Comparing Gender Differences in the Neuropsychological Functioning of College Students with Attention Deficit Hyperactivity Disorder: A Comparative Study

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Abstract

Each year the number of individuals entering post-secondary education with a diagnosis of attention deficit hyperactivity disorder (ADHD) is increasing; however, little empirical data is currently available investigating gender differences in the neuropsychological functioning of these students. Individuals with ADHD transitioning from secondary school to begin their college careers are subjected to an environment that entails a unique combination of stressors and challenges, which adversely disrupts key behaviours that are assoicated with academic success in post-secondary education. As an increasing proportion of students with ADHD are pursuing post-secondary education, this study sought to compare gender differences in the neuropsychological functioning of these students using objective and subjective measures of ADHD symptomatology. Data included in this study was obtained from a sample comprised of 35 college students. A total of 18 students self-reported a diagnosis of ADHD and 17 students self-reported no diagnosis of ADHD. Results from Mann-Whitney U tests revealed that female students with ADHD were significantly more impaired on objective measures of ADHD symptomatology (inattention and impulsivity) compared to male students with ADHD. However, subjective measures of impulsive symptoms revealed that male students with ADHD were more impaired than female students with ADHD. A t-test was performed to compare overall psychological wellbeing scores among students with ADHD and students without ADHD. Results revealed that non-ADHD students reported higher levels of psychological wellbeing compared to students with ADHD, however the result did not reach statisitcal significance. Practical implications, limitations and future directions for researchers, educational policy makers and support services are discussed.

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Literature Review

Attention-deficit/Hyperactivity disorder (ADHD) is a neurodevelopmental disorder with symptomatology classified by inattention, hyperactivity and impulsivity, deemed to be behaviourally inappropriate and adversely interferes with normal functioning and/or development (American Psychiatric Assocation, 2013). The symptoms of this disorder onset in early childhood, they are persistent in nature, and are correlated with clinically significant impairment across multiple areas of functioning, such as academic, social, psychological, and occupational functioning (Weyandt, Oster, Gudmundsdottir, & DuPaul, 2017). Formally, ADHD was originally cited as being primarly a disorder in childhood and adolescence (Wender, 1987), however further advancements in the field of ADHD research have refuted such a claim, with several studies in the extant literature alluding to adults demonstrating impairment related to ADHD symptomatology across the lifespan (Barkley, 2015; Biederman, Petty, Clarke, Lomedico, & Faraone, 2011; Fischer, Barkley, Smallish, & Fletcher, 2005; Fischer, Barkley, Edelbrock, & Smallish, 1990; Gittelman, Mannuzza, Shenker, & Bonagura, 1985; Manuzza, Klein, Bessler, Malloy, & LaPadula, 1993; Weiss & Hechtman, 1993). There is a substantial body of research literature that exists citing adults with ADHD, compared to their same-age peers without ADHD, are at an increased risk for neuropsychological deficits (i.e., attention and concentration problems), comorbid psychiatric disorders (i.e., substance use/misuse disorders, personality disorders, anxiety disorders), vehicular accidents, criminal offences, and psychosocial problems (Barkley, Murphy, DuPaul, & Bush, 2002; Kessler et al., 2006; Mostert et al., 2015).

In the past decade, scholars have attempted to define the worldwide prevelance of ADHD (Polanczyk, Silva de Lima, Horta, Biederman, & Rohde, 2007) however, the reported prevalence rate has shown great varability between studies, ranging in some instances from as low as 1%, to as high as 20% (Bird, 2002; Faraone, Sergeant, Gillberg, & Biederman,

2003). Polanczyk, Salum, Sugaya, Caye, and Rohde (2015) performed a meta-analysis investigating the worldwide prevalence of mental disorders and concluded with a worldwide prevalence rate of 3.4% for ADHD. In general, consensus among researchers is that ADHD is one of the most prevalant disorders diagnosed in childhood, with a noted prevalence of 5% (Drechsler, Brem, Brandeis, Grünblatt, Berger, & Walitza, 2020). Interestingly, the ratio of males to females being diagnosed with ADHD has been cited in the literature at ranging from 2:1 to 3:1 in community based samples (Bauermeister et al., 2007; Rucklidge, 2008). As such, males are receiving clincial referals for assessment and diagnosis at a significantly higher rate than that of females (Slobodin & Davidovitch, 2019). Coles, Slavec, Bernstrin, and Baroni (2012) suggest the reason for females being underdiagnosed and undertreated is due to clinician and informant bias. The authors suggest that the more overt and disruptive behaviours of impulusivity and hyperactivity associated with ADHD, have a greater impact on teachers' initiation of the referral process, as opposed to the less noticeable symptoms of inattention. Evidently, due to females being more likely to display symptoms of inattention, they are less likely to be referred for clinical assessment than their male peers, however such is not due to gender differences specifically, but because females are more likely to be overlooked based on their symptom presentation. Additionally, a lack of early identification of ADHD in females equates a four to nine times higher prevalence rate for the development of a comorbid disorder including, anxiety, depression, personality disorders, schizophrenia and substance use disorders (SUD), when compared to the general population (Solberg, Halmoy, Engeland, Igland, Haavik, & Klungsoyr, 2017). As a result, females are more likely to remain undiagnosed until adolescence/adulthood, wherein, increased task demands and more independent living present a more chaotic environment in which to exacerbate comorbid ADHD (Nutt et al., 2007).

Neuropsychological Functioning and Gender

Several research studies have alluded to the school environment being adversely affected by ADHD, which can be seen by the weaker academic performance shown by these children, compared to their non-ADHD peers, in turn, subjecting them to an increased risk of failure or complete cessation of their academic careers (Barbaresi, Katusic, Colligan, Weaver, & Jacobsen, 2007; Barkley, Murphy, & Fischer, 2008; Daley & Birchwood, 2010; Fabiano & Pyle, 2019). The symptomatology associated with ADHD, combined with the cognitive and executive functioning deficits also associated with this disorder, have all been cited as contributing factors in the poor academic performance displayed by these children (Daley & Birchwood, 2010; Merrell, Sayal, Tymms, & Kasim, 2017; Sonuga-Barke, 2002). Most notably, a large area of research literature has identified a correlation between ADHD and neuropsychological functioning impairments in children in several domains including, sustained attention, response inhibition, working memory and processing speed (Li, Jiang, Du, & Rossbach, 2017; Lin et al., 2017; Stern & Shalev, 2013; Villemonteix et al., 2017). However, it must be noted, findings are not entirely consistent across studies and it has been suggested that it may be of importance to consider the possible influence of gender on the decreased neuropsychological functioning observed in children with ADHD (Muñoz-Suazo, Navarro-Muñoz, Díaz-Román, Porcel-Gálvez, & Gil-García, 2019). For instance, relevant meta-analyses have indicated greater intellectual impairments in females with ADHD, as opposed to their male peers with ADHD (Gaub & Carlson, 1997; Gershon, 2002). In a study by Newcorn and colleagues (2001) investigating gender differences among a sample of children with ADHD, it was reported that males with ADHD incurred significantly more errors of commission than females with ADHD while undertaking a continuous performance test (CPT). On the contrary, no such findings were observed by Yang, Jong, Chung, and Chen (2004) who reported no significant gender differences among a sample of children with

ADHD on errors of commission or omission following a CPT. Thus, further highlighting discrepancies that are evident in the available research literature regarding gender differences in the neuropsychological functioning of individuals with ADHD.

A review of the literature pertaining to ADHD and gender differences alludes to findings that are inconsistent, with researchers noting methodological issues impeding meaningful inferences being drawn. To illustrate, Fedele and colleagues (2012) investigated gender differences among a sample of college students who self-reported ADHD symptomatology. Findings from this study concluded that gender differences were reported for both inattention and impulsivity, with females showing significantly higher rates of impairment in the abovementioned symptomatology compared to males. However, such findings have not been replicated, with multiple studies identifying no gender differences in ADHD symptomatology (Biederman et al., 2005; DuPaul et al., 2001; Murphy & Barkley, 1996; Rucklidge, Brown, Crawford, & Kaplan, 2007). Additionally, McKee (2008) assessed ADHD symptomatology in college students, an area at the time of research that was in the infancy stage with regards to available literature on such. Findings from this study conclude that both males and females reported excessive inattention, with few females reporting excessive levels of impulsivity, however, males eclipsed females in the number and severity of inattentive symptomatology. Conversely, a noted limitation, again attributed to the extant literature concerning ADHD, is the scant information that is present concerning the impact of this disorder on neuropsychological functioning and also the nature of this disorder in young adults, most notably, college students. Thus, highlighting the need for more heterogeneous research to be conducted in this cohort (DuPaul, Weyandt, O'Dell, & Varejao, 2009; DuPaul et al., 2001; McKee, 2008).

