The Relationship between ADHD Symptoms, EF, Personality, and Creativity

Autumn T. Cox

Roanoke College

Author Note

Correspondence considering this paper should be addressed to Autumn T. Cox, 810 E. Riverside Dr., Salem, VA 24153. E-mail: atcox@mail.roanoke.edu.

Abstract

Creativity is divided into three categories: creative process, person, and product. Creative process occurs during creativity through the mental processes of divergent and convergent thinking. This project focused on creative process, specifically divergent thinking. Divergent thinking is the ability to come up with multiple solutions to a problem. High levels of creativity/divergent thinking are associated with a high IQ, ADHD, and high openness from the Big Five Personality Scale. Past research has examined only one or two of these associated variables at a time. In the current study, we aimed to investigate the relation between ADHD symptoms, EF, personality traits, and divergent thinking. We expected that individuals high in inattentive symptoms, low in inhibition, and high in openness would show greater divergent thinking as measured by the Alternative Uses Task (AUT). We found openness to experience to be consistently correlated to divergent thinking, while inattentiveness was found to be correlated with fluency and Sluggish Cognitive Tempo (SCT) was found to be correlated to originality. Although we did not expect to find a correlation between originality and SCT, it still supports the underlying theory that inattentiveness or mind-wandering tendencies are related to high levels of divergent thinking. Future research should further evaluate this previously unfound correlation between SCT and high levels of creativity.

Key words: creativity, inattention, openness, sluggish cognitive tempo, divergent thinking

The Relationship between ADHD Symptoms, EF, Personality, and Creativity

It is believed that creativity was originally developed in humans due to the advantage it provided in environmental adaptation and survival because creativity helped individuals locate food, build shelter, find heat, problem solve, and even reproduce (Kaufman & Sternberg, 2010). Creativity is also important in the modern world and has led to the development of theories on both creative product and creative person (Kaufman & Sternberg, 2010). Creativity is the ability to produce original, innovative ideas that may be used to construct something or solve problems (Kaufman & Sternberg, 2010). According to Paek, Abdulla, and Cramond (2016) there are three categorizations of creativity: creative process, creative person, and creative product. A creative person is usually described as an individual with creative behaviors and personality; a creative product is something that is produced as result of one's creativity (Paek et al., 2016). Meanwhile, creative process occurs through the mental processes of convergent and divergent thinking during the generation of imaginative and innovative thoughts.

Convergent thinking occurs when one thinks of several ways to solve a problem until they come to the one single answer that is believed to be the best solution (Kaufman & Sternberg, 2010). For example, when trying to figure out the best way to attach two pieces of wood together, one may think about using glue, tape, or staples, but eventually decide that the best tools would be a hammer and nail. Divergent thinking is the ability to imagine different potential relationships between otherwise seemingly unrelated concepts in order to come up with multiple solutions to a problem (White & Shah, 2006). If the individual from the previous example realized they did not have a hammer, they could then begin thinking of different things to use as a hammer, such as a brick, stone, wrench, or even a tire iron, in order to accomplish their task. The combination of these two creative thinking processes leads to the development of

a creative idea. In the previous example the individual used convergent thinking to decide that using a hammer and nails would be the best way to attach two boards, but then they used divergent thinking in order to find an object that could be used like a hammer such as a brick. Therefore, a creative idea must be innovative, of high quality, and relevant to the task at hand (Kaufman & Sternberg, 2010).

Most studies on creativity measure the construct by evaluating their participants' divergent thinking (Kaufman & Sternberg, 2010). Studies often choose to study divergent thinking over convergent thinking because convergent thinking often results in "correct" ideas over original ones (Runco & Acar, 2012). In addition, studies often prefer to study divergent thinking because it makes testing their hypothesis more feasible, since the AUT measure is easy to interpret, and results in a dependable evaluation for creative thought by removing participants' common cognitive bias that creativity refers solely to creative person (Runco & Acar, 2012). The concept of divergent thinking was first established by William James, who explained that:

> Instead of thoughts of concrete things patiently following one another in a beaten track of habitual suggestion, we [humans] have the most abrupt cross-cuts and transitions from one idea to another... [and create] the most unheard-of combinations of elements, [via] the subtlest associations of analogy; in a word, we seem suddenly introduced into a seething caldron of ideas (Becker, 1995, p. 456).

Here James attempts to describe the limitlessness and unorthodoxies of creative thought and the human mind's potential and ability to fashion innovative, original ideas. Guilford, however, was the individual who distinguished convergent thinking from divergent thinking (Kaufman & Sternberg, 2010). He also created the most used and commonly accepted measure of divergent thinking, the Alternative Uses Task (Guilford, 1967). The AUT measures divergent thinking by

calculating an individual's levels of fluency, originality, flexibility, and elaboration during a task where participants are asked to list alternative uses for a common object, such as a paperclip or brick (Guilford, 1967). Many researchers have examined the connection between divergent thinking and personality and have found several correlations.

Although there is not one singularly accepted definition, personality is generally understood to be a unique sequence of mostly stable traits and characteristics that creates consistency in an individual's behavior (Roberts & Mroczek, 2008). Although there are several personality theories such as Eysenck's PEN model (Eysenck & Eysenck, 1994), the HEXACO-PI-R model (Ashton & Lee, 2009), and the Big Seven model (Tellegen, Grove, & Waller, 1991), the most well researched and supported personality theory is the Five Factor Model (FFM; Costa & McCrae, 1992; John, 1990). There are several theories that are based on the FFM and several measures to assess the FFM; however, one of the most commonly used is the Big Five Inventory (BFI), which measures an individual's levels of each of the five personality traits (John & Srivastava, 1999). An individual's unique level on each of the five personality traits can vary from a high score to a low score (Feist, Feist, & Roberts, 2013). The FFM's five traits are openness (e.g. high score: imaginative, curious, and prefers variety; low score: uncreative, conventional, and prefers routine), extraversion (e.g. high score: affectionate, sociable, and active; low score: reserved, loner, and passive), agreeableness (e.g. high score: soft-hearted, trusting, and lenient; low score: suspicious, critical, and irritable), conscientiousness (e.g. high score: punctual, ambitious, and well-organized; low score: negligent, late, and disorganized), and neuroticism (e.g. high score: self-conscious, vulnerable, and anxious; low score: self-satisfied, calm, and even-tempered; Feist, Feist, & Roberts, 2013). A meta-analysis found high levels of extraversion and openness to be positively linked to high levels of creativity; meanwhile, high

