-C	-.23**	-0.06	0.12	-0.05	0.04	-0.03	0.06	0.01	1.00									
10	CUDIT-R	-.18**	-0.04	-.23**	0.00	-0.06	0.09	-0.06	0.08	.17**	1.00								
11	SRS	-.28**	-0.05	-0.03	-0.02	0.07	0.12	0.03	0.01	.37**	.17**	1.00							
12	FASM – Engagement	0.09	0.00	.13*	0.11	.13*	.18**	-.15*	0.12	0.10	.15*	0.02	1.00						
13	FASM – Types	0.04	-0.02	0.10	.19**	0.10	.22**	-.16*	.17**	0.09	.23**	0.06	.75**	1.00					
14	EVLN – Positive	-.15*	-0.06	0.03	0.01	-.19**	-0.03	0.11	-0.09	0.08	0.06	0.12	0.01	-0.03	1.00				
15	EVLN – Negative	.24**	.18**	-0.07	0.12	0.12	.35**	-.37**	.35**	-0.03	0.11	-0.03	.17**	.25**	-.21**	1.00			
16	S-ERB (Alcohol)	0.11	0.02	-.20**	0.06	0.08	.27**	-0.09	.20**	.20**	0.11	0.11	.17**	.18**	0.00	0.12	1.00		

17	S-ERB (Cannabis)	-0.12	-0.01	-.18**	0.09	-0.06	.16*	-0.10	.23**	.18**	.64**	.16*	.25**	.26**	0.05	.17**	.38**	1.00	
18	S-ERB (Condom-less Sex)	0.03	-0.04	-.13*	-0.03	0.05	.17**	-0.05	.21**	.23**	.15*	.30**	0.09	0.06	0.03	0.03	.34**	.33**	1.00

*Note: * p < 0.05, ** p < 0.01*

BITe, Brief Irritability Test; IRS, The Impairment Rating Scale; AUDIT-C, Alcohol Use Disorders Identification Test-Consumption; CUDIT-R, Cannabis Use Disorders Identification Test-Revised; SRS, Sexual Risk Survey; FASM, Functional Assessment of Self-Mutilation; EVLN, Exit-Voice-Loyalty-Neglect; S-ERB, State desire to engage in potentially risky behaviors.

[a] The BITe is used as Pre/Post measure of Irritability.

Table 7
Results of Linear Regressions

Hypothesis	***Dependent Variable***		***β***	***t***	***R***	ΔR^2	ΔF	***p***
		Model 1			.18	.03	4.05	**.02**
1	BITe change	Total ADHD	.18	2.8				**.01**
		Model 2			.18	.00	.187	.67
	BITe change	ADHD x Depletion	.04	.43				.67
		Model 1			.05	.00	.32	.72
	PASAT-C persistence duration	Total ADHD	-.05	-.77				.44
		Model 2			.05	.00	.02	.89
	PASAT-C persistence duration	ADHD x Depletion	-.01	-.14				.89
		Model 1			.19	.04	4.42	**.01**
2a/3a	BITe change	$DERS_{total}$	.15	2.14				**.03**
		FDS_{total}	.07	1.03				.30
		Model 2			.20	.01	1.38	.24
		Frustration Tolerance	-.08	-1.18				.24
		Model 3			.22	.01	2.45	.12
		Total ADHD	.12	1.57				.12
		Model 4			.27	.02	5.14	**.02**
		ADHD x FT	.14	2.27				**.02**
		Model 1			.40	.16	11.66	**.00**
2b/3b	IRS	Gender	-.20	-3.30				**.00**