Moreover, of the little empirical information that is available investigating the neuropsychological performance of college students with ADHD, students with ADHD have

been shown to perform poorly on working memory tasks and also on continuous performance tasks (Gropper, Gotlieb, Kronitz, & Tannock, 2014; Jarrett, Rapport, Rondon, & Becker, 2017; Kim, Liu, Glizer, Tannock, & Woltering, 2014; Weyandt, Mitzlaff, & Thomas, 2002). However, other studies have found no differences in college students with ADHD compared to their non-diagnosed peers on measures of intelligence (Advokat, Martino, Hill, & Gouvier, 2007; Weyandt, Mitzlaff, & Thomas, 2002), continuous performance task measures (Weyandt et al., 2013) and visual search tasks (Dehili, Prevatt, & Coffman, 2017). Merkt and Gawrilow (2016) explored ADHD in a sample of college students, with findings from this study concluding that the sample reported increased impairment in psychological functioning, noted impairment in their overall mental health and reported significantly more ambition and less self-control. In addition to the abovementioned findings, gender differences were also discovered, whereby, females with ADHD reported impaired psychological functioning, and gender differences in obsessive-compulsive behaviour and compensatory effort were mediated by the timing of such a diagnosis (Merkt & Gawrilow, 2016). This suggests that college students, most notably females with ADHD, are significantly more impaired with health-related issues, which is an important point to note, as such impairments can place students with ADHD at a greater disadvantage in the academic setting than their peers who are not diagnosed with ADHD. Although at present there is relatively little research literature concerning ADHD in college students, it has been suggested that ADHD symptoms affect 2% to 4% of the college student population (DuPaul et al., 2001; Heiligenstein, Conyers, Berns, & Miller, 1998; Weyandt, Linterman, & Rice, 1995). As a result, failed identification and lack of referrals for assessment increases the likelihood that such individuals will under achieve academically, while also putting this cohort at an increased risk for the development of a comorbid condition that will adversely affect psychological functioning in an already vulnerable group (Barbaresi, Katusic, Colligan, Weaver, & Jacobsen, 2007; Barkley,

Murphy, & Fischer, 2008; Biederman, Faraone, Monuteaux, Bober, & Cadogen, 2004; Daley & Birchwood, 2010; Fabiano & Pyle, 2019; Solberg, Halmoy, Engeland, Igland, Haavik, & Klungsoyr, 2017; Stern & Shalev, 2013; Villemonteix et al., 2017). For this reason, more heterogeneous research on gender differences in adult ADHD is required, with particular focus on college students who have remained significantly unexplored (Rucklidge et al., 2007).

The Current Study

Research over the last decade in adults with ADHD has highlighted impariments in several key domains of self-regulation, most noted in academic achievement, cognitive performance and overall mental wellbeing (Biederman, Faraone, Monuteaux, Bober, & Cadogen, 2004; Rucklidge, Brown, Crawford, & Kaplan, 2007). Adults with ADHD have been identified as being more vulnerable to cognitive problems, more susceptible to adverse psychological impairment and at a higher risk for development of adverse health problems/behaviours, such as obesity, alcohol abuse, smoking and substance use/dependency (Biederman, Faraone, Monuteaux, Bober, & Cadogen, 2004; Cortese, Faraone, Bernardi, Wang, & Blanco, 2013; Klein et al., 2012; Merkt & Gawrilow, 2016; Ramos Olazagasti et al., 2013). However, there is a lack of available literature relating to college students with ADHD specifically and how their overall functioning may be impeded in an environment that places new and demanding challenges on the individual. To illustrate, no studies to date, have investigated the executive function skills of college students with ADHD based on their own self-judgements, nor have any studies systematically investigated academic performance with regards to weekly performance reported by college students themselves. Additionally, no studies have investigated the effects of educational supports and psychosocial interventions provided for college students with ADHD, and there is little research investigating the effects medications have on these student's academic, interpersonal and psychological outcomes

(DuPaul, Weyandt, O'Dell, & Varejao, 2009; Weyandt & DuPaul, 2006). Likewise, no study that the author is aware of, has looked to examine the changes in functioning of students with ADHD across their college careers. In the context of Irish university/college student's, no study to date has investigated gender differences in the neuropsychological functioning of student's with ADHD.

Individuals with ADHD transitioning from secondary school to begin their college careers are subjected to an environment that entails a unique combination of stressors and challenges which adversely disrupts key behaviours that are assoicated with academic success in post-secondary education (Weyandt et al., 2013). Research has suggested that there is an association between greater ADHD inattentive symptomatology and poorer academic, psychological and career related outcomes. As such, it is important that future research examines this association further to understand if individuals with the predomintantly inattentive subtype of ADHD report more impairments and decreased psychological wellbeing than individuals with the implusive/hyperactive subtype of ADHD or the combined type (Betz, 2000; Blasé et al., 2009; Frazier, Youngstrom, Glutting, & Watkins, 2007; Norwalk, Norvilitis, & MacLean, 2008; Rabiner, Anastopoulos, Costello, & Hoyle, 2008; Schwanz, Palm, & Brallier, 2007). As described, college students diagnosed with ADHD are at a higher risk for maladaptive functioning across several crucial domains, such as academic performance, psychological functioning and social functioning (Sedgwick, 2018). Perhaps the most concerning finding relates to the aforementioned impairments and how such have been most notably cited in female college students when compared to their male peers with ADHD. Findings related to gender differences among college students with ADHD, most notably psychological and social functioning impairments in females with ADHD in particular, highlights a need to investigate such findings further to better

understand do female college students with ADHD report greater levels of impairment in inattention, impulsivity and wellbeing than that of their male peers with ADHD.

The current study identified a gap in the literature related to gender differences in the neuropsychological functioning of college students with ADHD. Additionally, gender differences in relation to ADHD symptomatology has revealed findings that are inconsistent (Biederman et al., 2005; DuPaul et al., 2001; Fedele, Lefler, Hartung, & Canu, 2012; Murphy & Barkley, 1996; Rucklidge, Brown, Crawford, & Kaplan, 2007). To illustrate, several studies have reported females exhibiting higher levels of inattention and impulsiveness compared to males, but such findings have proved hard to replicate, leading some scholars to refute such claims, citing no gender differences amongst individuals with ADHD. Conflicting results pertaining to college students with ADHD has also ensued disagreement among scholars. For example, several studies have cited that both males and females report high levels of inattention, but few females report greater levels of impulsivity, and males have been cited at eclipsing females in number and severity of inattention symptomatology.

As such, sparse research literature surrounding such a critical area is something the current study attempts to rectify by providing more research in this area to help better understand gender differences in college students with ADHD, most notably differences in neuropsychological performance and psychological wellbeing. Therefore, it is the aim of the current study to first, compare gender differences in the symptomatology of college students with ADHD, most specifically differences in inattention and impulsivity. Second, investigate if college students with ADHD self-report lower levels of psychological wellbeing compared to their non-diagnosed peers. Third, investigate gender differences in self-report levels of impulsivity among college students with ADHD. This study is important as understanding gender differences in the neuropsychological performance of college students with ADHD in the abovementioned symptomatology helps to better inform educational policy makers in the

future, providing opportunities to devise and implement integral strategies that will assist these individuals to navigate through their college careers as successfully as their non-diagnosed peers. Specifically, the research questions of interest to the current study are, first, is there a difference in the neuropsychological performance of male and female college students with ADHD following an objective neurocognitive test to assess levels of inattention and impulsivity. Second, is there a significant difference in levels of self-reported psychological wellbeing between college students with and without ADHD and lastly, do male and female college students with ADHD differ on subjective measures of impulsivity and do male college students with ADHD self-report greater levels of impulsive symptomatology than female students with ADHD.

With reference to previous research it is hypothesized that

(1) Male college students with ADHD will incur more errors of commission compared to female students with ADHD.
(2) There will be no significant gender difference in college students with ADHD on errors of omission.
(3) Students with ADHD will self-report lower levels of psychological wellbeing compared to their non-diagnosed peers.
(4) Male college students with ADHD will self-report higher levels of impulsive symptomatology compared to female students with ADHD.

Methodology

Participants

The sample for the current study initially consisted of 64 participants who were recruited using a non-probability, online convenience sampling technique. The study was advertised to potential participants online via the researchers social media accounts (Instagram and Twitter) and also with the help of ADHD Ireland who shared a link to the study and a detailed description online on all their social media platforms. In accordance with ethical considerations, participants were required to be 18 years of age to be eligible to participate in the current study. All participants were required to provide informed consent before they could proceed to undertake the study. A total of 29 participants were excluded from the analyses as they had not completed all of the appropriate measures and therefore did not provide sufficient data needed to be eligible for participation in the study. The final study sample was comprised of 35 college students (Males: n = 19; Females: n = 16). Of those 35 college students, 51.4% (n = 18) self-reported a diagnosis of ADHD and 48.6% (n = 17) did not self-report a diagnosis of ADHD. Participants in the current sample ranged in age from 18 to 45 years.

Materials

The study questionnaire was comprised of demographic questions, a URL link for Inquisit Labs to a computerised continuous performance task, and two distinct scales that measured psychological wellbeing and impulsiveness, integrated using the survey builder, Google Forms. Administration of the demographic questions was done to gain a general profile of the college students' sampled in this study, questions regarding their gender, age, and if a diagnosis of attention deficit hyperactivity disorder (ADHD) had been received, were included in this section.