levels of agreeableness and conscientiousness were found to be negatively linked to high levels of creativity (Feist, 1998). Specifically, agreeableness tends to have a negative relationship with fluency in divergent thinking, while extraversion and openness tend to have a positive relationship with fluency (Batey, Chamorro-Premuzic, & Furnham, 2009; Chamorro-Premuzic & Reichenbacher, 2008; Furnham & Bachtiar, 2008; Furnham, Batey, Anand, & Manfield, 2008). In addition to connections to creativity, researchers have examined how personality relates to various forms of psychopathology. Evidence suggests that certain personality characteristics may increase risk for developing psychological disorders such as high neuroticism predicting anxiety (Eysenck, 1967) and low agreeableness as well as low extraversion predicting depression (Hakulinen et al., 2015).

Researchers have also begun attempting to understand the relationship between personality and more stable neurodevelopmental disorders such as Attention-Deficit/Hyperactivity Disorder (ADHD; Nigg et al., 2002). According to the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5;* American Psychiatric Association [APA], 2013) ADHD is diagnosed when an adolescent or adult displays five or more symptoms of inattention and/or hyperactivity/impulsivity for at least six months that are impairing and inconsistent with a person's developmental levels. ADHD is diagnosed by a professional and can be measured using several different psychological tests and self-rating scales, such as Conner's Adult ADHD Rating Scale (CAARS; Conners, Erhardt, & Sparrow, 1999), Behavior Assessment System for Children (BASC; Reynolds & Kamphaus, 2015), and the Barkley Adult ADHD Rating Scale-IV (BAARS-IV; Barkley, 2011a). There are three subtypes of ADHD: predominately inattentive type, predominately hyperactive-inattentive type, and combined type (APA, 2013; Fugate, Zentall, & Gentry, 2013). Common symptoms of ADHD include fidgeting,

interrupting others, talkativeness, difficulty sustaining attention, and poor organization skills (APA, 2013).

Knouse, Traeger, O'Cleirgh, and Safren (2013) have found correlations between ADHD symptoms and personality. Their study showed that hyperactivity-impulsivity was related to high extraversion, inattention was related to lower conscientiousness and higher neuroticism, and intrusive behavior was related to lower agreeableness, higher extraversion, and higher neuroticism (Knouse et al., 2013). Knouse et al. (2013) found a medium correlation between openness to experience and ADHD symptoms, which they believe signified that people with ADHD are more open to experience, even though this personality trait did not vary with ADHD symptoms. Nigg and colleagues (2002) also examined the relationship between personality traits and ADHD and found that those with ADHD had low agreeableness and conscientiousness as well as high neuroticism but no relationship with extraversion or openness. Meanwhile, another study found higher neuroticism, lower conscientiousness, lower extraversion, and neutral levels of agreeableness to be prevalent among individuals with ADHD (Jacob et al., 2007). Low levels of agreeableness and conscientiousness may be related to the correlation between low inhibition and social impairment that is often developed during childhood in those with ADHD, the effects of which often persist through adulthood (Bunford et al., 2014). Although there are numerous theories of ADHD, several well-supported theories implicated impairment in the executive function (EF) system as a primary contributing factor to the disorder (Barkley, 1997; Sonuga-Barke, 2002). EF has three main components shifting, inhibition, and working memory (WM; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000) and is believed to be involved in processes such as problem solving, sustaining attention, self-regulation, emotional self-control, and goal-oriented actions (Barkley, 2013).

While EF dysfunction may create problems in many areas of life, there have been studies who have found that EF impairments are associated with improved results in creative performance (Dietrich, 2004). For example, the gene neuregulin 1; T/T, which is associated with fronto-executive dysfunction, was also positively correlated with creative achievement (Keri, 2009; Hall et al., 2006; Radel, Davranche, Fournier, & Dietrich, 2015). White and Shah (2006) found that, compared to non-ADHD participants, those with ADHD scored significantly higher in the Unusual Uses Test (comparable to the AUT) for fluency, originality, and flexibility. Chrysikou et al. (2013) discovered that a reduction in cortical excitability in the lateral frontal cortex, a finding present in those with ADHD (Bruckmann et al., 2012), resulted in better performance on divergent thinking tasks. Radel et al. (2015) hypothesized that the link between each of these was inhibition impairment, which is the inability to resist or control impulsive behaviors. They found that for those with ADHD and lateral frontal lesions the idea-generation portion of creativity was affected by their inhibition impairment resulting in higher fluency and originality scores on the AUT (Radel et al., 2015). The researchers concluded that inhibition impairment was only advantageous for idea generation processes of creativity such as divergent thinking (Radel et al., 2015). Edl, Benedek, Papousek, Weiss, & Fink (in press) found that, when measuring inhibition using the Stroop test, there was a positive correlation between inhibition and divergent thinking performances.

Another EF construct that has been found to be correlated to divergent thinking is WM; however, this finding includes the covariance of intelligence. Studies have regularly, found a significant, positive correlation between measures of intelligence and WM capacity (Ackerman, Beier, & Boyle, 2005; Colom, Abad, Quiroga, Shih, & Flores-Mendoza, 2008; Conway, Kane, & Engle, 2003; Oberauer, Süß, Wilhelm, & Wittmann, 2008; Shelton, Elliot, Hill, Calania, &

Gouvier, 2009). WM is the ability to apply, manipulate, and hold several pieces of information in memory simultaneously, in order to evaluate their different possibilities and various outcomes (Fugate et al., 2013). Ackerman et al.'s (2005) meta-analysis found the average correlation between intelligence and WM capacity to be .48 and, using a latent variable approach, the average latent correlation indicated that WM and fluid intelligence have an even higher correlation (Kane, Hambrick, & Conway, 2005; Oberauer, Schulze, Wilhelm, & Süß, 2005; Shelton et al., 2009). When studying the relationship between each component of the EF and fluid intelligence, Benedek, Jauk, Sommer, Arendasy, and Neubauer (2014) found that the correlation between fluid intelligence and WM to be significant but insignificant for shifting and inhibition. However, there are not many studies on the relationship between WM and creativity. Two studies report a positive correlation between WM and creativity (De Dreu, Nijstad, Baas, Wolsink, & Roskes, 2012; Oberauer et al., 2008) while another found there to be an insignificant relationship between the two (Lee & Therriault, 2013). Benedek et al. (2014) also found that WM and inhibition were a significant prognostic of divergent thinking.