Hypothesis	*Dependent Variable*		*β*	*t*	*R*	ΔR^2	ΔF	*p*
		$DERS_{total}$	.32	4.82				**.00**
		$UPPS_{total}$	-.08	-1.28				.20
		FDS_{total}	.05	.83				.41
		Model 2			.40	.00	.12	.73
		Frustration Tolerance	-.02	-.34				.73
		Model 3			.41	.01	1.58	.21
		Total ADHD	.09	1.26				.21
		Model 4			.42	.01	3.30	.07
		ADHD x FT	-.11	-1.82				.07
		Model 1			.34	.12	7.50	**.00**
	Positive Relationships	Sexual Orientation	-.10	-1.63				.11
		Race	-.12	-1.94				**.05**
		$DERS_{total}$	-.22	-3.27				**.00**
		FDS_{total}	-.10	-1.45				.15
		Model 2			.34	.00	.06	.81
		Frustration Tolerance	.02	.24				.81
		Model 3			.34	.00	.03	.87
		Total ADHD	-.01	-.17				.87
		Model 4			.38	.03	7.93	**.01**
		ADHD x FT	.18	2.82				**.01**

Hypothesis	*Dependent Variable*		*β*	*t*	*R*	ΔR^2	ΔF	*p*
					.33	.11	9.51	**.00**
		Model 1						
	Negative Relationships	Sexual Orientation	.11	1.72				.09
		$DERS_{total}$	.19	2.92				**.00**
		$UPPS_{total}$	-.19	-3.06				**.00**
		Model 2			.33	.00	.01	.94
		Frustration Tolerance	-.00	-.07				.94
		Model 3			.34	.01	3.24	.07
		Total ADHD	.13	1.80				.07
		Model 4			.36	.01	2.50	.12
		ADHD x FT	-.10	-1.58				.12
		Model 1			.32	.10	12.90	**.00**
2e/3e	SRS	Race	-.24	-3.78				**.00**
		$UPPS_{total}$	-.16	-2.55				**.01**
					.33	.00	1.03	.31
		Model 2						
		Frustration Tolerance	-.06	-1.01				.31
		Model 3			.33	.00	.44	.51
		Total ADHD	.04	.66				.51
		Model 4			.33	.00	1.11	.29
		ADHD x FT	.07	1.05				.29

Hypothesis	*Dependent Variable*		*β*	*t*	*R*	ΔR^2	ΔF	*p*
		Model 1			.41	.17	11.94	**.00**
2f/3f	NSSI-Type	Sexual Orientation	.13	2.19				**.03**
		$DERS_{total}$	.32	4.76				**.00**
		$UPPS_{total}$	-.10	-1.58				.12
		FDS_{total}	.02	.26				.80
		Model 2			.41	.00	.25	.62
		Frustration Tolerance	-.03	-.50				.62
		Model 3			.47	.05	15.38	**.00**
		Total ADHD	.28	3.92				**.00**
		Model 4			.48	.01	4.44	**.04**
		ADHD x FT	-.12	-2.11				**.04**
		Model 1			.15	.02	4.99	**.03**
2g/3g	EVLN (Positive)	Race	-.15	-2.23				**.03**
		Model 2			.15	.00	.30	.58
		Frustration Tolerance	.04	.55				.58
		Model 3			.16	.00	.72	.40
		Total ADHD	-.06	-.85				.40
		Model 4			.16	.00	.01	.91
		ADHD x FT	-.01	-.12				.91
		Model 1			.39	.16	10.40	**.00**
	EVLN (Negative)	Race	.22	3.66				**.00**

Hypothesis	*Dependent Variable*		*β*	*t*	*R*	ΔR^2	ΔF	*p*
		Ethnicity	.16	2.62				**.01**
		$DERS_{total}$	.27	3.98				**.00**
		FDS_{total}	.02	.30				.77
		Model 2			.41	.01	3.39	.07
		Frustration Tolerance	-.11	-1.84				.07
		Model 3			.41	.01	1.03	.31
		Total ADHD	.08	1.01				.31
		Model 4			.42	.01	1.76	.19
		ADHD x FT	-.08	-1.33				.19
		Model 1			.31	.09	8.25	**.00**
2h/3h	State Desire for Alcohol	Gender	-.21	-3.44				**.00**
		$DERS_{total}$	.13	1.95				**.05**
		FDS_{total}	.15	2.17				**.03**
		Model 2			.33	.02	4.54	**.03**
		Frustration Tolerance	.13	2.13				**.03**
		Model 3			.34	.01	1.30	.26
		Total ADHD	.09	1.14				.26
		Model 4			.35	.01	1.59	.21
		ADHD x FT	.08	1.26				.21