Continuous Performance Test. The Continuous Performance Test (CPT; Rosvold, Mirsky, Sarason, Bransome, & Beck, 1956; Zane, Gfeller, Roskos, & Bucholz, 2016) was used to measure participants sustained attention and selective attention. The administration of the CPT was done remotely, such was achieved with the procurement of an Inquisit Lab web license from the Millisecond Test Company, granted to the researcher by the National College of Ireland for the purpose of this study. The CPT is a computer-based test that involves the rapid presentation of a series of visual stimuli (letters). The CPT is divided into two sections, the CPT-X and the more difficult variant, the CPT-AX. The total test duration for the CPT was twenty-five minutes, each section took ten minutes to complete and a default rest period of 2000 milliseconds was provided to participants between each section. Participants were instructed to respond to the 'target' stimulus by pressing the 'spacebar' on their keyboard or mobile device and to refrain from responding to 'non-target' stimuli. Task one presented participants with two practice blocks and 20 test blocks. Each block runs 31 letters with eight targets (order is randomly determined). The no-target letters are selected randomly with replacement from item "X" letters.

Task one entails participants responding only when "X" is displayed on screen. Letters were presented on screen in black font against a white background for a duration of 690 milliseconds with inter-stimulus intervals (ISI) (blank screen) between letter presentations lasting 230 milliseconds. An example of the trial sequence is as follows: (*Letter (690ms) - ISI: blank screen (230ms) - letter…*). Participants' responses are accepted until the end of the letter duration. Task two presented participants with two practice blocks and 20 test blocks. Each block runs 31 letters with six targets (target = letter X that follows an A). The no-target letters are selected randomly with replacement from item A-X letters (with the constraint that no A is followed by an X). In task two, any letter can precede an X (including X itself); any letter can follow an A (including A itself); and the number of 'no-signal As' as

well as ‘no target Xs’ are randomly determined per block. In the second half of this experiment, participants responded whenever “A” followed by an “X” was displayed. Letters were displayed on screen in black font against a white background for a duration of 690 milliseconds with inter-stimulus intervals (ISI) (blank screen) between letter presentations lasting 230 milliseconds.

The CPT X and AX tasks measured the following items: omission errors (the number of times participants fail to respond to target stimulation), commission errors (number of times participants respond to non-target stimulation), average reaction time and coefficient of variance for both correct reactions and commission errors (Suwa, Matsushima, Ohta, & Mori, 2004). This test used two main scores to measure participants ADHD symptomatology including omission errors and commission errors. Omission error scores indicate the number of times the target was presented, but the participant did not respond/press the space bar on their keyboard. High omission rates indicate that the participant is either not paying attention (distractibility) to the stimuli or has a sluggish response. Commission error scores indicate the number of times the participant responded but no target was presented. Previous research has shown the CPT to demonstrate good sensitivity to ADHD and correlates well with symptomatology for this disorder (see Epstein et al., 2003).

Psychological Well-Being Scales. The Psychological Well-Being Scales (PWB; Ryff & Keyes, 1995), a 42-item self-report measure, was used to determine participants’ levels of wellbeing and happiness. Participants read 42 statements and rated them on six-point Likert scale from 1 (strongly disagree) to 6 (strongly agree). The scale consisted of 22-items that were positively worded and 20-items that were negatively worded. An example of an item that was positively worded is as follows: “*I am not afraid to voice my opinions, even when they are in opposition to the opinions of most people*.” An example of an item that was negatively worded is as follows: “*I often feel lonely because I have few close friends with*

whom to share my concerns." The scale consisted of six subscales that measured six components of psychological functioning: autonomy (sample item - "*My decisions are not usually influenced by what everyone else is doing*"), environmental mastery (sample item - "*I often feel overwhelmed by my responsibilities"*), personal growth (sample item - "*I am not interested in activities that will expand my horizons*"), positive relations with others (sample item - "*I enjoy personal and mutual conversations with family members or friends*"), purpose in life (sample item - "*I enjoy making plans for the future and working to make them a reality*"), and self-acceptance (sample item - "*I feel like many of the people I know have gotten more out of life than I have*"). Seven-items were designed to measure each of the six subscales, higher scores for each of the six subscales indicates greater levels of psychological wellbeing/mastery in that domain of the participants' life. Conversely, lower scores for each of the six subscales indicates lower levels of psychological wellbeing in that domain of the participants' life. Prior to analysis, 20-items that were negatively worded were reverse scored so that high scores indicated greater levels of psychological wellbeing. Scores can be computed by adding up each of the scores for the seven-items in each of the six subscales. Scoring of the six subscales ranges from 7 to 42, and the total score ranges from 42 to 252, with higher scores indicating higher levels of psychological wellbeing (see Appendix B). Previous research has reported Cronbach's alpha coefficients ranging from .87 to .96, and test-retest reliability coefficients ranged between 0.78 and 0.97 for the six subscales (Akin, 2008). In the current sample, the Cronbach's alpha coefficient was (α = .96).

Barratt Impulsiveness Scale. The Barratt Impulsiveness Scale (BIS-11; Patton, Stanford, & Barratt, 1995), a 30-item self-report measure, was used to determine participants' levels of impulsiveness. Participants read 30 statements and rated them on a four-point Likert scale from 1 (rarely/never) to 4 (almost always/always), with four indicating the most impulsive response. The scale also consisted of three subscales that measured three main

dimensions/subtraits of impulsive behaviour: attentional impulsiveness (8-items; "a lack of focus on the ongoing task"), motor impulsiveness (11-items; "acting without thinking"), and non-planning impulsiveness (11-items; "orientation to the present rather than to the future"). The BIS also assessed six first order factors: attention (5-items; I don't "pay attention"), cognitive instability (3-items; I have "racing" thoughts), motor (7-items; I act "on impulse"), perseverance (4-items; I change jobs), self-control (6-items; I plan tasks carefully), and cognitive complexity (5-items; I get easily bored when solving thought problems). To avert a response set/bias, items 1, 7, 8, 9, 10, 12, 13, 15, 20, 29, and 30 were worded to indicate non-impulsiveness behaviors and were reverse scored accordingly prior to data analysis. An example of a non-impulsiveness worded question is as follows: "*I am self-controlled*" or "*I concentrate easily*". An example of an impulsiveness worded question is as follows: "*I say things without thinking*" or "*I buy things on impulse*". Total scores are computed by adding up the answers to all 30-items, with higher scores indicating higher levels of impulsiveness. Scores for each subscale are determined by summing the participants' answers to each subscale's items, with higher scores on each subscale indicating higher levels of impulsiveness on that dimension. The highest possible score is 120 and the lowest is 0 (see Appendix C). This scale has shown good levels of predictive and concurrent validity, and a Cronbach's alpha coefficient ranging from .69 to .83 has been reported (Vasconcelos, Malloy-Diniz, & Correa, 2012; Stanford et al., 2009). In the current sample, the Cronbach's alpha coefficient was (α = .95).

Design

The current study implemented an experimental, cross-sectional comparison research design and adopted a quantitative approach. All four hypothesis were investigated using a between-subjects design as different groups/genders (male and female) were compared on objective measures of ADHD symptomatology and subjective measures of psychological

wellbeing and trait impulsiveness. There were two independent variables in the current study and they included gender and ADHD diagnosis. There were four dependent variables in the current study and they were as follows: total omission and commission errors, total psychological wellbeing scores and total impulsiveness scores.

Procedure

Data was collected online using a Google Forms survey and also using Inquisit Lab software from the Millisecond Test Company. The Inquisit Lab software made online administration of an objective computerised neuropsychological assessment of sustained and selective attention feasible in the current study. Prior to the study being advertised online, it was piloted to four individuals to ensure the URL link to the Inquisit Lab flash player was working accordingly. Also, to determine the length of time it took to complete the study and to ensure no other issues were encountered. The average time for completion of this study was 40 minutes and no issues were encountered using Google Forms or the Inquisit Lab software. The estimated time of completion was then included in the participant information sheet. Data from the four participants' whom the study was piloted on were excluded from analysis. The study was advertised on the researcher's social media platforms (Instagram and Twitter), through a link with a brief description of the study, eligibility criteria for participation, and it invited anyone interested in partaking in the study to click on the link provided. Approval was sought and granted from ADHD Ireland to advertise the research study on all their social media platforms (Facebook, Instagram, and Twitter), which included a description and a link to the study.

The Google Forms survey was comprised of seven sections in total. When participants decided to participate in the study and open the link, they were provided with a participant information sheet detailing the nature and purpose of the study, the author, eligibility requirements for the study as well as any risks or benefits involved in participation

(see Appendix D). Participants were informed that participation was voluntary and consent could be withdrawn at any stage during the study and such would incur no penalties or expose them to any disadvantages. Participants were instructed that this could be achieved by closing the link to the study. Participants were informed that data collected in the study was done so anonymously and once participants clicked submit it would not be possible to withdraw their data as it would not be identifiable. The second section of the survey contained the consent form, which again outlined the nature and purpose of the study (see Appendix E). Participants were required to answer three questions on the consent page before proceeding to the next section. Participants were required to confirm that they were over 18 years of age, provide consent to voluntarily take part in the research study, and click "I agree" to confirm reading and understanding the participant information sheet and the details on the consent form and agreeing consent to participate in the research study.

