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# Unique Potential and Challenges of Students With ADHD in Engineering Programs

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## Abstract

A critical need exists in engineering education to draw on the non-traditional divergent thinking and risk-taking necessary for making radical technological breakthroughs. Literature suggests that individuals with Attention Deficit Hyperactivity Disorder (ADHD) characteristics demonstrate unparalleled creativity and risk-taking potential. While this group of students may offer significant benefits to the advancement of the nation, they are currently significantly underrepresented in engineering programs because of the major academic and emotional challenges that the rigidly structured engineering programs impose on them. Funded by the Division of Engineering Education and Centers of the National Science Foundation, this study is aimed at understanding creative potential and challenges of engineering students with ADHD characteristics. A cohort of 18 female and 36 male undergraduate students were recruited from the School of Engineering at the University of Connecticut ($n$=54). To quantify the level of ADHD-related characteristics and the creative potential of the participants, the investigators administered Brown ADD Scales for Adults and Torrance Test of Creative Thinking (TTCT) Figural Form A, respectively. A 40-question instrument was designed and administered to understand the learning styles, the perception of current engineering programs in terms of rewarding creativity and risk-taking, and the difficulties of the participants in engineering programs. It was found that there is a statistically significant positive correlation between the Brown total score and the Creativity Index ($r$=.45, p=.001). Among Brown subscale scores, *attention* was found to have the largest correlation with the Creativity Index. There were positive significant correlations with the Creativity Index and all of the Brown subscales except for *memory*. The Brown scores were found to have positive significant correlations with three of the TTCT sub-categories; *fluency, originality,* and *resistance to premature closure*. A negative correlation exists between the GPA and total Brown score, suggesting weaker academic accomplishments of students with ADHD characteristics. GPA showed no correlation with the Creativity Index, suggesting a lack of creativity appreciation in current engineering programs. The Mann-Whitney test on survey questions revealed that students with a higher Brown t-score are significantly more willing to take a chance in which they may fail in order to pursue innovation. This study found that only three of the eighteen students who are formally diagnosed with ADHD are receiving services from the Center of Students with Disabilities CSD. It is expected that the outcomes of this study lead to a paradigm shift in how these individuals are

perceived by both our society and our engineering educational system. The knowledge generated through this study will help identifying the academic struggles of this group of students and facilitate development of specialized education programs that foster largely unrecognized talents and unique potential of this underrepresented population.

## Introduction

Engineering *breakthroughs* play a crucial role in our nation's ability to face the significant challenges of the coming decades. We cannot afford to rely solely on the incremental advancements currently being made by engineers. A *critical need* exists in engineering education to draw on the *divergent thinking* and *risk-taking* necessary for revolutionizing industries and making radical technological discoveries. Engineering education today reinforces students for using shallow and tired methods to solve problems. Students may understand how to solve certain kinds of problems, but not necessarily why it works or where it came from (Cropley, 2015). In recent years, engineering programs have emphasized the significance of creativity but have not necessarily reinforced risk-taking personality traits. It is not often until there is a desperate need for new ideas that the push for creativity and divergent thinking is desired. A clear example of this is the "Sputnik Shock" of 1957. The Soviet Union's immense success in the space race pushed the Western world to challenge what they knew and come up with new innovations. This need for new technology was in such a high demand, the US National Defense Education Act of 1958 that was created with the purpose of stimulating and supporting STEM education. The act states that *"The defense of this Nation depends upon the mastery of modern techniques developed from complex scientific principles. It depends as well upon the discovery and development of new principles, new techniques, and new knowledge"* (National Defense Education Act, 1958).

Published literature supports the idea that individuals with ADHD may have the potential to be more creative than their peers (Abraham, Windmann, Siefen, Daum, & Güntürkün, 2006; Fugate, Zentall, & Gentry, 2013; Moon, Zentall, Grskovic, Hall, & Stormont, 2001; White, & Shah, 2006, 2011). Their ability to be spontaneous and divergent thinkers allows them to take more risks. As they naturally tend to think outside of the box, individuals with ADHD have the potential to offer unexpected solutions to complex problems (Roberts, 2012). Despite the significant contribution ADHD students can make, they often struggle in traditional educational environments. Mainly, how the traditional educational setting functions does not cater to how students with ADHD achieve success, nor do teachers have sufficient training and understanding of how ADHD affects learning and academic performance (Rogers, & Meek, 2015).