Hypothesis	*Dependent Variable*		*β*	*t*	*R*	ΔR^2	ΔF	*p*
		Model 1			.34	.12	8.04	**.00**
	State Desire for Cannabis	Gender	-.21	-3.40				**.00**
		$DERS_{total}$	.14	2.00				**.05**
		$UPPS_{total}$	-.20	-3.23				**.00**
		FDS_{total}	.07	.07				.28
		Model 2			.35	.00	.99	.32
		Frustration Tolerance	.06	1.00				.32
		Model 3			.37	.02	4.07	**.05**
		Total ADHD	.15	2.02				**.05**
		Model 4			.37	.00	.47	.49
		ADHD x FT	.04	.69				.49
		Model 1			.29	.08	11.17	**.00**
	State Desire for Condom-less Sex	Gender	-.14	-2.33				**.02**
		$UPPS_{total}$	-.26	-4.27				**.00**
		Model 2			.29	.00	.04	.84
		Frustration Tolerance	-.01	-.21				.84
		Model 3			.29	.00	.57	.45
		Total ADHD	.05	.76				.45
		Model 4			.32	.02	4.20	**.04**
		ADHD x FT	.13	2.05				**.04**

Note. BITe, Brief Irritability Test; IRS, The Impairment Rating Scale; DERS, Difficulties in Emotion Regulation; UPPS, Urgency, Premeditation, Perseverance, and Sensation Seeking Impulsivity Scale; FDS, Frustration Discomfort Scale; SRS; Sexual Risk Survey; FASM, Functional Assessment of Self-Mutilation;

NSSI, Non-suicidal self-injurious behaviors; PASAT-C, Paced Auditory Serial Addition Task-Computerized Version; S-ERB, State desire to engage in potentially risky behaviors; EVLN, Exit-Voice-Loyalty-Neglect; FT, Frustration Tolerance.

[a]The BITe change score is post-measure of Irritability - pre-measure of Irritability.

Table 8
Results of Logistic Regressions

Hypothesis	***Dependent Variable***		***β***	***SE***	***Wald X^2***	***Nagelkerke R^2***	***p***	***95% CI***
		Model 1				.12	**.00**	
2c/3c	AUDIT-C	Race	-.39	.13	9.13		**.00**	.52-.87
		$UPPS_{total}$	-.03	.01	4.41		**.04**	.95-1.00
		Model 2				.12	.92	
		Frustration Tolerance	.00	.04	.01		.92	.94-1.08
		Model 3				.12	.59	
		Total ADHD	.01	.02	.29		.59	.98-1.04
		Model 4				.12	.77	
		ADHD x FT	-.00	.00	.08		.77	.99-1.00
		Model 1				.21	**.00**	
2d/3d	CUDIT-R	Race	-.38	.16	5.86		**.02**	.50-.93
		Gender	-1.52	.40	14.69		**.00**	.10-.48
		$DERS_{total}$	.03	.01	4.08		**.04**	1.00-1.05
		$UPPS_{total}$	-.03	.02	4.28		**.04**	.94-1.00
		Model 2				.21	.34	
		Frustration Tolerance	.04	.04	.90		.34	.96-1.14

Hypothesis	*Dependent Variable*		*β*	*SE*	*Wald X^2*	*Nagelkerke R^2*	*p*	*95% CI*
		Model 3				.22	.43	
		Total ADHD	.02	.02	.61		.43	.98-1.06
		Model 4				.22	.92	
		ADHD x FT	.00	.00	.01		.92	.99-1.01
2f/3f		Model 1				.13	**.00**	
	FASM (History)	Gender	.47	.30	2.45		.12	.89-2.87
		$DERS_{total}$	.03	.01	9.41		**.00**	1.01-1.05
		$UPPS_{total}$	-.02	.01	4.09		**.04**	.96-1.00
		FDS_{total}	.01	.03	.22		.64	.96-1.06
		Model 2				.13	.75	
		Frustration Tolerance	-.01	.03	.10		.75	.93-1.05
		Model 3				.22	**.00**	
		Total ADHD	.07	.02	15.93		**.00**	1.04-1.11
		Model 4				.23	**.05**	
		ADHD x FT	-.01	.00	3.67		.06	.99-1.00