The third section asked for demographic information from the participants relating to gender, age, and also to indicate if a diagnosis of ADHD had been received (see Appendix F). The fourth section presented participants with a set of instructions regarding the CPT, ensuring the task was performed in a room free from any distractions that may affect performance was explicitly stated, a link to the Millisecond Test Company who provided the software for online administration of the CPT, and a reminder to return back to the Google Forms page and to click continue upon completion of the CPT (see Appendix G). Briefly, participants clicked the link provided which took them to the Millisecond Test default page for undertaking the CPT. Participants were instructed to download the Inquisit Lab flash player, which took approximately 2 minutes to download and was compatible with most smartphones. Participants then proceeded to click start. Participants were then instructed to enter the four-digit code they had created on Google Forms and click ok. The four-digit code enabled the researcher to assign the correct data obtained from the CPT to the appropriate

participants data on Google Forms. Instructions regarding task one were then presented on the participants screen. Participants were instructed to press the 'spacebar' whenever the letter X (target stimulus) was presented on screen. Participants responded by pressing the 'spacebar' whenever the letter X was presented on screen and inhibited responding if the letter presented was not that of the target stimulus. Letters were presented on screen in black font against a white background for a duration of 690 milliseconds with inter-stimulus intervals (ISI) (blank screen) between letter presentations lasting 230 milliseconds. This task lasted for approximately 10 minutes and once complete participants were presented with instructions on screen asking them to rest for two minutes. When the two-minute rest period had elapsed, participants were presented with instructions regarding task two on their screens. Participants were instructed to press the 'spacebar' whenever the letter presented on screen was an X that follows an A. Participants responded if the letter A was followed immediately by the presentation of the letter X. Letters were presented on screen in black font against a white background for a duration of 690 milliseconds with inter-stimulus intervals (ISI) (blank screen) between letter presentations lasting 230 milliseconds. This task lasted for approximately 10 minutes and once complete participants were presented with a default page indicating their data had successfully been recorded and thanking them for their participation. Participants then closed the Inquisit Lab flash player and returned to section four of the Google Forms survey and clicked continue to proceed to section five.

The fifth section involved participants undertaking the Psychological Well-Being Scales (PWB; Ryff & Keyes, 1995), a 42-item self-report questionnaire assessing participants levels of wellbeing and happiness. Following this in the sixth section was the Barratt Impulsiveness Scales (BIS-11; Patton, Stanford, & Barratt, 1995), a 30-item self-report questionnaire used to assess participants levels of trait impulsiveness. Finally, in section seven participants were presented with the study debriefing form, which again detailed the

nature of the study, provided the contact details of the supervisor and the researcher, and thanked the participants for their participation (see Appendix H). The debriefing form also contained contact information for various support services in the event any participant was feeling distressed following their participation in the study.

Ethical Considerations

This research study was approved by the National College of Ireland's Ethics Committee. The study was conducted in accordance with the National College of Ireland's Ethical Guidelines and Procedures for Research involving Human Participants. All the data collected was done so in line with the ethical guidelines of National College of Ireland. The risks and benefits of participation in the study were clearly outlined to participants, no incentive was offered to participate in the study and all of the participants provided informed consent. The debrief form included contact information for two support services, Pieta House and Aware, for participants' experiencing any distress as a result of participation in the study (see Appendices E & H).

Results

Descriptive Statistics

The current data is taken from a sample of 35 college students (*n* = 35). The sample consisted of 54.3% males (*n* = 19) and 45.7% females (*n* = 16). Of those 35 college students, 51.4% (*n* = 18) self-reported a diagnosis of ADHD, and 48.6% (*n* = 17) did not self-report ADHD. The sample consisted of 54.3% (*n* = 19) participants aged 18 to 25 years; 34.3% (*n* = 12) aged 26 to 35 years; and 11.4% (*n* = 4) aged 36 to 45 years. Descriptive statistics were performed for all continuous variables including commission errors, omission errors, impulsiveness scores and psychological wellbeing scores. Means (M), Medians (MD), Standard Deviations (SD), and Minimum and Maximum scores were obtained. The results for commission and omission errors in college students with ADHD are presented below in Table 1. Results for impulsiveness and psychological wellbeing scores in college students with and without ADHD are presented in Table 2.

Table 1

Descriptive statistics for total commission and omission errors in college students with ADHD (N = 18)

	Mean (95% Confidence Intervals)	Median	SD	Minimum	Maximum
Commission errors	8.44 (5.28 - 11.61)	6	6.36	1.00	22.00
Omission errors	18.78 (6.88 - 30.68)	10	23.93	.00	76.00

Table 2

Descriptive statistics for total impulsiveness and psychological wellbeing scores in college students with and without ADHD (N = 35)

	Mean (95% Confidence Intervals)	Median	SD	Minimum	Maximum
Impulsivity	75.29 (68.93 - 81.64)	79	18.50	38.00	113.00
Psychological wellbeing	163.77 (150.52 - 177.02)	156	38.56	97.00	240.00

Inferential Statistics

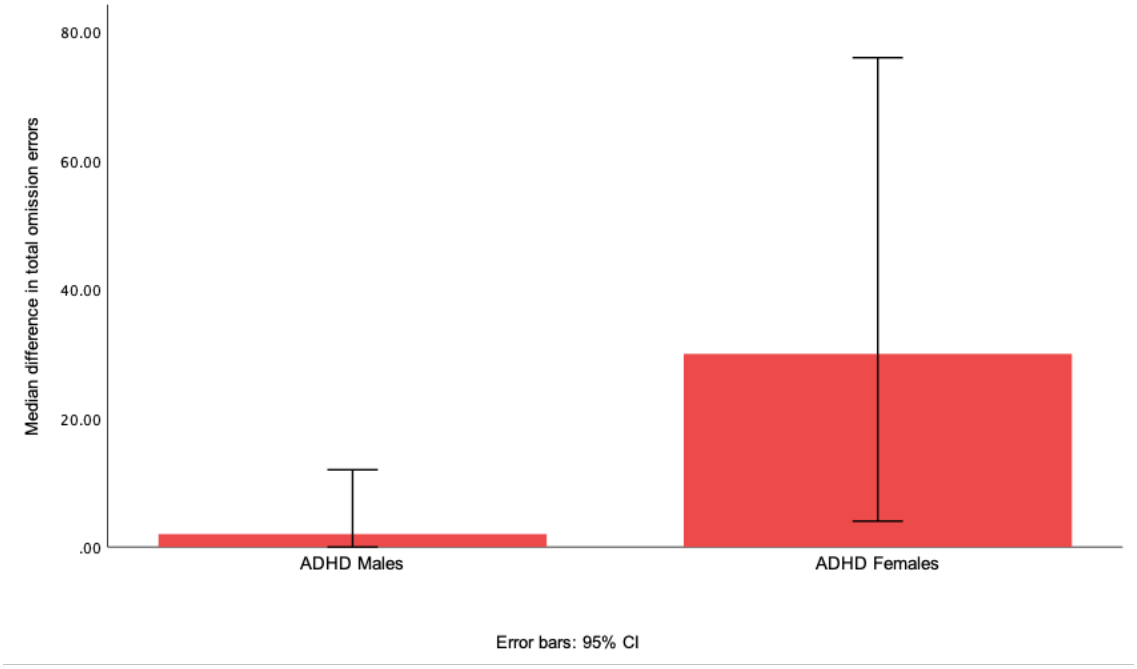
Preliminary analysis was performed on the data set and this indicated that two of the four continuous variables violated the assumptions of normality. A significant result ($p < .05$) of the Shapiro-Wilk test statistic was found for commission and omission errors indicating that they are non-normally distributed. A further inspection of the histograms pertaining to the two variables of interest showed both were positively skewed. Attempts to transform the data did not result in the removal of the skewness and as such, were not applied. Therefore, a non-parametric Mann-Whitney U test was conducted to compare total commission errors made between male and female college students with ADHD. The results indicated that there was a statistically significant difference in total commission errors made, with females (Md = 13.00, n = 7) incurring significantly more errors of commission than males (Md = 4.00, n = 11), U = 14.50, z = -2.19, p = .028, r = .52. According to Cohen's (1988) criteria for effect sizes, this result indicates a large effect size between genders in the current sample of students with ADHD.

An additional non-parametric Mann-Whitney U test was conducted to compare total omission errors made among male and female college students with ADHD. The results from this test indicated that there was a statistically significant difference in total omission errors

made between genders, with females (*Md* = 30.00, *n* = 7) incurring significantly more omission errors than males (*Md* = 2.00, *n* = 11), *U* = 11.00, *z* = -2.50, *p* = .012, *r* = .59. This result indicates a large effect size. See Figure 1 for bar chart illustrating the median difference in total omission errors made between male and female college students with ADHD.

