

# Cognitive Flexibility and Its Relationship to Academic Achievement and Career Choice of College Students With and Without Attention Deficit Hyperactivity Disorder

Suneeta Kercood<sup>1</sup>  
Tara T. Lineweaver<sup>1</sup>  
Colleen C. Frank<sup>2</sup>  
Erik D. Fromm<sup>3</sup>

## Abstract

The purpose of this study was to investigate the relationship between cognitive flexibility, academic skills, educational trajectories, and career goals of college students with and without Attention Deficit Hyperactivity Disorder (ADHD). Participants completed a demographic questionnaire, objective and subjective measures of cognitive flexibility, and tests of academic achievement. Cognitive Flexibility predicted academic achievement; reading skills increased as subjective cognitive flexibility increased and as the tendency to perseverate (i.e., to stick with an ineffective strategy) on the Wisconsin Card Sorting Test decreased. Objective cognitive flexibility also predicted mathematical and writing skills. Although students with different college majors did not vary significantly in their cognitive flexibility, the interaction between cognitive flexibility and ADHD shared a significant relationship with career confidence. Our results expand on the literature examining cognitive flexibility and have implications for both academic and career planning, particularly for students who may struggle with attention.

*Keywords: Attention Deficit Hyperactivity Disorder, cognitive flexibility, academic achievement, career choice, career confidence*

Cognitive flexibility has been described as the ability to switch thoughts between two different concepts, to think about multiple concepts simultaneously (Scott, 1962), or to select among multiple representations of an object, multiple strategies, or multiple tasks given specific or changing situations (Jacques & Zelazo, 2005). It is an important aspect of executive functioning at all stages of the life span (Bakos et al., 2008; Pureza, Jacobsen, Oliveira & Fonseca, 2011) and appears to rely heavily upon dopamine levels in the prefrontal cortex (Dreisbach & Goschke, 2004).

The ability to switch between modes of thought and to simultaneously consider multiple concepts is a vital component of learning, language development (Deák, 2004; Jacques & Zelazo, 2005), arithmetical skills (Bull & Scerif, 2001), interpersonal communication (Rubin & Martin, 1994), communication self-efficacy, assertiveness, responsiveness, (Martin & Anderson, 1998), multi-tasking, (Ionescu, 2012),

decision making (Dunleavy & Martin, 2006), problem solving and creativity (Lin, Tsai, Lin, & Chen, 2014; Ritter et. al., 2012), willingness to collaborate, and leadership (Reiter-Palmon, 2003). Although many of these skills may overlap with or influence those necessary to succeed in academic environments, the relationship between cognitive flexibility and the academic achievement of different types of students has not been directly examined in the literature. Thus, we designed the current study to investigate cognitive flexibility in the context of a postsecondary academic setting. We had two primary aims: (1) to identify the differences in cognitive flexibility across college students based on the diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) and gender, and (2) to investigate the relationship between cognitive flexibility and academic achievement, choice of college major, and future career goals in the collegiate population.

<sup>1</sup> Butler University; <sup>2</sup> University of Michigan; <sup>3</sup> Indianapolis, Indiana

## Factors that Influence or Could Influence Cognitive Flexibility

Cognitive flexibility develops rapidly from preschool years through early adolescence (Anderson, 2002) and can be impaired in individuals who have suffered significant stress in childhood such as living in orphanages, living in poverty, or being victims of neglect or abuse (Clearfield & Niman, 2012; Hostinar, Stellern, Schaefer, Carlson & Gunner, 2012; Spann et al., 2012). Cognitive flexibility can also be negatively impacted by childhood medical and psychological conditions. Past research has documented decreased cognitive flexibility in children with traumatic brain injuries (Anderson & Catroppa, 2005; Brooks et al., 2016; Milders, Ietswaart, Crawford, & Currie, 2008), eating disorders (Sarrar et al., 2011), obsessive compulsive disorders (Britton et al., 2010), and autism spectrum disorders (Kaland, Smith & Mortensen, 2008; de Vries & Geurts, 2012). More relevant to the current purpose, two past studies found that children diagnosed with learning disabilities or attention deficit disorders are lower in cognitive flexibility than their peers without these learning differences (Geurts, Verté, Oosterlaan, Roeyers & Sergeant, 2005; Marzocchi et al., 2008).

Although research has identified cognitive flexibility differences in groups of children and adolescents with differing backgrounds and diseases, past research has not focused on how the personal characteristics of college students may correlate with their cognitive flexibility. Moore (2013) examined the links between cognitive flexibility and other cognitive domains in college students and found that increased cognitive flexibility is associated with self-regulation of attention and mindfulness. This suggests that students with attentional regulation difficulties may also be less cognitively flexible. One group of college students who struggle with attentional regulation are those with ADHD. Numerous longitudinal research studies have shown that the symptoms of ADHD, which emerge during childhood, may continue into adulthood and commonly interfere with time management, language comprehension, academic performance, and daily problem solving (Barkley, 1998; Shekim, Asarnow, Hess, Zaucha & Wheeler, 1990). Thus, it is possible that the cognitive flexibility deficits that Geurts et al. (2005) and Marzocchi et al. (2008) documented in children with attentional deficits also persist into the collegiate or adult years (Cubillo et al. 2010; Harpin, 2005).