Funded by the Division of Engineering Education and Centers of the National Science Foundation, this study is aimed at understanding creative potential and challenges of engineering students with ADHD characteristics. A quantitative study was suggested to achieve the goals of this research. A cohort of undergraduate students was recruited from the School of Engineering at the University of Connecticut and several characteristics of the sample population were measured. The potential for ADHD was quantified using the Adult form of Brown ADD Scales. Creative thinking potential was measured using the Torrance Tests of Creative Thinking® (TTCT). The investigators designed a survey instrument to understand the learning styles, the perception of current engineering programs in terms of rewarding creativity, and the difficulties of the participants. This 40-question survey was administered using online tools. To evaluate the academic performance, academic records for each participant was acquired from the Office of the Registrar. The independent-groups T-test and correlation analyses were conducted to examine the difference in Creativity Index and its sub-constructs between the lower ADHD potential group and the higher ADHD potential group.

## Background and Motivations

### Creative Potential of Individuals With ADHD Characteristics

The literature supports the idea that individuals with ADHD have the potential to be more creative than their peers. It has been proposed that ADHD characteristics including sensation seeking, stimulation seeking, and a greater use of imagery, are highly similar to creative behaviors (Cramond, 1994; Shaw, 1992). Additionally, it has been found that creativity and risk-taking behaviors are related (Eisenman, 1987). Research has shown that gifted students with ADHD characteristics have higher levels of creativity than gifted students without ADHD characteristics (Fugate, Zentall, & Gentry, 2013; Moon, Grskovic, Hall, & Arlene Stormont, 2001). Building on these findings, additional research has indicated that non-gifted individuals with ADHD perform higher on specific areas of creativity than non-gifted individuals (Abraham et al., 2006; White & Shah, 2006, 2011). Not only does research support the idea that those with ADHD score higher on creativity assessments, but also a study examining the real world creative achievement among adults with ADHD found that *"adults with ADHD showed higher levels of original creative thinking and higher levels of real-world creative achievement when compared to adults without ADHD"*(White & Shah, 2006). Roberts suggests that those with ADHD tend to be creative, spontaneous, and divergent thinkers and these qualities allow them to take more risks, as they naturally tend to think outside of the box (Roberts, 2012). Verheul, Block, Bumeister-Lamp, Thuril, Tiemeier, and Turturea found that students with a higher level of ADHD-like behavior are more likely to have entrepreneurial intentions. They were also able to identify risk taking as a mediator that partly explains this positive effect. They suggest that an underlying factor may be the tendency to search for, and engage in, stimulating activities to compensate for their experienced under-arousal (Verheul et al, 2015). A study by Issa utilized several different tests in order to identify a correlation between ADHD and higher levels of creativity. The Kirton Adaption-Innovation Inventory (KAI) indicated preferences for originality, nonconformity, paradigmbreaking, and low efficiency in those diagnosed with ADHD. Puccio's FourSight showed preferences for generating novel ideas and overlooking details and the Adjective Check List (ACL) scores determined a tendency to seek novelty and avoid routine (Issa, 2015). The results from these tests suggest a positive correlation between ADHD and higher levels of creativity.