Those with ADHD tend to have impaired EF, which is important because EF has influence over convergent and divergent thinking (Paek et al., 2016). For those with ADHD, their inhibition results in the inability to keep multiple thoughts in WM as well as their inattentiveness, which leads to an underperformance of convergent thinking (White & Shah, 2006). However, divergent thinking, the ability to come up with multiple solutions to a problem, is where those with ADHD may have an advantage (White & Shah, 2006). White and Shah (2006) found that the lower inhibition in participants with ADHD appeared to result in their ability to outperform participants without ADHD on divergent thinking tasks. Fugate et al. (2013) found that gifted students with ADHD and WM deficits displayed higher creativity

compared to other gifted students. Carson, Peterson, and Higgins (2003) found that individuals with low executive inhibitory control and high creative achievement often performed better on divergent thinking tasks than those with low creative achievement. Healey and Rucklidge (2006) found that 40% of highly creative children displayed symptoms of ADHD.

Although many studies have found a positive correlation between creativity and high levels of extraversion and openness, they may be overlooking the significance of its negative correlation with low conscientiousness. Impulsivity and inattentiveness are related to low conscientiousness and may be influenced by low inhibition. The aim of the present study was to examine the relation between inhibition, ADHD symptoms, personality, and divergent thinking. We hypothesized that impulsiveness and/or inattentiveness would be positively associated with divergent thinking, specifically, fluency and originality since the impulsive, uninhibited mind may generate more creative ideas. Unlike past studies that focused on just a few variables in isolation, this study examined multiple variables simultaneously in order to discover whether there was a specific set of conditions that would be able to reliably identify individuals with high divergent thinking abilities. Although this study does not seek to explain why certain traits covary with divergent thinking, this study may aid in future research to find the origin of or characteristics necessary that result in divergent thinking. This study compared ADHD symptoms, EF, and personality to creativity in order to determine whether there is a specific link between these variables and creativity itself.

Methods

Participants

Two-hundred and seventy-three participants ranging from age 18 to 45 were recruited through Prolific, an online survey service. Prolific's demographic screeners ensured that our

population was within the specified age group and that all participants were from the United States. In an attempt to gather a demographically diverse and representative sample, no other exclusion criteria were used. Participants were paid at a rate of $9.51 per hour for their participation. Our survey was expected to take 40 minutes so participates were paid $6.34.

Measures

Alternative Uses Task (AUT; Guilford, 1967). The AUT is a creativity measure used to evaluate divergent thinking, with a high level of reliability (α =.80). Participants were given two free-response questions with a time limit of 5 minutes each (10 minutes total). Participants were asked to supply as many creative, unusual uses for their given object as possible. The participant's creativity score is based on their fluency, originality, flexibility, and elaboration. Fluency is the number of unusual uses one can think of, originality is based on how unusual each use is (thinking outside the box), flexibility is the range of ideas or categories, and elaboration is dependent on the amount of detail/how much an idea has been developed. Example answers for the object paperclip: 1) a pick for a lock, 2) a spring, 3) a prop to make 3D pop-up art, 4) a way to poke a hole into paper to then pull a string through, and 5) a connector for a broken chain. Using the paperclip as an example, scoring requirements are as follows. For fluency, find the total number of responses (5 responses = 5 points). For originality, compare each response to all the other participants' responses; responses given by 5% of participants are unusual (1 point), answers given by 1% of respondents are considered unique (2 points). For flexibility, evaluate how many different categories one could put the participant's answers into; the paperclip example only has 3 categories = 3 points (3 and 4 can be categorized as crafts and 1 and 5 are both problem-solving tools while 2 can be classified as an object/tool). Elaboration is the amount of detail each participant used to explain their idea; for the example: 2 would be 0 points, 1, 5,

and 3 would be 1 point, and 4 would be 2 points (one for the explanation of creating a hole in the paper, two for more detail about pulling the string through the hole). Lastly, add all of the participant's points together and compare their score to all of the other participants' scores, those with the highest scores should be considered more creative. Therefore, each participant's performance on the AUT determined their level of creativity, the higher their score the more creative they were considered to be.

Barkley Adult ADHD Rating Scale-IV (BAARS-IV; Barkley, 2011a). The BAARS-IV is a self-report symptom scale that is used to assess the presence of ADHD symptoms as well as the domains of impairment and is often used in diagnosing ADHD. The BAARS-IV includes 30 items and uses a 4-point Likert scale (e.g., 1 = never or rarely, 2 = sometimes, 3 = often, and 4 = very often). The BAARS-IV typically takes 5 to 7 minutes to complete and is designed for participants age 18 to 81. Its four subscales are ADHD Inattention, ADHD Hyperactivity, ADHD Impulsivity, and Sluggish Cognitive Tempo (SCT). SCT includes symptoms of mental fogginess, daydreaming, staring, hypoactivity, etc. and is a part of the inattentive subtype of ADHD. The BAARS-IV has a high internal validity ($\alpha = .92$) and a high test-retest reliability over a 2-to-3-week interval ($\alpha = .75$). The BAARS-IV was modeled after the DSM-IV-TR criteria and was found to have a positive predictive value across subscales ranging from .78 to .91 and a negative predictive value ranging from .84 to .98, making the test both valid and predictive (BAARS-IV; Barkley, 2011a). This scale was used to assess the extent to which each participant displayed ADHD symptoms.

Barkley Deficits in Executive Functioning Scale (BDEFS-LF; Barkley, 2011b). The BDEFS-LF is a measure used to assess an adult's dimensions of executive functioning in their everyday-life. In its long form version, its ADHD risk index can be used to examine executive

functioning deficits that indicate ADHD. The BDEFS-LF's age range is from 18 to 81 and takes about 15 to 20 minutes to complete. There are five scales with 88 items total, which use a 4-point Likert scale (e.g., 1 = Never or rarely, 2 = Sometimes, 3 = Often, and 4 = Very often). The BDEFS-LF's five sales measure time management and organization, problem solving, self-restraint, self-motivation, and self-regulation of emotions. The BDEFS-LF is considered to have high validity and has been found to correlate to other measures of EF. The BDEFS-LF's reliability scores have found there to be high internal consistency ranging from .91 to .95 across all five scales, above average interobserver agreement ranging from .66 to .79, and high test-retest reliability over a 2-to-3-week interval ranging from .62 to .90 across all scales.