Gender may also influence cognitive flexibility amongst college students. Most past studies of cognitive flexibility in this population have included both men and women as participants, but they have not directly evaluated gender differences when analyzing their results. One exception is a study by Kim and Omizo (2006) that examined cognitive flexibility's influence on acculturation of men and women college-age immigrants. They included gender as a factor in their analyses, and they did not find any gender differences in cognitive flexibility in the Asian-American students in their study. This does not, however, rule out gender differences in college students in general. Thus, we also assessed the relationship between gender and cognitive flexibility in our study.

## Cognitive Flexibility and the Academic and Career Paths of College Students

Although past studies have not focused on academic achievement, prior research with college students has demonstrated that increased cognitive flexibility relates to lower levels of anxiety, higher levels of motivation and success in training programs (Timarova & Salaets, 2011), positive perceptions of group work (Myers et al., 2009), bilingualism (Teubner-Rhodes et al., 2016), and lower levels of distress and avoidance among collegiate women with post-traumatic stress disorders (Palm & Follette, 2011). These findings, together with those that indicate that cognitive flexibility impacts learning, language development (Deák, 2004; Jacques & Zelazo, 2005), and math skills (Bull & Scerif, 2001), suggest there could be a link between cognitive flexibility and achievement in academic settings.

Beyond academics, cognitive flexibility could affect the extent to which college students consider different academic paths and explore various career options during their undergraduate years. Adams, Hean, Sturgis, and Clark (2006) found that first-year college students who are higher in cognitive flexibility report stronger professional identity than those lower in cognitive flexibility. These findings suggest that cognitive flexibility could affect career choice and confidence, at least at certain points in students' collegiate education since the Adams et al. (2006) study specifically focused only on first-year students and only on students enrolled in a pre-professional health and social care program. Thus, we sought to assess whether a broader group of undergraduate students with higher versus lower levels of cognitive flexibil-

ity tend towards particular academic paths, choose to pursue particular careers, and experience different levels of confidence in their career choice.

### **Purpose of the Current Study and Hypotheses**

Young adults with ADHD are enrolling in postsecondary education in increasing numbers (Henderson, 1999; Wagner & Blackorby, 1996). ADHD affects 4% to 11% of the college student population (DuPaul, Gormley, & Laracy, 2013; Heiligenstein, Conyers, Berns & Smith, 1998; Robin, 1998; Weyandt, Linterman & Rice, 1995), with recent national norms indicating a prevalence of 5.9% amongst 2014 freshmen across a variety of baccalaureate institutions (Eagan et al., 2014). The Americans With Disabilities Act Amendments Act ([ADAAA], 2008) and Section 504 of the Rehabilitation Act prohibit discrimination against students with disabilities. Despite these mandates, college students who have ADHD are more likely to be on academic probation, have a lower grade point average, report more academic problems, and fail repeatedly than students without this disorder (Heiligenstein, Guenther, Levy, Savino & Fulwiler, 1999; Tominey, 1996; Vogel & Adelman, 1992; Weyandt et al., 2013; Wilczenski, 1993). College students with ADHD also report greater fatigue and feelings of being overloaded in their role as a student than their non-ADHD counterparts (Bolton, Hughes, & Kessler, 2008), perhaps due to having fewer coping strategies (Kaminski, Turnock, Rosén, & Laster, 2006).

As a result of these academic difficulties, young adults with a history of ADHD show lower levels of academic and occupational attainment than young adults without such history (Kuryian, et al., 2013). Thus, identifying specific patterns of cognitive challenges associated with this disorder, such as cognitive inflexibility, and understanding how it affects academic achievement can provide knowledge necessary for developing non-medical interventions that have the potential to positively impact both students with ADHD and the faculty educating them, as well as for guiding students with ADHD towards appropriate educational and career goals. We designed this study to assess cognitive flexibility across college students, with a goal of determining whether personal characteristics such as a diagnosis of ADHD and gender relate to levels of cognitive flexibility in undergraduate college students. Additionally, we examined the relationship between cognitive flexibility and academic achievement, choice of college major, and

future career goals. We hypothesized that men and women would be similar in their levels of cognitive flexibility, but that students with ADHD would be less cognitively flexible than those without the disorder. We also expected students higher in cognitive flexibility to perform better on tests of academic achievement, to pursue a greater number of majors and minors during their college careers, and to be more confident in their career goals than students lower in cognitive flexibility.

## **Method**

### **Participants**

After obtaining Institutional Review Board approval from the university, we invited college students with and college students without an ADHD diagnosis to participate in this study. We advertised the study via posters, online announcements to the full campus community, emails distributed through a list-serv managed by the university's Student Disabilities Services (SDS) Office, and postings on an online research participation management system used by the Department of Psychology. To qualify for the study, individuals had to: (a) be a college student, (b) be 18 years of age or older, and (c) voluntarily consent to participate after being informed of all study procedures. Because of the emphasis on academic achievement, any student diagnosed with a verbal or non-verbal learning disability was excluded from the study, regardless of whether or not they had ADHD. Even though there is a high rate of comorbidity between ADHD and specific learning disabilities (DuPaul et al., 2013), we chose to exclude students with learning disabilities because learning disabilities would necessarily lead to lower scores on selected academic achievement outcome measures and could easily confound the potential relationship between cognitive flexibility and academic skills. Students with ADHD who volunteered to participate provided written documentation of their diagnosis approved by the SDS office. The documentation included a medical record review conducted by the SDS office and a structured clinical interview form that included DSM-IV criteria for ADHD that was completed by a physician or a clinical psychologist. Those not registered with the SDS office provided a current prescription for an ADHD medication or a formal testing report. Students who had inadequate documentation or reported only a past history of ADHD symptomatology with-

out a current diagnosis were excluded from the study. Ninety two percent of our ADHD participants reported being prescribed a medication to treat ADHD, and 88% reported taking at least one medication to treat their ADHD symptoms on most weekdays. We did not instruct participants to alter their medication routine in any way as part of their participation in this study. All student participants received either \$30 or extra credit applied towards a psychology class in compensation for their time.