Note. AUDIT-C, Alcohol Use Disorders Identification Test-Consumption; CUDIT-R, Cannabis Use Disorders Identification Test-Revised; FASM, Functional Assessment of Self-Mutilation; DERS, Difficulties in Emotion Regulation; UPPS, Urgency, Premeditation, Perseverance, and Sensation Seeking Impulsivity Scale; FDS, Frustration Discomfort Scale.

Table 9
Study Hypotheses

Hypothesis		***Support Determination***	
H1	ADHD symptoms will be associated with observed frustration tolerance and state irritability, and self-control resource depletion will intensify this difference.	Partially Supported	ADHD symptoms are associated positively with irritability.
H2a	Higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower self-reported state irritability.	Not Supported	-
H2b	Higher abilities to tolerate frustration, regardless of depletion status, will be associated with higher self-reported social functioning.	Not Supported	-
H2c	Higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower levels of self-reported hazardous alcohol consumption.	Not Supported	-
H2d	Higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower levels of self-reported hazardous cannabis use.	Not Supported	-
H2e	Higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower levels of self-reported engagement in risky sexual behavior.	Not Supported	-
H2f	Higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower levels of self-reported engagement in NSSI.	Not Supported	-
H2g	Higher abilities to tolerate frustration, regardless of depletion status, will be associated with state response to hypothetical dissatisfaction in close relationships.	Not Supported	-
H2h	Higher abilities to tolerate frustration, regardless of depletion status, will be associated with lower self-reported state desires to engage in potentially risky behaviors.	Partially Supported	Frustration tolerance is associated positively with state desire to drink alcohol.

H3a	ADHD symptoms will moderate associations between frustration tolerance and self-reported state irritability.	Supported	The interaction between frustration tolerance and total ADHD symptoms is significantly positively associated with increased state irritability. Higher ADHD symptoms strengthened the association between frustration tolerance and state irritability.
H3b	ADHD symptoms will moderate associations between frustration tolerance and self-reported social functioning.	Partially Supported	The interaction between frustration tolerance and total ADHD symptoms was significantly positively associated with positive relationships with friends. The association between frustration tolerance and positive relationships was stronger in individuals with lower ADHD symptoms.
H3c	ADHD symptoms will moderate associations between frustration tolerance and self-reported hazardous alcohol consumption.	Not Supported	-
H3d	ADHD symptoms will moderate associations between frustration tolerance and self-reported hazardous cannabis use.	Not Supported	-
H3e	ADHD symptoms will moderate associations between frustration tolerance and self-reported engagement in risky sexual behavior.	Not Supported	-
H3f	ADHD symptoms will moderate associations between frustration tolerance and self-reported engagement in NSSI.	Partially Supported	The interaction between frustration tolerance and total ADHD symptoms is significantly positively associated with the number of different types of NSSI. Those with lower frustration tolerance used more types of NSSI, and higher reported ADHD symptoms strengthened this relationship.
H3g	ADHD symptoms will moderate associations between frustration tolerance and state response to hypothetical dissatisfaction in close relationships.	Not Supported	-
H3h	ADHD symptoms will moderate associations between frustration tolerance and self-reported state desires to engage in potentially risky behaviors.	Partially Supported	The interaction between frustration tolerance and total ADHD symptoms was significantly positively associated with state desire to engage in condom-less sex. The association between frustration tolerance and state desire to engage in condom-less sex was stronger in individuals with higher ADHD symptoms.