It has been suggested that inhibitory effects and lower working memory of those with ADHD allow creativity to flourish. Fugate, Zentall, and Gentry found that lower working memory scores shared a relationship with higher creativity scores in a population of gifted individuals with ADHD characteristics(Fugate et al., 2013). These findings are supported by a study done by Kalbfleisch, which used electroencephalograms (EEG) in populations of gifted boys with ADHD, and found that they have cognitive strengths that potentially make them more adept in creativity and problem solving situations (Kalbfleisch, 2000). There is strong evidence that the

ADHD brain is functionally different, and these differences may help facilitate positive cognitive functioning (Durston et al, 2003; Kalbfleisch, 2009; Kalbfleisch & Banasiak, 2008; Sowell et al, 2003). The research regarding the brain structures and functioning of those with ADHD has been furthered by the suggestion that those with ADHD actually help advance societies and are not simply a genetic coincidence. Williams and Taylor suggest that the prevalence of ADHD and the fact that the seven-repeat allele of DRD4 (dopamine receptor type D4) is positively selected in evolution, indicates that individuals with ADHD aid the evolution of society; the authors also emphasize that those with ADHD often engage in risk-taking and cognitive idiosyncrasy thus benefiting society. Specially, Williams and Taylor state that, *"we have suggested two advantages of ADHD-HI to society: first, increased exploration of behavioral possibilities and second, the confining of concomitant social and physical risk to a minority"* (Williams & Taylor, 2006, p. 408).

Although some studies have indicated that there is no significant difference in creativity between those with ADHD and those without ADHD (Healey & Rucklidge, 2005), it is our suggestion that more research must be done to investigate this phenomenon specifically among the engineering students with ADHD. The present study attempts to discover a similar trend by using the Brown ADD Scales for Adults and Torrance Test of Creative Thinking (TTCT) Figural Form A.

**Specific Goals and Objectives**

It is relevant to learn more about students with ADHD in engineering fields. It is likely that there are students with ADHD in engineering who are not having their learning needs met and are not having their creativity nurtured and thus may not be reaching their full potential. Additionally, studies have shown that there are very few students receiving services for ADHD in the college of engineering, thus these findings raise the question of why students with ADHD are not pursuing engineering education. The proposed project will specifically investigate this phenomenon and will gather information about the perceptions on engineering education from students with ADHD in the engineering college. We suggest that recruiting and retaining students with ADHD in engineering programs is a significant problem in engineering education, and may result in the loss of creative and innovative individuals. As such, this project attempts to gather information to help address this problem and will present a significant and important potential addition to the existing body of work. The specific research questions are:

- Is there statistically significant association between creative potential and ADHD characteristics for engineering students?
- Is there a difference between academic performance in students with strong and weak ADHD characteristics?

## Methods

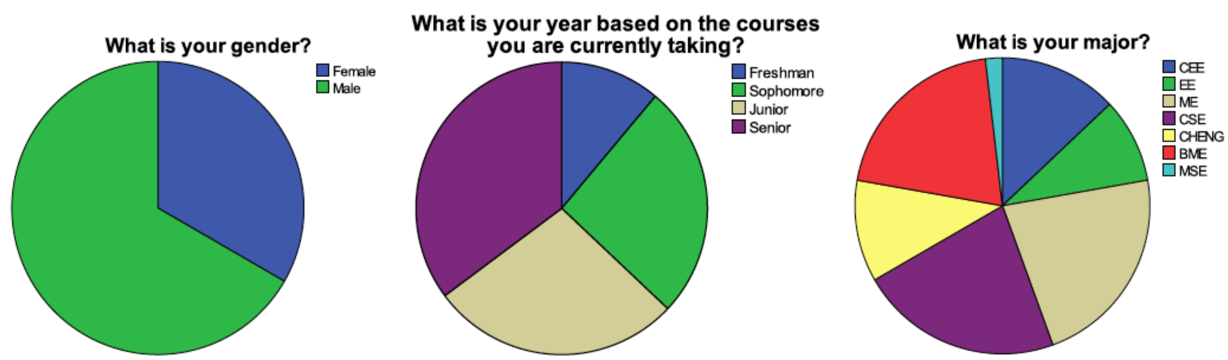
### Participants

This study is part of our ongoing to explore the association of ADHD characteristics with creative potential and academic challenges of engineering students. The first major activity was the submission of the research protocol to the university Institutional Review Board (IRB) and response to the reviewers' comments. After receiving the IRB approval to begin the study, an advertisement to recruit participants was posted in the Daily Digest of the University of Connecticut so that emails were sent to all of the university's engineering students. In the first recruitment effort, 33 engineering students volunteered to participate in the study. The investigators met with participants individually to provide more information about the study and obtain the consent of each participant. Given the level of interest received from students and after consideration of the effect of the sample size, the investigators submitted an amendment to the approved IRB in order to increase the allowed number of participants. Following the same process as was previously used for recruitment, 27 additional students joined the study and consented to participation.