Table 1 summarizes the demographic characteristics of the 55 participants who volunteered for our study. Although the men in our sample were slightly older than the women, this difference did not reach significance ( $F(1, 51) = 3.30, p = 0.08$ ), and all participants were typical college student age, men range = 18-22; women range = 18-22. All groups were statistically equivalent in their level of education, with the average student participant being in their sophomore year at the time of the study. As expected, students with ADHD reported more ADHD symptomatology on the Conner's Adult ADHD Rating Scale than students without ADHD (all  $ps < .01$ ; see Table 1). Significant gender differences emerged on two CAARS subscales, DSM Inattention:  $F(1, 51) = 3.89, p = .05$  and the ADHD Index:  $F(1, 51) = 4.14, p < .05$ . Male participants reported more inattention than female participants, but females scored higher than males on the overall ADHD Index.

## Materials

**Demographic and academic questionnaire.** This questionnaire asked participants for basic information about themselves such as their age, gender, years of education, and race. Students with ADHD also provided their age at diagnosis, their ADHD medication regimen, and an indication of whether or not they were registered for and were receiving academic accommodations through the SDS office. On the academic portion of this questionnaire, all participants indicated their past and current academic majors and minors, their future career goals, and their personal confidence (1 = "Not at all sure" to 10 = "100% sure") in their planned career path.

**Conners' Adult ADHD Rating Scale ([CAARS]; Conners, Ehrhard & Sparrow, 1999).** The CAARS is a reliable and valid self-report measure of ADHD symptoms for use with adults. Participants rated themselves on 66 behaviors and characteristics commonly associated with ADHD. Scores total onto several primary

subscales, each of which is normed by age and gender. For the purposes of this study, we focused on four subscales that represent the DSM-IV criteria for ADHD: DSM Inattention, DSM Hyperactivity, DSM Total, and the ADHD Index. Each of these subscales results in a T-score ( $M = 50, SD = 10$ ).

**Woodcock Johnson Tests of Achievement-Third Edition (Woodcock, McGrew & Mather, 2001).** The Woodcock Johnson is a battery of academic achievement measures designed for individuals ages 2 to over 90 years of age. Participants completed the Standard Battery, which includes twelve subtests that provide a broad set of scores primarily in the domains of reading, spelling, writing, and mathematics, as well as the academically-related skills of understanding directions, learning, and memory. Scores on each subtest are normed for age and gender and result in a Standard Score ( $M = 100, SD = 15$ ).

**Cognitive Flexibility Scale ([CFS]; Martin & Rubin, 1995; Martin & Anderson, 1998).** This subjective measure of cognitive flexibility consists of 12 statements that participants rate on a 6-point scale ranging from 1 = "Strongly Disagree" to 6 = "Strongly Agree" to indicate the extent to which they feel the statement describes them. Example items include: "I can communicate an idea in many different ways," "I avoid new and unusual situations," and "I have many possible ways of behaving in any given situation." Some items are indicative of high cognitive flexibility whereas others represent a lack of (reverse scored). This scale has high internal reliability and supporting validity (Johnco, Wuthrich, & Rapee, 2014; Martin & Rubin, 1995). The responses are totaled to determine an overall score that can range from 12 (low cognitive flexibility) to 72 (high cognitive flexibility). Cronbach's alpha for this measure in our study reflected acceptable reliability ( $\alpha = .742$ ).

**Wisconsin Card Sorting Test ([WCST]; Heaton, 1993).** The WCST, an objective assessment of cognitive flexibility, measures complex problem-solving abilities. Participants completed this computer-administered measure following standardized test procedures. Scores on this measure included: total number of correct sorts, total errors, non-perseverative errors (changing the sorting rule to another incorrect rule after an incorrect or a correct sort), perseverative responses (using the same sorting rule as the previous trial regardless of whether it was correct or incorrect), perseverative errors (using the same sorting rule as the previous sort, even though it was incorrect on the

previous trial), trials to complete the first category (number of sorts required to determine and consistently apply the first rule) and set failures (changing the sorting rule after a correct sort rather than sticking with the rule that worked). We used a number of perseverative responses and number of perseverative errors as indicators of cognitive flexibility, with increased perseveration reflecting less cognitive flexibility. These scores have been used by other researchers as measures of cognitive flexibility (Delahunty, Morice & Frost, 1993; Geurts et al., 2005; Kaland et al. 2008; Tchanturia et al., 2012). Unfortunately, due to a computer error, scores on the WCST were missing for eight participants.

### Procedures

After providing informed consent, participants completed one individual testing session lasting approximately 2-2½ hours in a quiet, distraction-free environment. Research assistants trained in test administration and supervised by a clinical neuropsychologist administered all measures associated with the study. Student participants completed the Demographic and Academic Questionnaire, followed by the two subjective self-report measures—the CAARS and the Cognitive Flexibility Scale, in that order. Next, they completed the 12 subtests of the Woodcock Johnson Tests of Achievement, Third Edition Standard Battery. Finally, the session concluded with the computerized administration of the WCST. After administration of each of these measures, we thanked participants and either paid them \$30 or awarded them extra credit in a psychology class for their time.