Big Five Inventory (BFI; John & Srivastava, 1999). The BFI is a self-report measure of the dimensions of personality which are then broken down into personality facets. The five dimensions include openness (someone who is imaginative and creative), extraversion (someone who is outgoing and easily socializes with others), agreeableness (someone who is laid-back, forgiving, and modest), conscientiousness (someone who is hard working, organized, and efficient), and neuroticism (someone who is irritable, shy, and has low self-esteem). The BFI has 44 items and uses a 5-point Likert scale (e.g., 1 = Disagree strongly, 2 = Disagree a little, 3 = Neither agree nor disagree, 4 = Agree a little, and 5= Agree strongly). The BFI uses reverse scoring, reverse scored questions are indicated on its scoring sheet along with the identification of which domain each question belongs to. When scoring, the higher a score is in a category the more the individual displays that personality trait, the lower the score the less the individual displays the personality trait. The test-retest reliability for the BFI is strong at .75, validity tests are also strong at .70, and reliability tests have strong reliability ranging from .79 to .88.

Procedure

Our study used the online survey service Prolific and its demographic screeners to recruit 200 participants from the United States, ages 18 to 45. After reading and agreeing to the consent form, the participants completed the AUT, BAARS-IV, BRIEF-A, BFI, and a set of follow up questions. Surveys were available during the summer and the fall of 2020. For the Alternative Uses Task (AUT; Guilford, 1967), two questions were used to evaluate divergent thinking: one asked about the multiple uses for a wire coat hanger and the other for a metal bucket. The questions were free-response and the participants were given 5 minutes per question. Participants then completed the other measures, including a demographic questionnaire on age, race, and diagnostic status. The study was expected to take a maximum of 40 minutes.

Results

The final sample consisted of 273 participants (M_{age} = 29; 50.2% female). Participants who did not complete the AUT or survey (n = 24), who failed attention checks (n = 3), or did not appropriately attend to the measure (n = 10) were removed. This was an *a priori* data management decision with the rationale that a lack of valid data for our outcome of creativity rendered the other data points unusable. A conservative power analysis revealed that a sample of at least 250 participants would provide sufficient power to examine primary relations between the variables. The two AUT measures were combined in order to provide a more representative measure of creativity for each participant. Descriptive statistics and zero-order correlations can be viewed in Tables 1 and 2, respectively.

Multiple Regression

Two sets of multiple regressions were run in order to explore the relationship between predictor variables for the outcomes of AUT fluency and AUT originality scores. The first block included the demographic variables of age, ethnicity, highest level of education, and biological

sex in order to control for the effect of these variables on creativity. The second block included the five dimensions of personality (i.e., openness, extraversion, neuroticism, agreeableness, and conscientiousness) as these are hypothesized to be fairly stable predictors of human behavior. The third block contained the three BAARS-IV variables to examine the incremental impact of ADHD symptoms on creativity. The fourth and final block included the five EF variables (i.e., self-management/to time, self-organization/problem solving, self-restraint, self-motivation, and self-regulation of emotions). The results of the regression analyses can be viewed in Table 3 and Table 4.

Fluency Multiple Regression

In the first block, demographics explained a significant proportion of variance in AUT fluency (F (4, 265) = 2.53, p = .04, r^2 = .037). The only significant variable was biological sex, β = .174, p = .005. In the second block, the total model was significant in predicting AUT fluency (F (9, 260) = 3.74, p < .001, r^2 = .115). The addition of personality explained a significant additional 7.8% of the variance. In block two, significant variables were biological sex, β = .181, p = .004, and openness, β = .311, p < .001. In the third block, ADHD symptoms explained a significant portion of variance in AUT fluency (F (12, 257) = 3.37, p < .001, r^2 = .136). The addition of ADHD symptoms explained a nonsignificant 2.2% of the variance. In addition to biological sex, β = .185, p = .004, and openness, β = .293, p < .001, inattentiveness, β = .233, p = .033 was a significant predictor in block three. In the final block, the total model including all variables was significant, (F (17, 252) = 2.51, p = .001, r^2 = .145). The addition of EF variables added a nonsignificant 0.9% of the variance. In the final block, the significant predictors were biological sex, β = .116, p = .012, openness, β = .296, p < .001, and inattentiveness, β = .266, p = .027.

Originality Multiple Regression

In the first model, demographics explained a nonsignificant proportion of variance in AUT originality (F (4, 265) = 1.09, p = .36, r^2 = .016). In the second model, the total block was significant in predicting AUT originality (F (9, 260) = 2.37, p = .014, r^2 = .076). The addition of personality explained a significant additional 6% of variance. In model two, the only significant variable was openness β = .205, p = .003. In the third model, ADHD symptoms explained a significant portion of variance in AUT originality (F (12, 257) = 2.32, p = .008, r^2 = .098). The addition of ADHD symptoms explained a nonsignificant 2.2% of the variance. The significant predictors included highest level of education, β = .135, p = .046, openness, β = .193, p = .005, and Sluggish Cognitive Tempo, β = .269, p = .019. In the final model, the total block including every predictor was significant, (F (17, 252) = 1.82, p = .026, r^2 = .109). The addition of the EF dimensions explained a nonsignificant 1.1% of the variance. In the final model, the significant variables were openness β = .178, p = .014, and Sluggish Cognitive Tempo, β = .309, p = .015.

Discussion

This study aimed to examine the potential relationships between divergent thinking, as measured by the AUT, and impulsivity, inattention, and openness to experience. Previous literature has found a positive relationship between ADHD symptoms and creativity (White & Shah, 2006; Radel et al., 2015), specifically fluency and originality. This finding was replicated in the current study. Our hypothesis that openness would be related to fluency and originality, as shown in previous research (e.g., Batey, Chamorro-Premuzic, & Furnham, 2009; Chamorro-Premuzic & Reichenbacher, 2008; Feist, 1998; Furnham & Bachtiar, 2008; Furnham, Batey, Anand, & Manfield, 2008), was supported and indicates that individuals high in openness are more creative and imaginative. Inattention was found to be correlated to fluency, which may be

explained by the notion that an inattentive individual whose mind tends to wander quickly from thought to thought would be able to come up with more answers than an individual without this tendency. Past theorists such as Carson, Peterson and Higgins (2003) and Eysenck (1999) have emphasized that they believe that high levels of inattention are an essential component of creativity. In addition, Healey & Rucklidge (2006) and Healey (2006) actually found a correlation between children with high creativity and inattentiveness.