Note. NSSI, Non-suicidal self-injurious behaviors

Figure 1
Participant Exclusion Process

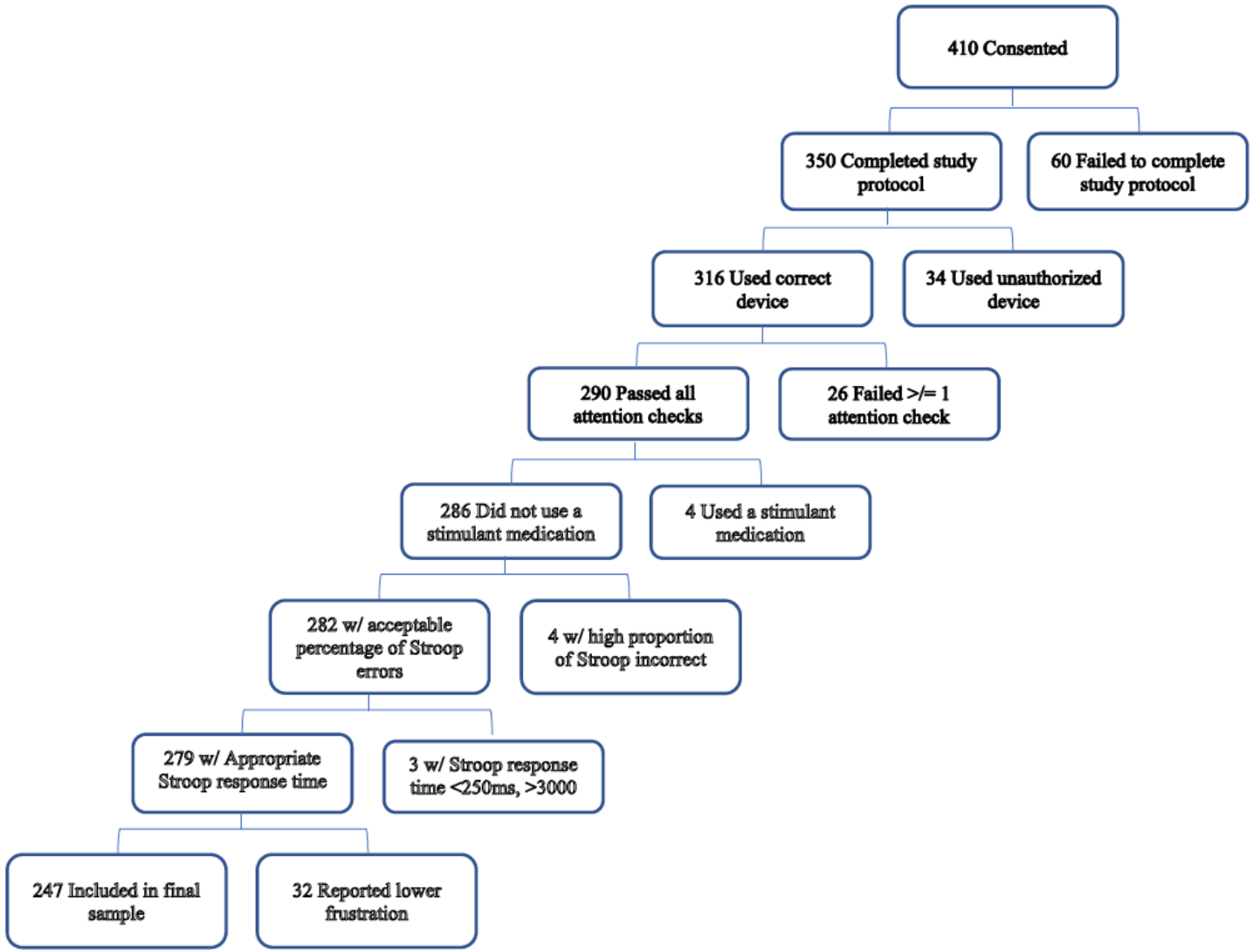