### Data Analysis

We utilized the computerized scoring program that accompanies the Woodcock Johnson Tests of Achievement, Third Edition to transform raw scores into standard scores on that measure. We also relied on the computerized scoring of the WCST. After all of the tests were scored and scores were entered into a database, we used SPSS to analyze our data. For group comparisons, we used two-way analyses of variance (ANOVAs), with an alpha level of .05. To examine the association between cognitive flexibility and academic achievement, we used stepwise regression analyses with alpha again set to .05.

## Results

### Cognitive Flexibility, ADHD, and Gender

Before examining whether male and female students with and without ADHD differ in their cognitive flexibility, we correlated scores on the Cognitive Flexibility Scale with perseverative responses and perseverative errors from the WCST to determine whether our subjective and objective measures of cognitive flexibility were assessing the same construct. Subjective cognitive flexibility did not significantly correlate with either the number of perseverative responses ( $r(47) = .14$ ) or the number of perseverative errors ( $r(47) = .15$ ) students made on the WCST. Because these two measures of cognitive flexibility did not relate to each other in the way we expected, we continued to examine subjective and objective cognitive flexibility separately in all analyses.

We next ran a series of 2 (Group: ADHD vs non-ADHD) x 2 (Gender: male vs female) between subjects ANOVAs to explore whether an ADHD diagnosis or gender related to subjective or objective cognitive flexibility. Table 2 summarizes scores on the subjective and objective measures of cognitive flexibility. On the Cognitive Flexibility Scale, there was no significant gender main effect nor a group by gender interaction. Although students with ADHD reported that they were less cognitively flexible than their non-ADHD peers, this group main effect also failed to reach statistical significance,  $F(1, 51) = 2.94, p = 0.09$ . No significant main or interaction effects were apparent on the objective WCST measures of cognitive flexibility.

To look at the relationship between cognitive flexibility and symptoms of ADHD in another way, we calculated the correlations between subjective and objective cognitive flexibility and self-reported ADHD symptomatology on the CAARS across the whole sample. Because this analysis involved calculating twelve correlation coefficients, we applied a Bonferroni correction to our critical  $p$  value to protect against a Type 1 error (Bonferroni-adjusted critical  $p = .05/12 = .004$ ). We found significant relationships between subjective, but not objective, cognitive flexibility and self-reported ADHD symptoms. Students higher in DSM Inattention described themselves as less cognitively flexible than those lower in DSM Inattention ( $r(55) = -.57, p < .001$ ). Similarly, those who reported more ADHD symptoms overall also described themselves as less cognitively flexible (DSM Total:  $r(55)$

= -.50,  $p < .001$ ; ADHD Index:  $r(55) = -.47, p < .001$ ). DSM Hyperactivity did not share a significant relationship with subjective cognitive flexibility ( $r(55) = -.20$ ), nor did any of the correlations between the four ADHD subscales and the two measures of objective cognitive flexibility reach significance ( $r_s(47)$  range =  $-.07$  to  $-.14$ , all  $p_s > .35$ ).

### Cognitive Flexibility and Academic Achievement

To examine the association between cognitive flexibility and academic achievement, we ran a series of stepwise regression analyses using measures of subjective and objective cognitive flexibility to predict scores on each of the Woodcock Johnson subtests. Table 3 summarizes the results of these analyses. Scores on reading subtests (Letter Word ID, Reading Fluency, and Passage Comprehension) were significantly associated both with a tendency to perseverate on the WCST (low cognitive flexibility as indicated by greater perseveration predicted lower reading achievement) and with subjectively reported cognitive flexibility (greater self-reported cognitive flexibility predicted better reading abilities). Mathematical achievement (Calculations and Applied Problems) was significantly higher for students who showed more objective cognitive flexibility by making fewer perseverative errors on the WCST; the regression equation for math fluency did not reach significance. For written communication skills, neither Spelling nor Writing Fluency was significantly related to either subjective or objective measures of cognitive flexibility. However, scores on the Writing Samples subtest were significantly predicted by perseverative errors on the WCST. The regression analyses failed to yield any significant results for the Woodcock Johnson subtests measuring more general academic skills like Understanding Directions, Story Recall, or Delayed Recall.

### Cognitive Flexibility, Academic Path, and Career Plans

Students in this study were pursuing undergraduate degrees in Marketing/ Business/ Finance ( $n = 6$ ; 11% of the sample), Natural Sciences (Biology/ Physics/ Chemistry;  $n = 18$ ; 33%), Social Sciences (Psychology/ Anthropology/ Sociology/ Media Studies;  $n = 18$ ; 33%), Strategic Communication ( $n = 10$ ; 18%), and Education/ Special Education ( $n = 3$ ; 5%). We used one-way ANOVAs to determine whether subjective or objective cognitive flexibility was associated with a particular choice of major. Students pursuing

different majors did not vary significantly in their subjective cognitive flexibility or in the number of perseverative responses and perseverative errors they made on the WCST.