Our unexpected finding was the association between originality and SCT. SCT is considered by some to be a subtype of inattentiveness (McBurnett, Pfiffner, & Frick, 2001) and includes symptoms such as mind-wandering, distractibility, daydreaming, and the tendency to be slow at finishing tasks. Although this correlation was not predicted, it still supports the underlying theory that inattentiveness or mind-wandering tendencies are related to higher levels of divergent thinking. This explains why those who are prone to daydreaming or getting distracted are more original than other people, since these individuals are more likely to have unique thoughts or distractions come to mind. The possibility that their minds may continue to wander down their straying train of thought may result in their identification of a new way to use an object in a way that others would not have thought of. The relationship found between SCT and creativity is new in the literature to our knowledge; however, past research *has* found a relationship between high openness and SCT (Carver & White, 1994; Becker et. al., 2018). The relation among these three variables may warrant additional investigation.

The goal of our study was to simultaneously examine the variables of personality, ADHD symptoms, and EF in order to obtain a greater understanding of which combination of characteristics best identify creative individuals. Our findings revealed that the types of people who are likely to exhibit the highest levels of divergent thinking (i.e., creativity) are those who

have the personality facet of high openness to experience and individuals who display inattentive tendencies and/or those who are prone to daydreaming and distractibility.

Limitations and Future Directions

One of the limitations of this study was that we were unable to test intelligence, which past research indicated was very likely to be a key aspect in finding the set of conditions that predicted high creativity. Future studies would benefit from the inclusion of some direct or indirect measurement of intellectual capacity to help isolate the impact of the variables studied herein beyond the stable characteristic of intelligence. Another possible limitation was that we were unable to control the environment in which our participants took the survey. This may have affected participant responses depending on whether they were in environments that fostered or discouraged creativity. On the other hand, our approach to measuring creativity may reflect a more ecologically valid assessment of creativity. Participants may have been more relaxed and comfortable in their own setting versus a controlled laboratory setting. Lastly, our survey was conducted during the COVID-19 pandemic, which may have further altered the environment in which the participants tested in. Cox, Taylor, Buchholz, and Galleo (2020) found that COVID-19 has produced a more distracting environment, which may have further promoted greater distractibility and mind-wandering tendencies and may have greatly altered their answers to the BAARS-IV than it would have if they took the survey before the pandemic. Emerging research has also shown that generally speaking, anxiety and stress have risen during the COVID-19 pandemic (Petzold et al., 2020). Given the consistent finding that both state and trait anxiety are inversely related to creativity (Bryon & Khazanchi, 2011), our results may have been impacted by the global stressor of the pandemic.

Due to limitations of the current study, it is recommended that future research examine the relationship between the ADHD-related symptoms of inattention and SCT, the personality dimension openness to experience, and intelligence in order to better understand the characteristics that predict creativity in humans. The lack of a relationship with EF indicates that deficits in EF are not likely to be responsible for ADHD's relationship with creativity. Rather, those who present a tendency towards inattentive ADHD symptoms, in particular, may have caused past research to conclude at times that ADHD had a relationship with high creativity. In reality, they may have just been detecting the potential relationship creativity has with inattentive and/or SCT symptoms. Future researchers may benefit from studying individuals with clinically elevated inattentive symptoms and/or SCT symptoms, as this may help magnify the underlying relationship between "ADHD" and divergent thinking.

References

Ackerman, P. L., Beier, M. E., & Boyle, M. O. (2005). Working memory and intelligence: The same or different constructs. *Psychological Bulletin*, *131*, 30-60.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: Author.

Ashton, M. C., & Lee, K. (2009). The HEXACO-60: A short measure of the major dimensions of personality. *Journal of Personality Assessment, 91*, 340-345.

Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: constructing a unifying theory of ADHD. *Psychological bulletin*, *121*(1), 65.

Barkley, R. A. (2011a). *Barkley Adult ADHD Rating Scale-IV (BAARS-IV)*. New York: Guilford Press.

Barkley, R. A. (2011b). *Barkley Deficits in Executive Functioning Scale (BDEFS).* Guilford Press.

Barkley, R. A. (2013). ADHD, executive functioning, self-regulation. *PsycEXTRA Dataset*. doi: 10.1037/e546532013-002

Batey, M., Chamorro-Premuzic, T., & Furnham, A. (2009). Intelligence and personality as predictors of divergent thinking: The role of general, fluid, and crystallized intelligence. *Thinking Skills and Creativity*, *4*(1), 60−69.

Becker, M. (1995). 19th century foundations of creativity research. *Creativity Research Journal*, *8*, 219–229.

Becker, S. P., Schmitt, A. P., Jarrett, M. A., Luebbe, A. M., Garner, A. A., Epstein, J. N., & Burns, G. L. (2018). Sluggish cognitive tempo and personality: Links to BIS/BAS

sensitivity and the five factor model. *Journal of Research in Personality*, *75*, 103–112. https://doi.org/10.1016/j.jrp.2018.06.001

Benedek, M., Jauk, E., Sommer, M., Arendasy, M., & Neubauer, A. C. (2014). Intelligence, creativity, and cognitive control: The common and differential involvement of executive functions in intelligence and creativity. *Intelligence*, *46*, 73–83. doi: 10.1016/j.intell.2014.05.007

Bruckmann, S., Hauk, D., Roessner, V., Resch, F., Freitag, C. M., Kammer, T., … Bender, S. (2012). Cortical inhibition in attention deficit hyperactivity disorder: New insights from the electroencephalographic response to transcranial magnetic stimulation. *Brain*, *135*(7), 2215–2230. doi: 10.1093/brain/aws071

Bryon, K., & Khazanchi, S. (2011). A meta-analytic investigation of the relationship of state and trait anxiety to performance on figural and verbal creative tasks. *Personlaity and Social Psychology Bulletin*, *37*(2), 269-283.