Figure 1

Median difference in total omission errors made between male and female college students self-reporting a diagnosis of ADHD (N=18)



An independent samples t-test was conducted to compare total psychological wellbeing scores between college students with and without ADHD. Levene's test for equality of variances was non-significant for total psychological wellbeing (*p* = .79); as such, the data does not violate the assumption of homogeneity of variance and equal variances assumed. The results revealed there was no statistically significant difference in

psychological wellbeing scores for students without ADHD (M = 175.35, SD = 37.39) and students with ADHD (M = 152.83, SD = 37.38; t (33) = 1.78, p = .084).

Lastly, a non-parametric Mann-Whitney U test was conducted to compare total self-reported levels of impulsivity among male and female college students with ADHD. This test indicated that there was a statistically significant difference in self-report levels of impulsiveness, with male students self-reporting higher levels of impulsiveness (Md = 91.00, n = 11) compared to females students (Md = 77.00, n = 7), U = 8.50, z = -2.72, p = .007, r = .64. This test indicates a large effect size.

To summarise, there is a significant difference in errors of commission and errors of omission made between male and female college students with ADHD, with females incurring more errors than males in the abovementioned. Overall psychological wellbeing was higher for students who did not self-report a diagnosis of ADHD, however this finding did not reach statistical significance. Lastly, male students with ADHD self-reported significantly higher levels of impulsive symptomatology than that of female students with ADHD.

Discussion

The current study was interested in three primary aims. The first was to investigate gender differences in a sample of college students who self-report a diagnosis of ADHD, most specifically differences in the symptomatology of inattention and impulsivity. The second was to investigate if college students with ADHD self-report lower levels of psychological wellbeing compared to their peers who do not self-report a diagnosis of ADHD. The third was to investigate gender differences in self-report levels of impulsive symptomatology among college students who self-report a diagnosis of ADHD. Previous research investigating gender differences among ADHD populations has revealed inconsistent findings. For example, some scholars articulate that ADHD females show significantly higher levels of impairment in symptomatology compared to ADHD males, while others refute such claims, suggesting more similarities exist among genders with regards to symptomatology, as opposed to differences (Biederman et al., 2005; DuPaul et al., 2001; Fedele, Lefler, Hartung, & Canu, 2012; McKee, 2008; Rucklidge, Brown, Crawford, & Kaplan, 2007).

For this reason, the current study sought to provide more research on gender differences in ADHD populations, particularly differences in the neuropsychological functioning of college students who self-report a diagnosis of ADHD. In the current study, an objective laboratory based measure of ADHD symptomatology was used to help reduce a reporters bias. Coles, Slavec, Bernstein, and Baroni (2012) suggest that using an objective laboratory based measure is especially important when assessing females with ADHD, who, according to the authors, tend to be underdiagnosed and undertreated for ADHD symptomatology due to clinician and informant biases. Also, consistent with previous research in this area, CPT commission errors were used as a measure of impulsivity and CPT omission errors were used as a measure of inattentive symptomatology (Hasson & Fine,

2012). Based on prior research and to address the aims of the current study, four hypotheses were formulated.

First, it was hypothesized that (H1), male college students with ADHD would incur more errors of commission compared to female students with ADHD. To investigate this hypothesis, a Mann-Whitney U test was conducted. Results from this test revealed that female college students who self-reported a diagnosis of ADHD incurred significantly more errors of commission than male students with ADHD. To clarify, female college students with ADHD produced more impulsive responses than male students with ADHD. As a result, female students with ADHD in the current sample showed significantly higher levels of impairment in impulsive symptomatology compared to their male peers with ADHD as measured by an objective neurocognitive test. This finding conflicts with prior research (e.g. Carlson, Tamm, & Gaub, 1997; Gaub & Carson, 1997; Gershon, 2002; McKee, 2008) which cites a comparable or lower severity of impulsive symptomatology in females with ADHD when compared to males with ADHD. Additionally, CPT analysis from several studies in the extant literature has revealed greater levels of impulsive symptomatology among males with ADHD (Newcorn et al., 2001; Slobodin & Davidovitch, 2019). However, one must note, such findings may be due to methodological differences between studies. For instance, results vary greatly depending on the specific assessment method chosen, some studies rely solely on self-report measures of impulsive symptomatology, while others use objective neurocognitive laboratory based measures to assess levels of impulsiveness. As such, this can create discrepancies between results among studies, which makes drawing firm inferences that are generalisable to the population difficult.

The second hypothesis (H2), stated that there will be no significant gender differences in college students who self-report a diagnosis of ADHD on errors of omission. Results from a Mann-Whitney U test revealed that female college students with ADHD incurred

significantly more errors of omission than male students with ADHD. This result indicates that females with ADHD are significantly more impaired in the domain of inattentive symptomatology compared to their male peers with ADHD. This finding is consistent with previous research by Fedele, Lefler, Hartung, and Canu (2012) who found that female college students self-reporting a diagnosis of ADHD had significantly higher rates of inattentive symptomatology when compared to college females and males with and without a diagnosis of ADHD. Likewise, in a sample of clinic-referred children with ADHD, it was reported that females had significantly more inattention problems than males (Slobodin & Davidovitch, 2019). This finding yield important clinical implications for female college students with ADHD. To illustrate, several research studies have shown significant associations between greater inattentive symptomatology and poorer academic, psychological and career related outcomes in college students with ADHD (Betz, 2000; Blasé et al., 2009; Frazier, Youngstrom, Glutting, & Watkins, 2007; Norwalk, Norvilitis, & MacLean, 2008; Schwanz, Palm, & Brallier, 2007). Evidently, high levels of inattentive symptomatology create more difficulty with tasks involving independent planning, such as mental planning, a key skill needed to successfully navigate through a college career. Therefore, high levels of inattentive symptoms in a college setting can severely impair an individual with ADHD causing them to present as easily distracted, disorganised, overwhelmed or to appear as though they are lacking in effort or motivation. These findings suggest that female college students with ADHD are at a higher risk for maladaptive functioning across several crucial domains such as, academic performance, psychological functioning and social functioning (Sedgewick, 2018).

For H3, an independent samples t-test was conducted to compare overall psychological wellbeing scores among college students with and without ADHD. The results revealed that non-ADHD college students reported greater levels of psychological wellbeing

compared to students who self-reported a diagnosis of ADHD, however, the result did not reach statistical significance. The large discrepancy in mean scores between the groups and the non-significant result may be attributable to the small sample size causing a lack of statistical power within the current study. As such, a larger sample size would be recommended for future studies to ensure sufficient power to uncover any statistical differences between groups.

Lastly, H4 stated that male college students with ADHD would self-report higher levels of impulsive symptomatology compared to female students with ADHD. Results from a Mann-Whitney U test revealed that male students with ADHD self-reported significantly higher levels of impulsive symptomatology compared to female students with ADHD. With regard to findings in the extant literature, inconsistencies in self-report impulsiveness levels by gender are most apparent. To illustrate, in population based studies, impulsivity levels are generally much higher in males, however when studies are conducted with a sample of clinically referred patients who have a psychiatric diagnosis, interestingly, females exhibit more impulsive symptomatology than males (Gökçe, Yusufoğlu, Akin, & Ayaz, 2017; Lejuez, Bornovalova, Reynolds, Daughters, & Curtin, 2007)**.** Further, in a study of undergraduate students it was reported that males had significantly higher motor impulsivity scores than females, but no significant differences were found among the sample scores for attentional impulsiveness or non-planning impulsiveness (Lage, Albuquerque, Fuentes, Corrêa, & Malloy-Diniz, 2013; Stoltenberg, Batien, & Birgenheir, 2008). On the contrary, several studies have found no gender differences on any dimension of self-report impulsiveness and research in this area has not consistently demonstrated gender differences in impulsivity (Petrovic & Castellanos, 2016; Reynolds, Ortengren, Richards, & de Wit, 2006) Based on the abovementioned findings, hypothesis one, two and three were not supported by the data, however hypothesis four can be accepted.

Findings obtained in the current study offer further insight into specific gender differences in the neuropsychological functioning of college students with ADHD. The current study provides evidence to suggest that female students with ADHD are just as impaired, if not more so, than their male peers with ADHD. Findings obtained from a neurocognitive test revealed that females were more impaired than males on objectively measured ADHD symptoms of inattention and impulsivity. However, a subjective measure of impulsiveness revealed that male students with ADHD reported greater impulsive symptom severity than female students with ADHD. The fact that males and females in the current sample varied quite considerably on objectively measured ADHD symptoms, may indicate that the overall severity of ADHD symptomatology is quite different between genders. It is concerning that female students with ADHD in the current sample are significantly more impaired than their male peers with ADHD. However, it must be noted that the use of objective or subjective measures with ADHD populations can entail different outcomes on similar measures assessing ADHD symptomatology. For example, CPT analysis in the current sample showed that objectively female students were more impaired with impulsive symptomatology, however subjective measures of impulsiveness revealed that male students had significantly higher levels of impulsive symptoms than females. Interestingly, more recent research conducted by Slobodin and Davidovitch (2019) concluded that gender effects on ADHD symptomatology may differ between subjective and objective measures. As such, when assessing this population it would be advisable to include multiple sources of information and methods of assessment to help reduce the gender gap. It has been suggested, high inattentive symptom severity in ADHD populations is predictive of the majority of variance in adaptive functioning (Stavro, Ettenhofer, & Nigg, 2007). The current study revealed that female students with ADHD had higher levels of objectively measured ADHD symptomatology compared to male students with ADHD. The study also revealed how

subjective measures of impulsive symptomatology differed greatly from the objective measures, such that, male students with ADHD reported greater impairment in impulsive symptomatology than females with ADHD. These findings lend support to previous research studies and help to further contribute to the small amount of research currently available investigating gender differences in the neuropsychological functioning of college students with ADHD.