To examine the potential interaction between cognitive flexibility and ADHD as a potential influence on students' academic and career paths, we applied a median split to scores on the Cognitive Flexibility Scale to classify participants into those with low subjective cognitive flexibility ( $n = 26$ ) and those with high subjective cognitive flexibility ( $n = 29$ ). We then ran a series of 2 (Cognitive Flexibility: low vs high)  $\times$  2 (Group: ADHD vs controls) between groups ANOVAs with (1) total number of declared majors since starting college, (2) total number of declared majors and minors since starting college, and (3) career confidence as outcome variables. Although students with ADHD had fewer declared majors on average ( $M = 1.44, SE = .14$ ) than their non-ADHD peers ( $M = 1.76, SE = .15$ ), this difference did not reach statistical significance,  $F(1, 50) = 2.91, p = .09$ . Neither cognitive flexibility ( $F(1, 50) = 1.09, p = .30$ ) nor its interaction with ADHD diagnosis ( $F(1, 50) = .055, p = .46$ ) was associated with number of declared majors. Similarly, none of the main (Cognitive Flexibility:  $F(1, 50) = 2.07, p = .16$ ; Group:  $F(1, 50) = 1.93, p = .17$ ) or interaction (Cognitive Flexibility  $\times$  Group:  $F(1, 50) = 0.08, p = .78$ ) effects reached significance for total number of declared majors and minors. Although neither of the main effects reached significance for career confidence (Cognitive Flexibility:  $F(1, 51) = 0.50, p = .48$ ; Group:  $F(1, 51) = 0.77, p = .38$ ), Cognitive Flexibility and ADHD interacted to significantly affect career confidence,  $F(1, 51) = 5.03, p < .05$  (See Figure 1.) Students with ADHD who were high in cognitive flexibility reported feeling less confident in their career choice ( $M = 7.18, SE = 0.71$ ) than students with ADHD who were low in cognitive flexibility ( $M = 8.53, SE = 0.42$ ), whereas non-ADHD students with lower subjective cognitive flexibility were less confident in their chosen career path ( $M = 7.91, SE = 0.46$ ) than non-ADHD students with higher subjective cognitive flexibility,  $M = 8.61, SE = 0.28$ .

### Discussion

This study had two primary objectives. The first was to identify whether male and female college students with or without attention deficits differ in their

cognitive flexibility. We examined both subjective cognitive flexibility (self-reported on the Cognitive Flexibility Scale) and objective cognitive flexibility (indicated by perseverative tendencies on the Wisconsin Card Sorting Test). We did not document any gender differences in either subjective or objective cognitive flexibility in the students in our sample. Men and women college students were similar in their subjective cognitive flexibility on the Cognitive Flexibility Scale, and they were similar in their tendency to perseverate on the WCST. Thus, our study suggests that men and women college students do not differ substantially in their cognitive flexibility, consistent with the past findings of Kim and Omizo (2006) who also found similar levels of cognitive flexibility across male and female Asian American college students.

We did, however, find some evidence to suggest that attention deficits may be associated with decreased cognitive flexibility. When we directly compared the subjective and objective cognitive flexibility of students with ADHD to that of their non-ADHD peers, we did not find any significant differences between the two groups of students, nor did a diagnosis of ADHD interact with gender to affect cognitive flexibility. However, when we looked at the relationship between ADHD symptomatology and cognitive flexibility across the entire sample, rather than classifying students based on an ADHD diagnosis, both symptoms of inattention and overall symptoms of ADHD were significantly associated with decreased cognitive flexibility. Thus, students who endorsed inattention or other ADHD symptoms also tended to believe themselves to be less cognitively flexible, regardless of whether or not they were officially diagnosed with an attentional disorder. This result suggests that future work should continue to explore the relationships between diagnosed and undiagnosed attention deficits and cognitive flexibility. Cognitive flexibility is essential to many academic and non-academic college tasks such as learning, interpersonal communication, assertiveness, collaboration, leadership, multi-tasking, problem solving, and creativity (Bull & Scerif, 2001; Déak, 2004; Dunleavy & Martin, 2006; Ionescu, 2012; Jacques & Zelazo, 2005; Martin & Anderson, 1998; Reiter-Palmon, 2003; Rubin & Martin, 1994). Although cognitive flexibility is only one of many potential influences on students' academic achievement, our findings suggest that both clinical and subclinical attentional deficits may put students at a disadvantage not only within but also beyond the classroom if they interfere with this critical ability.

The second objective of this study was to investigate the relationship between cognitive flexibility and academic achievement, choice of college major, and future career goals. Cognitive flexibility was a significant predictor of academic skills as evaluated by the Woodcock Johnson Tests of Achievement. Reading skills increased as subjective cognitive flexibility increased and as the tendency to perseverate (i.e., to stick with an ineffective strategy) on the WCST decreased. Thus, both subjective and objective cognitive flexibility related to reading achievement. Cognitive flexibility also predicted mathematical and written communication abilities, although only objective, not subjective, cognitive flexibility was associated with math and writing skills. Thus, our results indicate that reading skills, mathematical skills and writing skills all significantly relate to cognitive flexibility, suggesting that cognitive flexibility has broad implications for academic achievement.

When we examined the academic and anticipated career paths of the students in our study, we did not find strong evidence to suggest that cognitive flexibility plays a large role in determining the particular academic course that students chose to follow. We classified students into groups based on their current major and found no differences amongst these groups in either subjective or objective cognitive flexibility. The relationship we documented is correlational. Thus, beyond the potential influence of cognitive flexibility on career choice, this result also suggests that particular types of majors (i.e., those in the natural sciences, social sciences, business, education) do not differentially develop cognitive flexibility relative to other types of majors.