Bunford, N., Brandt, N. E., Golden, C., Dykstra, J. B., Suhr, J. A., & Owens, J. S. (2014). Attention-deficit/hyperactivity disorder symptoms mediate the association between deficits in executive functioning and social impairment in children. *Journal of Abnormal Child Psychology*, *43*(1), 133–147. doi: 10.1007/s10802-014-9902-9

Carson, S. H., Peterson, J. B., & Higgins, D. M. (2003). Decreased latent inhibition is associated with increased creative achievement in high-functioning individuals. *Journal of Personality and Social Psychology*, *85*(3), 499–506. doi: 10.1037/0022-3514.85.3.499

Carver C. S., & White T. L. (1994). Behavioral inhibition, behavioral activation, and affective

responses to impending reward and punishment: The BIS/BAS Scales. *Journal of Personality Social Psycholo*gy, *67*, 319–333. doi: 10.1037/0022-3514.67.2.319

Chamorro-Premuzic, T., & Reichenbacher, L. (2008). Effects of personality and threat of evaluation on divergent and convergent thinking. *Journal of Research in Personality*, *42*(4), 1095−1101.

Chrysikou, E. G., Hamilton, R. H., Coslett, H. B., Datta, A., Bikson, M., & Thompson-Schill, S. L. (2013). Noninvasive transcranial direct current stimulation over the left prefrontal cortex facilitates cognitive flexibility in tool use. *Cognitive Neuroscience*, *4*(2), 81-89.

Colom, R., Abad, F. J., Quiroga, M. A., Shih, P. C., & Flores-Mendoza, C. (2008). Working memory and intelligence are highly related constructs, but why? *Intelligence*, *36*, 584-606.

Conners, C. K., Erhardt, D., Sparrow, M. A. (1999). *Conners Adult ADHD Rating Scales (CAARS).* New York: Multi-health Systems, Inc.

Conway, A. R. A., Kane, M. J., & Engle, R. W. (2003). Working memory capacity and its relation to general intelligence. *Trends in Cognitive Sciences*, *7*(12), 547-552.

Costa, P.T., & McCrae, R. R. (1992). *Revised NEO personality inventory (NEO-PI-R) and NEO five-factor inventory (NEO-FFI) professional manual.* Odessa, FL: Psychological Assessment Resources.

Cox, A. T., Taylor, C. E., Buchholz, C., & Galleo, C. A. (2020). *How extraversion and COVID-19's impact on one's work environment effects performance.* Roanoke College.

De Dreu, C. K. W., Nijstad, B. A., Baas, M., Wolsink, I., & Roskes, M. (2012). Working

memory benefits creative insight, music improvisation, and original ideation through maintained task-focused attention. *Personality and Social Psychology Bulletin*, *38*, 656-669.

Dietrich, A. (2004). The cognitive neuroscience of creativity. *Psychonomic Bulletin and Review*, *11*(6), 1011-1026.

Edl, S., Benedek, M., Papousek, I., Weiss, E. M., & Fink, A. Creativity and the Stroop interference effect. *Personality and Individual Differences*, (in press). http://dx.doi.org/10.1016/j.paid.2014.05.009

Eysenck, H. J. (1967). *The biological basis of personality.* Springfield, IL: Charles C Thomas.

Eysenck, H.J. (1999). Personality and creativity. In M.A. Runco (Ed). Creativity Research Handbook. Cresskill, NJ: Hampton Press.

Eysenck, H. J., & Eysenck, S. B. G. (1994). *Manual of the Eysenck Personality Scales—Revised*. San Diego, CA: Educational and Industrial Testing Service.

Feist, G. J. (1998). A meta-analysis of personality in scientific and artistic creativity. *Personality and Social Psychology Review*, *2*, 290-309.

Feist, J., Feist, G., & Roberts, T. (2013). *Theories of personality* (8th ed.). New York, NY: McGraw-Hill.

Fugate, C. M., Zentall, S. S., & Gentry, M. (2013). Creativity and working memory in gifted students with and without characteristics of attention deficit hyperactive disorder. *Gifted Child Quarterly*, *57*(4), 234–246. doi: 10.1177/0016986213500069

Furnham, A., & Bachtiar, V. (2008). Personality and intelligence as predictors of creativity. *Personality and Individual Differences*, *45*(7), 613−617.

Furnham, A., Batey, M., Anand, K., & Manfield, J. (2008). Personality, hypomania, intelligence,

and creativity. *Personality and Individual Differences*, *44*(5), 1060−1069.

Guilford, J. P. (1967). *The nature of human intelligence*. New York: McGraw-Hill.

Hall, J., Whalley, H. C., Job, D. E., Baig, B. J., McIntosh, A. M., Evans, K. L., et al. (2006). A neuregulin 1 variant associated with abnormal cortical function and psychotic symptoms. *Nature Neuroscience*, *9*, 1477-1478.

Hakulinen, C., Elovainio, M., Pulkki-Raback, L., Virtanen, M., Kivimaki, M., & Jokela, M. (2015). Personality and depressive symptoms: Individual participant meta-analysis of 10 cohort studies. *Depression and Anxiety*, *32*(7), 461–470. doi:10.1002/da.22376

Healey, D. (2006). *Attention deficit/hyperactivity disorder and creativity: an investigation into their relationship: a dissertation submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Psychology* (dissertation). University of Canterbury, Christschurch, New Zealand.

Healey, D., & Rucklidge, J. J. (2006). An investigation into the relationship among ADHD symptomatology, creativity, and neuropsychological functioning in children. *Child Neuropsychology*, *12*, 421-438.

Jacob, C., Romanos, J., Dempfle, A., Heine, M., Windemuth-Kieselbach, C., Kruse, A., Reif, A., Walitza, S., Romanos, M., Strobel, A., Brocke, B., Schäfer, H., Schmidtke, A., Böning, J., & Lesch, K-P. (2007). Co-morbidity of adult attention-deficit/hyperactivity disorder with focus on personality traits and related disorders in a tertiary referral center. *European Archives of Psychiatry and Clinical Neuroscience*, *257*(6), 309–317. doi:10.1007/s00406-007-0722-6

John, O.P. (1990). The “Big Five” factory taxonomy: Dimensions of personality in the natural

language and in questionnaires. In L.A. Pervin (Ed.), *Handbook of Personality: Theory and Research* (pp. 66-100). New York: Guilford Press.