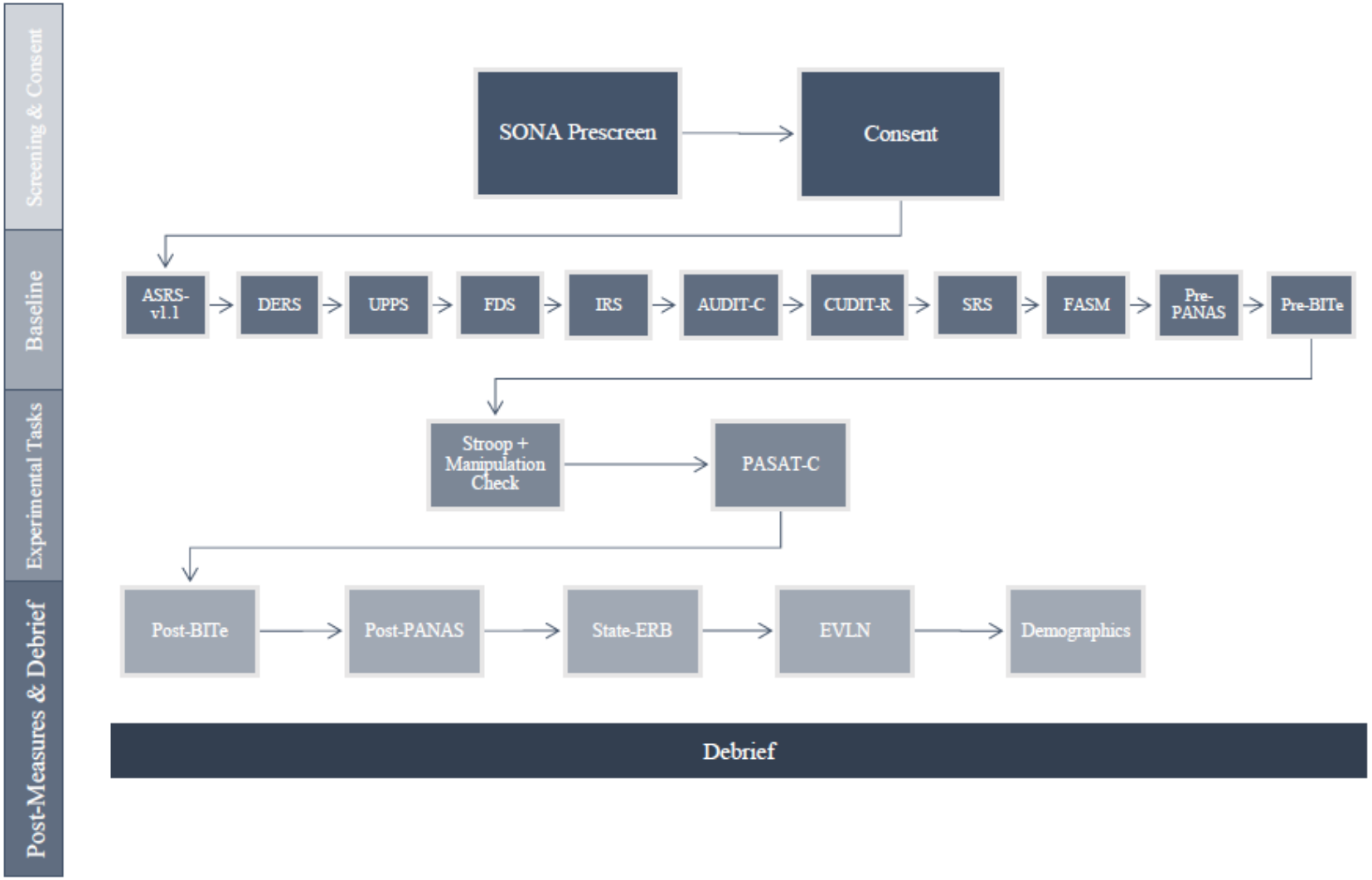


Figure 2
Study Procedure



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