Cognitive flexibility also failed to show significant relationships with the number of majors or minors students in our sample had pursued during their college careers. Although we anticipated that students high in cognitive flexibility would be more likely to explore multiple majors and minors during their college career compared to those lower in cognitive flexibility, we did not find evidence to support that conclusion. Perhaps investigating this issue with a larger sample of students who are all at later stages in their college career (seniors, rather than sophomores, on average) would lead to different results that better fit expected patterns. Seniors would have had more time to fully explore different majors and to implement formal changes to their major than their less educationally advanced peers.

Where cognitive flexibility did play a role in students' academic and career trajectories was through an interaction with ADHD that affected how confident students felt about their planned career path. We expected that students high in cognitive flexibility would feel less confident about their choice of career than students lower in cognitive flexibility because they might better recognize the many alternate career paths available to them. We found evidence to support this idea, but only in students with ADHD. Students with ADHD who were high in subjective cognitive flexibility were less confident in their career choice than students with ADHD who were lower in subjective cognitive flexibility.

To the contrary, for students without attentional deficits, an opposite pattern of results emerged. In the control group, students with higher subjective cognitive flexibility were more confident in their career choice than students with lower subjective cognitive flexibility. Although speculative, one possible explanation for this result is that the control group students who are high in cognitive flexibility had already considered and ruled out multiple career paths, leading to more confidence in the career path they were currently pursuing compared to the less cognitively flexible students who may have rushed to a career path without fully considering all of their options (resulting in less career confidence). We did not find differences in number of declared majors and minors, although consideration of academic paths may not always result in official changes in majors and minors. Replication of this result while measuring other variables that might influence this relationship could help elucidate this complex and somewhat unexpected finding in the future.

### **Implications**

Together, we found that students with attentional deficits (regardless of whether or not they are diagnosed with ADHD) tend to describe themselves as less cognitively flexible than students without attention deficits and that cognitive flexibility is significantly related to academic achievement in reading, math and writing. These results suggest at least one mechanism that may undermine the academic performance of students with ADHD and offers a possible avenue for future intervention with these students. If the cognitive flexibility deficits documented in childhood (Geurts et al., 2005) continue into young adulthood for students with ADHD, inflexibility may, at least in

part, account for some of their diminished academic achievement relative to their non-ADHD peers. It is possible that these deficits typically improve as children develop into young adults and that may be why we found correlations between cognitive flexibility and ADHD symptomatology but not group differences between our ADHD and non-ADHD students in this skill. Individual differences in the timing of this developmental process may leave some students with ADHD particularly vulnerable to academic struggles. That is, students who are slower to outgrow or who fail to outgrow cognitive inflexibility may perform worse in their classes due to weaker reading, writing and mathematical skills. These students could be identified by including measures of objective and subjective cognitive flexibility in assessment batteries. This, in turn, could help indicate which students with ADHD might show improved academic achievement in response to interventions designed specifically to improve their cognitive flexibility.

The finding that cognitive flexibility interacts with ADHD in influencing career confidence also has implications for career counseling and the academic guidance provided to students with ADHD in high school and college. Prior studies have provided evidence that higher levels of ADHD symptoms are significantly related to lower levels of career decision-making self-efficacy, academic adjustment, study skills, and GPA (Norwalk, Norvilitis, & MacLean, 2009), and traditional programs for career counseling have been considered inadequate in meeting the needs of students with ADHD (Nadeau, 2005). Researchers have recommended taking into consideration the specific neuro-cognitive profile of those with ADHD, including details of how the profile can influence career-related skills like work performance, interpersonal skills, conflict management, flexibility with change, and work dissatisfaction (Nadeau, 2005; Painter, Prevatt, & Welles, 2008). Our results demonstrating that cognitive flexibility can not only influence academic achievement, but can also impact self-perceptions of confidence in academic and career plans can buttress the assistance provided with long-term academic and career planning for individuals with ADHD. Students with ADHD who are high in cognitive flexibility might need assurance that their intended career path is a good fit for them given their lower confidence in their career choice. Conversely, students with ADHD who are low in cognitive flexibility might benefit from encouragement to explore



multiple options if they are overly or prematurely confident in their chosen career path.

Though stimulant medications have also been shown to influence cognitive flexibility (Tannock, Schachar & Logan, 1995), we did not ask our students with ADHD to alter their medication regimen as part of participating in our study, and it is likely that the majority of our participants were on their medications at the time of their testing session given the large number of participants who reported being prescribed medications and taking them every weekday. Because stimulant medications have been reported to improve or normalize behavior and the cognitive functions of those with ADHD (Medina et al. 2010), the differences we documented between students with and without attention deficits are particularly noteworthy because the ADHD participants in our sample were on their medications. More specifically, our results that attentional deficits may be associated with decreased cognitive flexibility and that cognitive flexibility is associated with decreased academic achievement suggest that students with ADHD may be at particularly high risk of struggling academically when unmedicated. Although this is in no way surprising, it does suggest one underlying mechanism (cognitive flexibility) that may account for the challenges students with ADHD face in academic settings. Thus, our results provide further evidence that students with ADHD should be encouraged to utilize the pharmacological treatments recommended for them by their physicians in order to maximize their academic performance during their college years.