Five participants had ages more than 25 years, which were not included in the current data analysis. One participant was excluded because of concerns about the accuracy of the scores of Brown ADD Scales. Ages of the participants range from 18–24 with mean=20, SD=1.5. Of the 55 participants, 35% are female and 65% are male engineering students (see Figure 1). Participants consist of 13% freshmen, 25% sophomores, 27% juniors, and 35% seniors. There are 8 participants from Civil and Environmental Engineering, 5 from Electrical Engineering, 12 from Mechanical Engineering, 12 from Computer Science and Engineering, 6 from Chemical Engineering, 11 from Biomedical Engineering, and 1 from Material Science Engineering. Participants' overall GPA out of a 4.0 scale consist of mean=3.26, SD=.51 while their engineering GPA has mean=3.26, SD=.50.

**Figure 1**

*Demography of the Participants*




**Materials**

The Torrance Test of Creativity (TTCT, Torrance, 2006) was used to quantify creative potential of the participants. This instrument is the most widely utilized measure of creativity and has strong psychometric properties, which ensures reliable scoring (Cramond, 1994; Healey & Rucklidge, 2005; Torrance, 1998). Data collected from Figural Form A of the TTCT, known as the Creative Index, was used to evaluate the creative aptitude of study participants (Healey & Rucklidge, 2005). The Creativity Index refers to a portion of the TTCT, which is determined through three subtests. The subtests ask participants to come up with unusual drawings. These drawings are scored by trained professional on five subscales: *originality, fluency, elaboration,* *abstractness of titles,* and *resistance to premature closure,* additionally aspects such as humor, emotional expressiveness, and richness of imagery are also included in the total score. Fluency scores show how many ideas the test subjects generated; originality scores show how unusual those ideas are; elaboration scores show how detailed the ideas are and how persistent the test subjects are in creative endeavors; abstractness of titles scores show how abstract and symbolic the ideas are and whether the test subjects exhibit the ability to synthesize information; resistance to premature closure scores show how open-minded the subjects are in deferring judgment (Kim, 2006; Torrance, 1998). According to Torrance, these scores were not intended to provide individual assessments, but rather to be combined into one final Creativity Index to serve as the overall assessment of creative potential. The Figural Form A of the TTCT was selected for this research because individuals with learning differences, including ADHD, may struggle with typical testing environments partially due to the challenges associated with their learning difference (Trail, 2011). The TTCT attempts to subvert the typical threatening testing environment, and instead emphasizes a game-like, thinking, and/or problem-solving atmosphere; Torrance emphasizes that participants should enjoy the activities, have fun, and the environment should be as comfortable and psychologically stimulating as possible (Torrance, 1966). Thus although multiple creativity assessment tools exist, the TTCT is ideal for assessing creativity in learners with ADHD because it allows for divergent thinking, flexibility, and attempts to continuously engage the learner in fun and stimulating manner. After all assessments were completed by the participants, the TTCT was sent to Scholastic Testing Services for professional scoring.

The ADHD characteristics were measured using the Adults form of the Brown ADD Scales that is suitable for individuals with 18 years and older. This screening test consists of 40 questions asking the recipient how frequently a particular symptom occurs. Examples are how often the person forgets things over a 24-hour period or how often they're overly frustrated. Brown ADD Scales are composed of five subscales of ADHD-related executive function impairments including *Activation, Attention, Effort, Affect,* and *Memory*. This test is based on self-report rather than the observations of others but is still a valid screening test for ADHD in adults. The scale has been proved with good internal consistency and good test-retest reliability. Because of the time limitations of the participants, only Brown Scales was used measure the strength of ADHD traits. The Brown ADD Scale was scored using a software developed by Pearson publisher. Both total scores and subscale scores are used in this paper. The typical syndromes associated with the five executive function impairments measured by the Brown test are (Brown, 2000):