Practical Implications

Findings obtained in the current study provide insight into specific gender differences in the neuropsychological functioning of college students with ADHD. These findings provide important clinical implications for educational policy makers and professionals working in the educational sector, particularly those who provide support services and academic accommodations to college students with ADHD. Results from the current study, and established recommendations from prior research on treatment approaches for ADHD, suggest a multimodal approach which incorporates psychopharmacological medication, academic accommodations, and behavioural interventions such as Cognitive Behavioural Therapy (CBT) (Asherson, 2005). Research suggests that the use of stimulant medication in adults with ADHD can entail significant symptom reduction (Fitzgerald, 2001; Weiss, Murray, & Weiss, 2002). For example, adults with ADHD have shown significant improvement in response inhibition, working memory, and sustained attention following the use of stimulant medication (Schweitzer et al., 2004; Turner, Blackwell, Dowson, McLean, & Sahakian, 2005). As such, the use of stimulant medication may be particularly helpful in alleviating/lowering functional impairment in college students with ADHD and would be recommended, particularly while the student is transitioning to the demands of post-secondary education.

The use of stimulant medication alone, however, does not provide students with successful coping mechanisms, nor does it provide strategies for managing the functional impairments or the quality of life impairments that are also associated with ADHD. To illustrate, students with ADHD may experience significant academic problems due to the increasing demands of college life making prior coping mechanisms ineffective (Shaw-Zirt, Popali-Lehane, Chaplin, & Bergman, 2005). It would be advisable where possible, for support services to provide students with the opportunity to gain knowledge and understanding about their ADHD, its associated symptoms, and how such may affect their college experience. Prior research has shown that students who are more knowledgeable about their ADHD symptomatology were more articulate about their own difficulties and were able to describe more success in planning and implementing strategies to manage their symptoms and the increased demands of post-secondary education (Meaux, Green, & Broussard, 2009).

By providing students with self-awareness and self-management skills for their symptoms, they will be better able to ask for specific accommodations and adapt successfully to a demanding college schedule, in turn increasing the likelihood for success in a challenging environment. Self-awareness, self-management, and a knowledgeable insight into the areas in which the student faces most impairment from his or her ADHD symptoms, allows support services to work with the student to devise and implement integral strategies to help these students successfully integrate and navigate through their college life in accordance with their non-diagnosed peers. Moreover, such will enhance the students learning and performance, while also providing them with a sense of achievement and belief in their ability to succeed at post-secondary level. At present, no research is available exploring the effects of tailored interventions for students with ADHD based on

neuropsychological testing, future research in this area would be advisable and may be particularly useful for students with ADHD.

Although there is a myriad of available research literature investigating academic accommodations in children and adolescences with ADHD, to date available literature regarding the efficacy of such accommodations in college students with ADHD is non-existent. Intuitively, the use of academic accommodations in college students with ADHD makes sense, specifically those that target deficits with attention and response inhibition, however, one must note, most lack empirical research investigating their effectiveness in this cohort (Weyandt & DuPaul, 2006). Nevertheless, based on the findings in the current study and the noted impairment in symptomatology of female students with ADHD, the following recommendations regarding academic accommodations will be proposed.

First, it is recommended that where possible the allocation of provisional lecture notes be made available to students with ADHD. Providing students with ADHD the opportunity to review lecture notes prior to the lecture taking place, provides these students with the opportunity to gain written structure, which in turn may help to increase attending in the lecture. Allowing students with ADHD to avail of such an accommodation creates an opportunity to ensure that the student obtains a more detailed and enriched set of notes that would otherwise be difficult to compile in a cohort of the student population who have significantly impaired attentive symptomatology and great difficulty inhibiting off task behaviours.

Second, the allocation of extra time for students with ADHD while undertaking examinations is also recommended. Allocating students with ADHD extra time in an examination allows them to “attend” for an amount of time that is comparable to their non-diagnosed peers who do not have impaired attention. Third, it is recommended that students with ADHD avail of computers while undertaking essay style examinations as such devices

enable the use of spell check which can greatly assist students with ADHD and allows them to better organise their thoughts. Finally, it is recommended that students with ADHD are offered a preferential examination room with less distractions present. For example, a smaller examination room may increase the ability of these students to attend and decrease distractibility, which may otherwise arise in a large examination hall.

Limitations and Future Directions

A strength of the current study is its attempt to expand on prior research on gender differences in ADHD populations by specifically focusing on a sample of college students, an area that has remained significantly unexplored, but is now starting to receive considerable interest from researchers as more individuals with ADHD enter post-secondary education. The current study notes several limitations that should be considered before interpreting the findings. First, due to the current Covid-19 pandemic the administration of the CPT was done remotely via a link to the testing software. Consequently, the results obtained must be interpreted with caution as the undertaking of the CPT was done outside the controlled environment of the psychology laboratory. As a result, it is impossible to control for confounding variables which may have obscured the findings obtained. In addition, there is no way of knowing if the participants in this sample performed the CPT in a room free of distracting stimuli that could have interfered with an individual's attentional levels.

Second, data obtained in the current study was derived from a small sample which often compromises statistical power and limits the scope of assessment. Future research studies should ensure a large sample of college students from different universities across Ireland to provide a better understanding of specific gender differences in the neuropsychological functioning of college students with ADHD. Third, comprehensive information concerning those who had received a diagnosis of ADHD or any associated comorbid psychiatric disorder were not collected. Future research studies should look to

include clinical interviews and a battery of assessment measures such as, self-report, parental reports, and background information concerning academic and social performance (DuPaul, Weyandt, O'Dell, & Varejao, 2009). Fourth, participants in the current study were not asked to disclose information regarding stimulant medication use, as such discrepancies may exist among the results regarding some participants taking medications for ADHD symptoms and others not. Future research is needed to investigate the effects of stimulant medication on the neuropsychological performance of college students with ADHD. Fifth, the experimental cross-sectional comparison design of the current study prevents the possibility of making casual inferences. Finally, another limitation of this study is the use of self-report scales, which may be subjected to retrospective recall bias.

Conclusion

The current study is one of only a few studies to investigate gender differences in the neuropsychological functioning of college students with and without ADHD. The findings obtained revealed that female college students with ADHD were significantly more impaired on objective measures of ADHD symptomatology, whereas self-report scales revealed that male students with ADHD were more impaired in impulsive symptoms than that of females. This study demonstrates that college students with ADHD differ in symptomatology by gender, with females citing more impairment than males. This research study shows how objective and subjective measures in this cohort have important implications for assessing ADHD symptomatology. As such, the findings in the current study highlight a greater need for attention to be given, most specifically towards the academic difficulties encountered by female college students with ADHD. The findings in this study support the implementation of intervention programmes and the allocation of tailored academic accommodations for students with ADHD. These academic accommodations may further help female students to

better manage their ADHD symptoms when faced with the significant challenges that may be encountered in post-secondary education.

Support services and educational practitioners are urged to give particular attention to recognising the potential energy, spontaneity, and creativity often displayed by students with ADHD when allocating specific academic accommodations to these students. Although many difficulties in educational settings are associated with specific ADHD deficits, more research is beginning to emerge documenting positive outcomes for these students. It is important for future research studies to continue to better understand the nature of ADHD in college students, as such an understanding provides integral opportunities for support services to develop effective interventions to help give these students the best possible opportunity to reach their potential and succeed in post-secondary education. Finally, research is needed to explore if college students with ADHD develop compensatory strategies, and if so, how such strategies may impact on these students adaptive functioning. This may provide a pivotal opportunity for support services to teach such compensatory strategies to students entering post-secondary education with ADHD and may hold important implications for the academic success of students with ADHD.