### **Limitations**

Our study examining gender differences in, the effects of ADHD on, and the interaction of these two factors in influencing cognitive flexibility extends the literature and also helps to demonstrate how cognitive flexibility affects both the academic achievement as well as the career planning of college students. However, there are a few limitations that should be considered before attempting to generalize these results to all young adults with ADHD. First, our sample was comprised of college students from an urban private university who may not be representative of all young adults with ADHD. These students may be more aware of their cognitive and behavioral strengths and challenges and are likely to have fairly well established academic and organizational skills given their admission to and retention at a private university. Fu-

ture research identifying career plans and cognitive flexibility at a younger age (for example, during high school) and continuing to evaluate long term success by way of longitudinal follow-up through college at a more diverse collection of institutions and the early stages of students' careers (even in those students who do not choose to attend college) could provide a broader description of the relationship between cognitive flexibility and career choices and success. Second, our sample size was moderate with small numbers of participants in some groups when the sample was divided by ADHD and gender, and the number of different academic majors represented within our sample was small. The university where we conducted this study is a private liberal arts university that predominantly offers undergraduate programs in arts and sciences. Although we advertised the study widely, the students who chose to participate were largely students from the social sciences or students from other majors who were enrolled in a social science class. As such, we could not examine the relationship between ADHD and choice of majors. Most of the students without ADHD were social science majors (students working for extra credit in one of their psychology classes) and most of the students who were not social science majors had ADHD (those recruited largely through the Student Disabilities Office list-serv). Future research with larger numbers of students from a wider variety of disciplines would expand the conclusions that could be drawn about how ADHD might impact students' choice of academic and future career paths.

Finally, it was harder than we expected to operationally define objective cognitive flexibility in our study, and we were not able to identify a way to classify students' cognitive flexibility using objective scores on the WCST. Thus, we were only able to examine the interaction between subjective, not objective, cognitive flexibility and ADHD in influencing students' academic and career choices. Additionally, we did not find significant relationships between our subjective and objective measures of cognitive flexibility. This result is not too surprising given that subjective and objective measures of memory or other cognitive abilities often share weak relationships with one another (e.g., Crumley, Stetler, & Horhota, 2014; Dellefield & McDougall, 1996; Small, LaRue, Komo, Kaplan & Mandelkern, 1995). It is also consistent with a recent study that demonstrated that objective and subjective measures of cognitive flexibil-

ity more specifically show little overlap, but instead measure different aspects of this construct (Johnco et al., 2014). This does not mean that both types of measures of cognitive flexibility are not important to consider when evaluating cognitive flexibility. It does suggest that the type of cognitive flexibility assessed (subjective vs objective) in past and future studies and in practice settings is important to consider when interpreting results. Our subjective cognitive flexibility measure yielded more results and more consistent results than our objective measure—students with attentional deficits were lower in subjective, but not objective, cognitive flexibility than their peers with fewer attentional symptoms. In contrast, both subjective and objective cognitive flexibility were significantly associated with academic achievement. Predicting reading achievement scores was best accomplished by taking both subjective and objective cognitive flexibility into account, whereas math and writing achievement were related to objective, but not subjective, cognitive flexibility, suggesting that objective cognitive flexibility may have more to contribute to understanding academic skills than subjective cognitive flexibility. Thus, we recommend that professionals working with college students with and without ADHD evaluate and consider both types of cognitive flexibility to try to assure the success of every student as they traverse their undergraduate education.

### Conclusion

Despite these limitations, our study offers new evidence about cognitive flexibility and its importance for the academic success and career planning of men and women college students with and without ADHD. It also suggests multiple avenues for future research to further explore the complex relationships between these factors. Including subjective and objective measures of cognitive flexibility (such as those used in this study) in assessments designed to aid with academic and career planning at the high school and collegiate level could improve the services and the education that counselors, teachers, and professors offer their students while simultaneously helping students better understand their own personal strengths in a way that will enhance their success in college and in their future careers.

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### About the Authors

Suneeta Kercood received her bachelor's degree (specializing in Intellectual Disabilities) and M.A in psychology, both from India, and her Ph.D. in special education (with a cognate in educational psychology) from Purdue University, West Lafayette, Indiana. She is currently a Professor, Special Education, in the College of Education at Butler University. Her research interests include cognitive functioning, especially working memory and cognitive flexibility of individual with learning disabilities and ADHD, and interventions to improve education and health of special populations. She can be reached by email at: skercood@butler.edu

Tara Lineweaver received her B.A. degree in psychology from Butler University, her M.S. degree in experimental psychology from Georgia Institute of Technology and her Ph.D. in clinical neuropsychology from the University of California, San Diego. Her experience includes working as a clinical neuropsychologist at both the Cleveland Clinic Foundation and the Rehabilitation Hospital of Indiana. She is currently a professor in the Department of Psychology at Butler University where she also directs the Neuroscience minor. Her research interests include cognitive functioning in college students with ADHD and how students' self-perceptions influence and reflect their objective abilities. She can be reached by email at: tlinwea@butler.edu.

Colleen Frank received her B.A. degree in psychology from Butler University. She is currently getting her Ph.D. in psychology at the University of Michigan with a specialization in Cognition and Cognitive Neuroscience. Her research focuses on the relationship between working memory, emotion, and aging. She can be reached by email at [ccfrank@umich.edu](mailto:ccfrank@umich.edu).

Erik Fromm received his B.A. degree in psychology from Butler University. He is currently an Orthopedic Sales Representative specializing in joint reconstruction for Stryker Orthopedics. He can be reached by email at: [erikdfromm4@gmail.com](mailto:erikdfromm4@gmail.com).