*Activation:* Have difficulty organizing tasks and materials; difficulty estimating time and prioritizing tasks; and trouble getting started on work

*Attention:* loses focus when trying to listen or plan; easily distracted—internal/external; and forgets what was read and needs to re-read

*Effort:* difficulty regulating sleep and alertness; quickly loses interest in task, especially longer projects; and difficulty to complete task on time, especially in writing

*Affect:* emotions impact thoughts, actions too much; frustration, irritations, hurts, desires, worries; "Can't put it to the back of my mind"

*Memory:* difficulty holding one or several things while attending to other tasks; difficulty "remembering to remember"; inadequate "search engine" for activating stored memories, integrating these with current info to guide current thoughts and actions.

## Results

Participants' Brown scores and creativity scores were compared to their GPAs and SAT scores. Since the GPA may vary from participant to participant due to types of courses taken and their academic year, GPAs were divided into three subsets: engineering GPA, non-engineering GPA, and Total GPA. SAT scores were chosen for their reliability to be a normalized test as well as their availability among the participants. SAT scores were divided into three subsets: Math SAT, Verbal SAT, and Total SAT score.

An independent t-test was performed on the Brown scores of the group of 18 students who were formally diagnosed with ADHD and the group of 42 students without formal diagnosis (the total number of participants was 60; Table 1). This table presents the results under two assumptions: 1) the variances within the two groups are equal and 2) the variances within the two groups are not equal, hence are estimated separately (also known as Welch's t-test.) It is evident that student with diagnosis had statistically significant higher Brown scores in all five subscores, backing the reliability of the Brown score test to properly indicate whether the participant has ADHD related symptoms or not.

Figure 2 shows the scatter plot of Brown total T-Scores and Creativity Indexes for the male and female participants. After testing a linear, quadratic, and cubic fit on the plotted data, the cubic model was found to be the best fit ($R^2$=0.25). This figure shows the ascending trend of Creativity Index with the strength of ADHD traits for Brown total T-Scores higher than 70. The cubic fit indicated by the solid line was bounded by a ± standard deviation dashed lines. The standard deviation increases with lower Brown T-Scores. There is higher confidence with increasing Brown total T-Scores. In terms of Creativity Index and Brown total T-Scores, there is no observable difference between male and female scores, indicating gender neutrality. Gender neutrality of Creativity Index is also observed in Figure 3 that shows a histogram of Creativity Index for male and female participants. Both genders have comparable normal distribution.

**Table 1**

*Independent* T*-test on the Brown Scores of Participants with and without Formal Diagnosis*

| | | Levene's Test for Equality of Variance | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| Activation_TScore | Equal var. assumed | 1.15 | .288 | -3.75 | 58 | .000 | -14.984 | 3.999 | -22.989 | -6.979 |
| | Equal var. not assumed | | | -4.52 | 50.879 | .000 | -14.984 | 3.311 | -21.633 | -8.336 |
| Attention_TScore | Equal var. assumed | 19.2 | .000 | -2.51 | 58 | .015 | -8.921 | 3.552 | -16.031 | -1.811 |
| | Equal var. not assumed | | | -3.36 | 57.999 | .001 | -8.921 | 2.658 | -14.242 | -3.600 |
| Effort_TScore | Equal var. assumed | .399 | .530 | -3.37 | 58 | .001 | -13.460 | 3.989 | -21.445 | -5.476 |
| | Equal var. not assumed | | | -3.45 | 34.012 | .001 | -13.460 | 3.897 | -21.380 | -5.541 |
| Affect_TScore | Equal var. assumed | 1.43 | .237 | -3.09 | 58 | .003 | -13.262 | 4.285 | -21.839 | -4.685 |
| | Equal var. not assumed | | | -3.66 | 48.558 | .001 | -13.262 | 3.622 | -20.542 | -5.981 |
| Memoru_TScore | Equal var. assumed | 3.71 | .059 | -2.19 | 58 | .033 | -10.889 | 4.981 | -20.589 | -.919 |
| | Equal var. not assumed | | | -2.75 | 54.868 | .008 | -10.889 | 3.965 | -18.836 | -2.942 |
| BrownTotal_TScore | Equal var. assumed | 7.55 | .008 | -3.71 | 58 | .000 | -13.913 | 3.748 | -21.415 | -6.410 |
| | Equal var. not assumed | | | -4.52 | 51.710 | .000 | -13.913 | 3.080 | -20.094 | -7.731 |