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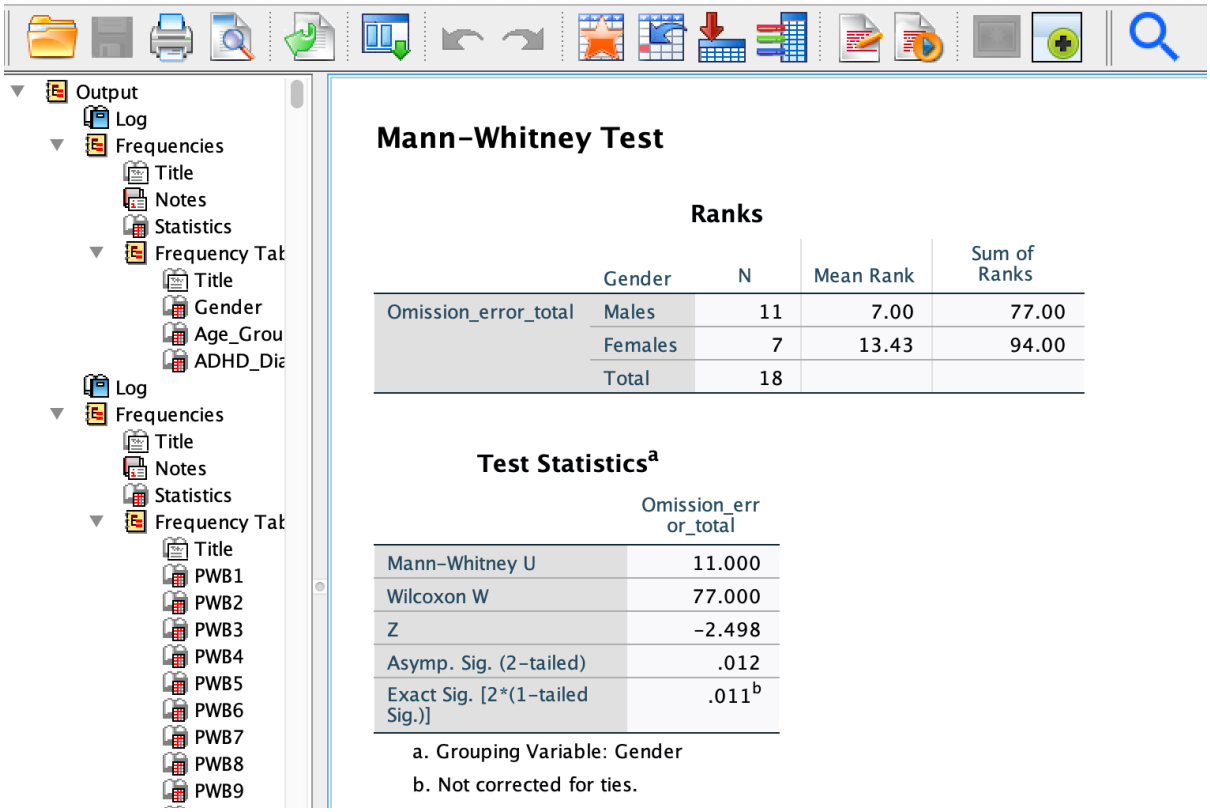
Appendices

Appendix A

Evidence of data and SPSS output (Full data file available upon request)

	Name	Type	Width	Decimals	Label	Values	Missing	Columns
1	ID	Numeric	3	0		None	None	11
2	Gender	Numeric	2	0	Gender	{1, Males}...	None	11
3	Age	Numeric	2	0	Age_Groups	{1, 18-25}...	None	11
4	ADHD_Grou...	Numeric	2	0	ADHD	Group}... ...	None	11
5	PWB1	Numeric	2	0		{1, Strongly ...	None	11
6	PWB2	Numeric	2	0		{1, Strongly ...	None	11
7	PWB3	Numeric	2	0		{1, Strongly ...	None	11
8	PWB4	Numeric	2	0		{1, Strongly ...	None	11
9	PWB5	Numeric	2	0		{1, Strongly ...	None	11
10	PWB6	Numeric	2	0		{1, Strongly ...	None	11
11	PWB7	Numeric	2	0		{1, Strongly ...	None	11
12	PWB8	Numeric	2	0		{1, Strongly ...	None	11
13	PWB9	Numeric	2	0		{1, Strongly ...	None	11
14	PWB10	Numeric	2	0		{1, Strongly ...	None	11
15	PWB11	Numeric	2	0		{1, Strongly ...	None	11
16	PWB12	Numeric	2	0		{1, Strongly ...	None	11
17	PWB13	Numeric	2	0		{1, Strongly ...	None	11
18	PWB14	Numeric	2	0		{1, Strongly ...	None	11
19	PWB15	Numeric	2	0		{1, Strongly ...	None	11
20	PWB16	Numeric	2	0		{1, Strongly ...	None	11
21	PWB17	Numeric	2	0		{1, Strongly ...	None	11
22	PWB18	Numeric	2	0		{1, Strongly ...	None	11
23	PWB19	Numeric	2	0		{1, Strongly ...	None	11
24	PWB20	Numeric	2	0		{1, Strongly ...	None	11
25	PWB21	Numeric	2	0		{1, Strongly ...	None	11



Mann-Whitney Test

Ranks

	Gender	N	Mean Rank	Sum of Ranks
Omission_error_total	Males	11	7.00	77.00
	Females	7	13.43	94.00
	Total	18		

Test Statistics[a]

	Omission_error_total
Mann-Whitney U	11.000
Wilcoxon W	77.000
Z	-2.498
Asymp. Sig. (2-tailed)	.012
Exact Sig. [2*(1-tailed Sig.)]	.011[b]

a. Grouping Variable: Gender

b. Not corrected for ties.

Appendix B

Psychological Well-Being Scales: PWB

Ryff & Keyes (1995)

Participant Instructions

Please indicate your degree of agreement (using a score ranging from 1-6) to the following sentences.

Strongly Disagree **Strongly Agree**

1 2 3 4 5 6

Items

1. I am not afraid to voice my opinions, even when they are in opposition to the opinions of most people.

2. In general, I feel I am in charge of the situation in which I live.

3. I am not interested in activities that will expand my horizons.

4. Most people see me as loving and affectionate.

5. I live life one day at a time and don't really think about the future.

6. When I look at the story of my life, I am pleased with how things have turned out

7. My decisions are not usually influenced by what everyone else is doing.

8. The demands of everyday life often get me down.

9. I think it is important to have new experiences that challenge how you think about yourself and the world.

10. Maintaining close relationships has been difficult and frustrating for me.

11. I have a sense of direction and purpose in life.

12. In general, I feel confident and positive about myself.

13. I tend to worry about what other people think of me.

14. I do not fit very well with the people and community around me.

15. When I think about it, I haven't really improved much as a person over the years.

16. I often feel lonely because I have few close friends with whom to share my concerns.

17. My daily activities often seem trivial and unimportant to me.

18. I feel like many of the people I know have gotten more out of life than I have.

19. I tend to be influenced by people with strong opinions.

20. I am quite good at managing the many responsibilities of my daily life.

21. I have the sense that I have developed a lot as a person over time.

22. I enjoy personal and mutual conversations with family members or friends.

23. I don't have a sense of what it is I'm trying to accomplish in life.

24. I like most aspects of my personality.

25. I have confidence in my opinions, even if they are contrary to the general consensus.

26. I often feel overwhelmed by my responsibilities.

27. I do not enjoy being in new situations that require me to change my old familiar ways of doing things.

28. People would describe me as a giving person, willing to share my time with others.

29. I enjoy making plans for the future and working to make them a reality.

30. In many ways, I feel disappointed about my achievements in life.

31. It's difficult for me to voice my own opinions on controversial matters.

32. I have difficulty arranging my life in a way that is satisfying to me.

33. For me, life has been a continuous process of learning, changing, and growth.

34. I have not experienced many warm and trusting relationships with others.

35. Some people wander aimlessly through life, but I am not one of them.

36. My attitude about myself is probably not as positive as most people feel about themselves.

37. I judge myself by what I think is important, not by the values of what others think is important.

38. I have been able to build a home and a lifestyle for myself that is much to my liking.

39. I gave up trying to make big improvements or changes in my life a long time ago.

40. I know that I can trust my friends, and they know they can trust me.

41. I sometimes feel as if I've done all there is to do in life.

42. When I compare myself to friends and acquaintances, it makes me feel good about who I am.

Scoring Instructions

Recode negative phrased items: 3, 5, 10, 13, 14, 15, 16, 17, 18, 19, 23, 26, 27, 30, 31, 32, 34, 36, 39, 41. (i.e., if the score is 6 in one of these items, the adjusted score is 1; if 5, the

adjusted score is 2; if 4, the adjusted score is 3; if 3, the adjusted score is 4; if 2, the adjusted score is 5; and if 1, the adjusted score is 6).

Add together the final degree of agreement in the 6 dimensions:

a. **Autonomy:** items 1, 7, 13, 19, 25, 31, 37
b. **Environmental mastery**: items 2, 8, 14, 20, 26, 32, 38
c. **Personal growth**: items 3, 9, 15, 21, 27, 33, 39
d. **Positive relations**: items 4, 10, 16, 22, 28, 34, 40
e. **Purpose in life**: items 5, 11, 17, 23, 29, 35, 41
f. **Self-acceptance**: items 6, 12, 18, 24, 30, 36, 42

Appendix C

Barratt Impulsiveness Scale: BIS-11

Patton, Stanford, & Barratt (1995)

Directions: People differ in the ways they act and think in different situations. This is a test to measure some of the ways in which you act and think. Read each statement and click on the appropriate circle. Do not spend too much time on any statement. Answer quickly and honestly.