John, O. P., & Srivastava, S. (1999). The Big Five trait taxonomy: History, measurement, and theoretical perspectives. *Handbook of Personality: Theory and Research*, *2*, 102–138.

Kane, M. J., Hambrick, D. Z., & Conway, D. Z. (2005). Working memory capacity and fluid intelligence are strongly related constructs: Comment on Ackerman, Beier, and Boyle (2005). *Psychological Bulletin*, *131*, 66-71.

Kaufman, J. C., & Sternberg, R. J. (2010). *The Cambridge handbook of creativity* (Vol. 3). Cambridge: Cambridge University Press.

Keri, S. (2009). Genes for psychosis and creativity. *Psychological Science*, *20*, 1070-1073.

Knouse, L. E., Traeger, L., O'Cleirgh, C., & Safren, S. A. (2013). Adult attention deficit hyperactivity disorder symptoms and five-factor model traits in a clinical sample. *The Journal of Nervous and Mental Disease*, *201*(10), 848–854. doi:10.1097/nmd.0b013e3182a5bf33

Lee, C. S., & Therriault, D. J. (2013). The cognitive underpinnings of creative thought: A latent variable analysis exploring the roles of intelligence and working memory in three creative thinking processes. *Intelligence*, *41*(5), 306–320. doi: 10.1016/j.intell.2013.04.008

McBurnett, K., Pfiffner, L. J. & Frick, P. J. (2001). Symptom properties as a function of ADHD type: An argument for continued study of sluggish cognitive tempo. *Journal of Abnormal Child Psychology*, *29*, 207–213. doi: 10.1023/A:1010377530749

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., & Howerter, A. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*, *41*, 49-100.

Nigg, J. T., John, O. P., Blaskey, L. G., Huang-Pollock, C. L., Willcutt, E. G., Hinshaw, S. P., & Pennington, B. (2002). Big Five dimensions and ADHD symptoms: Links between personality traits and clinical symptoms. *Journal of Personality and Social Psychology*, *83*(2), 451–469. doi: 10.1037/0022-3514.83.2.451

Oberauer, K., Schulze, R., Wilhelm, O., & Süß, H. -M. (2005). Working memory and intelligence—Their correlation and their relation: Comment on Ackerman, Beier, and Boyle (2005). *Psychological Bulletin*, *131*, 61-65.

Oberauer, K., Süß, H. -M., Wilhelm, O., & Wittmann, W. (2008). Which working memory functions predict intelligence? *Intelligence, 36*, 641-652.

Paek, S. H., Abdulla, A. M., & Cramond, B. (2016). A meta-analysis of the relationship between three common psychopathologies—ADHD, anxiety, and depression—and indicators of little-c creativity. *Gifted Child Quarterly*, *60*(2), 117–133. doi: 10.1177/0016986216630600

Petzold, M. B. Bendau, A., Plag, J., Pyrkosch, L., Mascarell Maricic, L., Betzler, F., … & Ströhle, A. (2020). Risk, resilience, psychological distress, and anxiety at the beginning of the COVID-19 pandemic in Germany. *Brain and behavior*, *10*(9), e01745.

Radel, R., Davranche, K., Fournier, M., & Dietrich, A. (2015). The role of (dis)inhibition in creativity: Decreased inhibition improves idea generation. *Cognition*, *134*, 110–120. doi: 10.1016/j.cognition.2014.09.001

Reynolds, C.R. & Kamphaus, R.W. (2015). Behavior Assessment System for Children (3rd ed.) [Assessment instrument]. Bloomington, MN: Pearson.

Roberts, B. W., & Mroczek, D. (2008). Personality trait change in adulthood. *Current*

Directions in Psychological Science, *17*(1), 31–35. doi: 10.1111/j.1467-8721.2008.00543.

Runco, M. A., & Acar, S. (2012). Divergent thinking as an indicator of creative potential. *Creativity research journal, 24*(1), 66-75. doi:10.1080/10400419.2012.652929

Shelton, J. T., Elliot, E. M., Hill, B. D., Calania, M. R., & Gouvier, W. D. (2009). A comparison of laboratory and clinical working memory tests and their prediction of fluid intelligence. *Intelligence*, *37*, 283-293.

Sonuga-Barke, E. J. (2002). Psychological heterogeneity in AD/HD—a dual pathway model of behaviour and cognition. *Behavioural brain research*, *130*(1-2), 29-36.

Tellegen, A., Grove, W. M., & Waller, N. G. (1991). *Inventory of Personal Characteristics #7 (IPC-7)*. Unpublished materials, University of Minnesota.

White, H. A., & Shah, P. (2006). Uninhibited imaginations: Creativity in adults with attention-deficit/hyperactive disorder. *Personality and Individual Differences*, *40*, 1121-1131.

Table 1
Mean and Standard Deviations

Variable		
Demographics		
Biological Sex	Men = 136	Women = 137
Race/Ethnicity	*N*	Percent of Sample
Caucasian/White	172	63.0%
African American/Black	29	10.6%
Asian American	50	18.3%
Hispanic/Latinx	12	4.4%
American Indian or Alaska Native	1	0.4%
Other	9	3.3%
	Mean (*M*)	Standard Deviation (SD)
Age	29.26	7.33
AUT		
Fluency	18.69	9.81
Elaboration	11.28	9.72
Flexibility	11.29	4.25
Originality	1.54	.63
Total	42.37	19.98
BFI		
Openness	33.91	7.58
Conscientiousness	31.84	6.85
Extraversion	21.88	7.14
Agreeableness	32.48	6.01
Neuroticism	23.65	7.43
BAARS-IV		
Inattentiveness	16.87	5.7
Hyperactivity & Impulsivity	16.15	4.87
Sluggish Cognitive Tempo	15.85	5.03
BDEFS		
S1: Time-Management	41.57	15.15
S2: Self-Organization	49.04	15.48
S3: Self-Restraint	31.24	9.7
S4: Self-Motivation	19.76	7.96
S5: Self-Regulation of Emotions	21.93	8.78