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Table 1

*Demographic Characteristics and Self-Reported Symptomatology Means (SEs) of the Male and Female Participants in the Control and ADHD Groups*

	Control Group <i>n</i> =29 M ( <i>SE</i> )		ADHD Group <i>n</i> =26 M ( <i>SE</i> )		Tests of Hypotheses <i>F</i> values: <i>df</i> =1, 51		
	Male <i>n</i> =10	Female <i>n</i> =19	Male <i>n</i> =10	Female <i>n</i> =16	Group x Gender Interac- tion	Group Main Effect	Gender Main Effect
Age	20.10 (0.31)	19.37 (0.23)	20.20 (0.42)	19.81 (0.28)	0.31	0.78	3.30
Years of Education	14.60 (0.27)	14.05 (0.21)	14.50 (0.45)	14.25 (0.21)	0.28	0.03	2.20
<b>CAARS</b>							
DSM-Inattention	58.50 (4.40)	46.89 (1.73)	68.20 (4.29)	67.38 (2.89)	2.92	22.92***	3.89*
DSM-Hyperactivity	46.70 (3.14)	45.89 (1.67)	55.20 (3.14)	55.56 (3.03)	0.05	10.82**	0.01
DSM-Total	54.00 (4.48)	46.21 (1.73)	64.80 (1.73)	63.56 (2.49)	1.52	28.01***	2.88
ADHD Index	43.80 (3.37)	47.16 (1.96)	54.20 (1.28)	60.69 (2.32)	0.42	24.48***	4.14*

Note. CAARS = Conners' Adult ADHD Rating Scale; \* $p < 0.05$ , \*\* $p < .01$ , \*\*\* $p < .001$

Table 2

*Means and SEs for the Measures of Cognitive Flexibility (cognitive flexibility) of the Male and Female Participants in the Control and ADHD Groups*

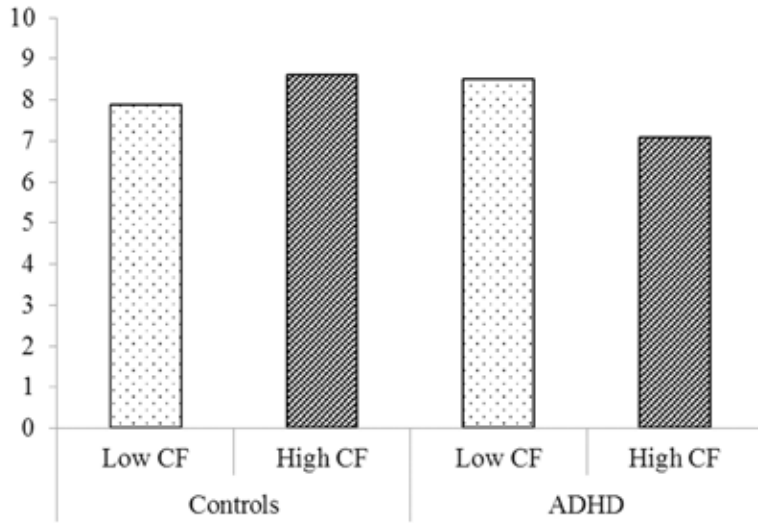
	Control Group		ADHD Group		Test of Hypotheses		
	Male	Female	Male	Female	Gender x Group Interaction	Group Main Effect	Gender Main Effect
Cognitive Flexibility Rating Scale	<i>n</i> = 10	<i>n</i> = 19	<i>n</i> = 10	<i>n</i> = 16	<i>F</i> values: <i>df</i> = 1, 51		
	55.70 (2.06)	59.05 (1.49)	54.60 (2.06)	53.88 (1.63)	1.24	2.94	0.52
<b>WCST</b>	<i>n</i> = 7	<i>n</i> = 17	<i>n</i> = 10	<i>n</i> = 13	<i>F</i> values: <i>df</i> = 1, 43		
Perseverative Responses	6.14 (0.88)	11.88 (3.60)	9.30 (1.10)	11.31 (3.41)	0.29	0.14	1.24
Perseverative Errors	5.71 (0.64)	11.12 (3.11)	8.80 (0.95)	10.46 (2.81)	0.40	0.17	1.43

Table 3

*Summary of the Regression Analyses Examining the Relationships Between Subjective and Objective Cognitive Flexibility and Academic Achievement*

Outcome Measure Significant Predictors	$\beta$	<i>p</i>	Adj. <i>R</i> <sup>2</sup>	<i>F</i>	<i>df</i>	<i>p</i>
<b>Letter Word ID</b>						
WCST Perseverative Responses	-.349	.014				
Cognitive Flexibility Scale	.330	.020	.163	5.47	(2, 44)	.008
<b>Reading Fluency</b>						
Cognitive Flexibility Scale	.335	.021	.093	5.70	(1, 45)	.021
<b>Passage Comprehension</b>						
WCAT Perseverative Errors	-.436	.002				
Cognitive Flexibility Scale	.291	.034	.202	6.82	(2, 44)	.003
<b>Calculations</b>						
WCST Perseverative Errors	-.384	.008	.129	7.78	(1, 45)	.008
<b>Applied Problems</b>						
WCST Perseverative Errors	-.332	.023	.091	5.58	(1, 45)	.023
<b>Writing Samples</b>						
WCST Perseverative Errors	-3.12	.033	.077	4.86	(1, 45)	.033

*Note.* Neither subjective nor objective cognitive flexibility significantly predicted academic achievement as measured by the Woodcock Johnson subtests of: Math Fluency, Spelling, Writing Fluency, Understanding Directions, Story Recall or Delayed Recall.



*Figure 1.* Career confidence of students without (left panel) or with (right panel) Attention Deficit Hyperactivity Disorder who described themselves as low (dotted bars) or high (striped bars) in cognitive flexibility.