(1)	**(2)**	**(3)**	**(4)**
Rarely/Never	**Occasionally**	**Often**	**Almost Always/Always**

1. I plan tasks carefully.
2. I do things without thinking.
3. I make-up my mind quickly.

4. I am happy-go-lucky.

5. I don't "pay attention."

6. I have "racing" thoughts.

7. I plan trips well ahead of time.

8. I am self controlled.

9. I concentrate easily.

10. I save regularly.

11. I "squirm" at plays or lectures.

12. I am a careful thinker.

13. I plan for job security.

14. I say things without thinking.

15. I like to think about complex problems.

16. I change jobs.

17. I act "on impulse."

18. I get easily bored when solving thought problems.

19. I act on the spur of the moment.

20. I am a steady thinker.

21. I change residences.

22. I buy things on impulse.

23. I can only think about one thing at a time.

24. I change hobbies.

25. I spend or charge more than I earn.

26. I often have extraneous thoughts when thinking.

27. I am more interested in the present than the future.

28. I am restless at the theater or lectures.

29. I like puzzles.

30. I am future oriented.

Appendix D

Participant Information Sheet

I would like to invite you to take part in a research study. Before you decide, you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully before deciding whether or not you would like to participate. This research study has been approved by the National College of Ireland Psychology Research Ethics Committee and was not externally funded.

WHO I AM AND WHAT THIS STUDY IS ABOUT

My name is Conor O'Neill and I am a final year psychology student studying at the National College of Ireland. As part of my undergraduate degree, I am conducting a research study for my final year thesis and would like to invite you to participate in my study. The aim of this research study is to compare gender differences in levels of attention and impulsivity in college students with and without attention deficit hyperactivity disorder (ADHD).

WHAT WILL TAKING PART INVOLVE?

Taking part in this research study involves the undertaking of an objective neuropsychological test measuring sustained and selective attention, followed by two self-report questionnaires. The duration of this study is 40 minutes and it can be completed in your own time. You will perform a computerised Continuous Performance Test (CPT; Rosvold, Mirsky, Sarason, Bransome, & Beck, 1956), followed by a psychological wellbeing questionnaire to assess wellbeing and happiness (PWB; Ryff & Keyes, 1995) and finally a

questionnaire to assess levels of trait impulsiveness (BIS-11; Patton, Stanford, & Barratt, 1995). This research study will be completed remotely with no person to person contact between the researcher and participants' required.

DO YOU HAVE TO TAKE PART?

Your participation in this study is completely voluntary, and you have the right to refuse to answer any of the questions on either measures administered. You have the right to withdraw at any time and such a decision will incur no penalties or expose you to any disadvantages. You can exit the study by closing the link, this can be done at any stage. All data collected in this study is done so anonymously and once you submit your data it will not be possible to withdraw as the data will not be identifiable.

WHAT ARE THE POSSIBLE RISKS AND BENEFITS OF TAKING PART?

There is no possibility of any physical risk as a result of participation in this research study. There is no risk that loss of privacy will befall the participant partaking in this research study, all data will be anonymous and confidential. Should you feel any upset from participation in this research study please contact the researcher. It is also advised that you contact Pieta House (01) 623 5606 or Aware 1800 80 48 48 if you experience any distress or upset following participation in this research study.

WILL TAKING PART BE CONFIDENTIAL?

All information provided to this research study will be done so anonymously and will remain confidential. Once information is submitted it will be sent to google forms where the data will be stored and protected. Google forms does not collect information on participants, as such, your information with not be identifiable. All information obtained will be further protected by being stored in a locked file that is password protected, with only the researcher

having access to the password. Data will be retained for five years in accordance with the National College of Ireland data retention policy.

WHAT WILL HAPPEN TO THE RESULTS OF THE STUDY?

The results that will be obtained from the undertaking of this research project will be used in my thesis that will be submitted to the National College of Ireland.

ETHICS

The ethics board at the National College of Ireland has ethically approved this research study.

WHO SHOULD YOU CONTACT FOR FURTHER INFORMATION?

For further information regarding the study please do not hesitate to contact Conor O'Neill at conorncirl@gmail.com where I would be more than happy to discuss any queries you may have in relation to the study.

THANK YOU

I have read this information and would like to continue □

Appendix E

Informed Consent

Consent to take part in the research study

Consent must be given to participate in this research study. If you have not read the participant information sheet on the previous page detailing what the study is about, I recommend that you do so now.

- I understand that if I agree to participate now, I can withdraw from the research study at any time or refuse to answer any question and such a decision will incur no penalties or expose me to any disadvantages.
- I understand that this research study will take approximately 40 minutes to complete and it will involve the undertaking of a Continuous Performance Test that will assess sustained and selective attention (CPT; Rosvold, Mirsky, Sarason, Bransome, & Beck, 1956), the Psychological Well-Being Scales (PWB; Ryff & Keyes, 1995) a self-report questionnaire that will assess six aspects of wellbeing and happiness such as, self-acceptance, purpose in life, environmental mastery, personal growth, positive relations with others, and autonomy, and the Barratt Impulsiveness Scales (BIS-11; Patton, Stanford, & Barratt, 1995) a self-report questionnaire to assess levels of impulsiveness.
- I understand that I will not benefit directly from participating in this research study.
- I understand that all information I provide to this study will be treated confidentially.
- I understand that in any report on the results of this research study my identity will remain anonymous.
- I understand that if I inform the researcher that myself or someone else is at risk of harm they may have to report this to the relevant authorities - they will discuss this with me first but may be required to report with or without my permission.
- I understand that I am free to contact any of the people involved in the research study to seek further clarification and information.

Conor O'Neill, conorncirl@gmail.com

I confirm that I am 18+ years of age *

□ please tick to consent

Do you agree to participate in this research study? *

□ Yes

□ No

By clicking the "I agree" button below you are confirming you have read the above information and would like to participate in the research study. *

□ I Agree

Appendix F

Demographics

Please provide the appropriate demographical information.

Please create a four-digit participant I.D code. *

_____

What is your gender? *

- o Female
- o Male
- o Prefer not to say
- o Other _____

What is your age? *

- 18 to 25
- 26 to 35
- 36 to 45
- 46 to 55
- 55 +

Have you ever received a diagnosis of attention deficit hyperactivity disorder (ADHD)? *

- Yes
- No

Appendix G

Continuous Performance Test (CPT)

Once task is complete, please return to this page and click continue to next section

Please ensure that you are in a room that is free from distractions. If there is a tv, radio, etc., please switch these devices off for the duration of this task. It is important to ensure you have little distractions while performing this task. You must download the flash player once you click on the link to start the test.

CLICK THE LINK BELOW TO COMMENCE THE TEST AND THEN RETURN TO THIS PAGE

https://mili2nd.co/4jxb

Task Description:

The CPT used in this research study provides two separate tasks for participants to complete. Participants undertaking this test will be presented with a sequence of letters (one-by-one) on their computer screens.

Task one:

During this task participants will be instructed to press the spacebar on their keyboard whenever the letter presented on screen is an X. Participants must only respond by pressing the spacebar when the letter X is presented and should not respond if no X is presented.

Task two:

During this task participants will be prompted to press the spacebar on their keyboard whenever the letter is an X that follows an A. Participants must only respond using their spacebar on the keyboard if the presentation of the letter A is followed immediately by the presentation of the letter X.

Please make sure you return to this section once the test has been complete

Appendix H

Study Debriefing

Thank you for taking the time to participate in this research study. This research study was concerned with comparing gender differences in levels of attention and impulsivity in college students with and without attention deficit hyperactivity disorder (ADHD).

How was this tested?

You were asked to perform a Continuous Performance Test (CPT) assessing sustained and selective attention. You were then asked to complete two separate self-report questionnaires that assessed psychological wellbeing and levels of impulsiveness. The Psychological Well-Being Scales (PWB) measured six aspects of wellbeing and happiness, including self-acceptance, purpose in life, environmental mastery, personal growth, positive relations with others, and autonomy. The Barratt Impulsiveness Scales (BIS-11), was used in order to assess levels of impulsiveness.

Why is this important to study?

Research has provided inconsistencies in relation to gender differences and neuropsychological function in the ADHD population. As such, gender differences in college students with ADHD on tests assessing neuropsychological functioning has remained significantly unexplored, most notably in Irish college students.

Confidentiality

All information that you provided during this research study will remain anonymous and your information will not be identifiable. The results obtained in this research study will be submitted to the National College of Ireland for the fulfilment of my final year thesis.

Contact information

If you have any concerns regarding your participation in this study please do not hesitate to contact the researcher or research supervisor.

Contact details: Researcher: Conor O'Neill Email: conorncirl@gmail.com

Supervisor: Dr. Conor Nolan Email: conor.nolan@ncirl.ie

Support services

If you are experiencing any distress as a result of participation in this research study, please contact one of the available support services whos details are provided below.

Contact details: Pieta House: (01) 623 5606 Email: Info@pieta.ie

Aware: 1800 80 48 48 Email: Info@aware.ie

Thank you kindly for your participation

Please click submit to end this study