Table 2
Correlations

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1. AUT Fluency	---														
2. AUT Originality	**.36***	---													
3. BFI Openness	**.26***	**.22***	---												
4. BFI Conscientiousness	.04	.05	**.20***	---											
5. BFI Extraversion	.04	**.15***	**.40***	**.27***	---										
6. BFI Agreeableness	.07	.07	**.31***	**.47***	**.26***	---									
7. BFI Neuroticism	.01	**-.14***	**-.20***	**-.49***	**-.34***	**-.38***	---								
8. BAARS-IV IA	.12	-.02	-.01	**-.59***	**-.17***	**-.27***	**.51***	---							
9. BAARS-IV HA & IP	.08	.06	.12	-.37	**.13***	**-.15***	**.41***	**.68***	---						
10. BAARS-IV SCT	.08	.03	-.06	**-.57***	**-.21***	**-.28***	**.58***	**.80***	**.67***	---					
11. BDEFS S1	.05	-.01	-.03	**-.67***	**-.23***	**-.29***	**.55***	**.79***	**.54***	**.76***	---				
12. BDEFS S2	.01	-.07	**-.21***	**-.54***	**-.30***	**-.28***	**.53***	**.71***	**.48***	**.76***	**.77***	---			
13. BDEFS S3	-.02	-.02	-.01	**-.48***	.01	**-.34***	**.45***	**.66***	**.62***	**.68***	**.67***	**.68***	---		
14. BDEFS S4	.01	.00	-.11	**-.60***	**-.17***	**-.36***	**.41***	**.65***	**.51***	**.65***	**.76***	**.68***	**.74***	---	
15. BDEFS S5	.02	-.03	-.07	**-.40***	**-.14***	**-.29***	**.69***	**.57***	**.50***	**.64***	**.62***	**.65***	**.72***	**.57***	---

Note: IA = Inattentiveness, HA & IP = Hyperactivity & Impulsivity, SCT = Sluggish Cognitive Tempo, * = significant at $p < .05$

Table 3
AUT Fluency Multiple Regressions

	Model 1			Model 2			Model 3			Model 4		
	B	*β*	*p*	B	*β*	*p*	B	*β*	*p*	B	*β*	*p*
Biological Sex	**3.390**	**.174**	**.005***	**3.538**	**.181**	**.004***	**3.621**	**.185**	**.004***	**3.236**	**.166**	**.012***
Age	.009	.007	.922	-.057	-.043	.544	-.053	-.040	.580	-.052	-.039	.588
Ethnicity	-.281	-.049	.445	-.258	-.045	.478	-.147	-.026	.686	-.119	-.021	.749
HLE	.540	.075	.257	.790	.109	.098	.899	.125	.061	.853	.118	.078
BFI O				**.401**	**.311**	**.000***	**.377**	**.293**	**.000***	**.381**	**.296**	**.000***
BFI C				-.039	-.027	.721	.080	.056	.504	.067	.047	.606
BFI E				-.123	-.090	.186	-.094	-.069	.341	-.057	-.042	.579
BFI A				-.028	-.017	.808	-.038	-.023	.739	-.067	-.041	.573
BFI N				-.029	-.022	.766	-.086	-.066	.422	-.082	-.062	.525
BAARS IA							**.399**	**.233**	**.033***	**.454**	**.266**	**.027***
BAARS HA & IP							-.156	-.078	.399	-.113	-.058	.554
BAARS SCT							-.002	-.001	.991	.077	.039	.750
BDEFS S1										-.019	-.030	.818
BDEFS S2										.004	.007	.954
BDEFS S3										-.170	-.167	.155
BDEFS S4										.040	.032	.760
BDEFS S5										.041	.036	.739
r^2	**.037**			**.115**			.136			.145		
r^2 change	.037			**.078**			.022			.009		

Note: HLE = Highest Level of Education, BFI O = BFI Openness, BFI C = BFI Conscientiousness, BFI E = BFI Extraversion, BFI A = BFI Agreeableness, BFI N = BFI Neuroticism, BAARS IA = BAARS Inattentiveness, BAARS HA & IP = BAARS Hyperactivity & Impulsivity, BAARS SCT = BAARS Sluggish Cognitive Tempo, * = significant at $p < .05$

Table 4

AUT Originality Multiple Regressions

	Model 1			Model 2			Model 3			Model 4		
	B	*β*	*p*	B	*β*	*p*	B	*β*	*p*	B	*β*	*p*
Biological Sex	-.082	-.066	.295	-.058	-.047	.470	-.073	-.059	.366	-.101	-.080	.228
Age	-.002	-.025	.720	-.005	-.064	.380	-.003	-.039	.598	-.004	-.043	.559
Ethnicity	.007	.020	.753	.013	.035	.588	.013	.036	.579	.013	.036	.582
HLE	.054	.117	.081	.060	.129	.057	**.063**	**.135**	**.046***	.059	.129	.060
BFI O				**.017**	**.054**	**.003***	**.016**	**.193**	**.005***	**.015**	**.178**	**.014***
BFI C				-.006	-.068	.385	-.003	-.032	.705	-.002	-.025	.790
BFI E				.005	.054	.434	.005	.061	.409	.006	.072	.351
BFI A				.000	-.002	.975	-.001	-.007	.924	-.001	-.014	.850
BFI N				-.007	-.083	.273	-.012	-.144	.085	-.015	-.014	.065
BAARS IA							-.015	-.135	.228	-.013	-.117	.338
BAARS HA & IP							.000	-.003	.978	.001	.007	.945
BAARS SCT							**.034**	**.269**	**.019***	**.038**	**.309**	**.015***
BDEFS S1										.002	.040	.763
BDEFS S2										-.004	-.106	.361
BDEFS S3										-.010	-.158	.187
BDEFS S4										.005	.065	.543
BDEFS S5										.009	.126	.259
r^2	.016			**.078**			.098			.109		
r^2 change	.016			**.060**			.022			.011		

Note: HLE = Highest Level of Education, BFI O = BFI Openness, BFI C = BFI Conscientiousness, BFI E = BFI Extraversion, BFI A = BFI Agreeableness, BFI N = BFI Neuroticism, BAARS IA = BAARS Inattentiveness, BAARS HA & IP = BAARS Hyperactivity & Impulsivity, BAARS SCT = BAARS Sluggish Cognitive Tempo, * = significant at $p < .05$