**Figure 2**
*Scatter Plot for Brown Total T-Score and Creativity Index*

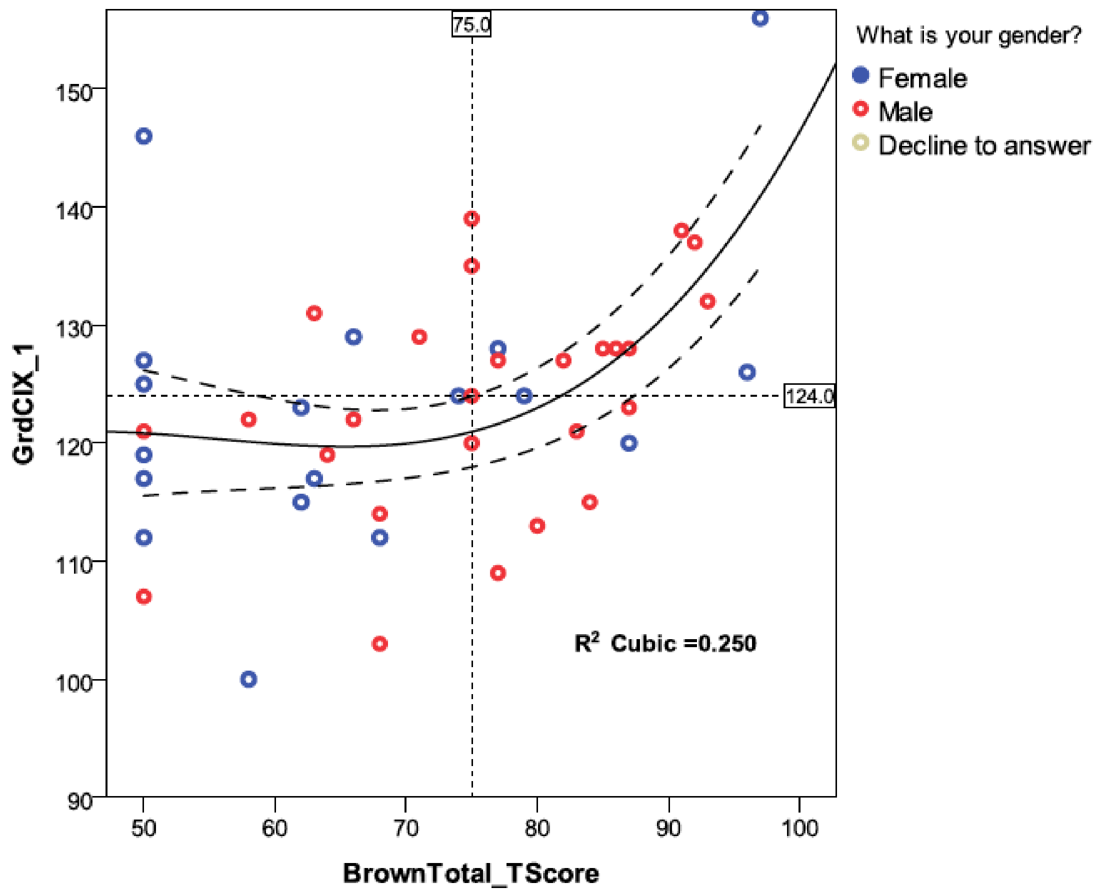



**Figure 3**
*Histogram of Creativity Index for Male and Female Students*

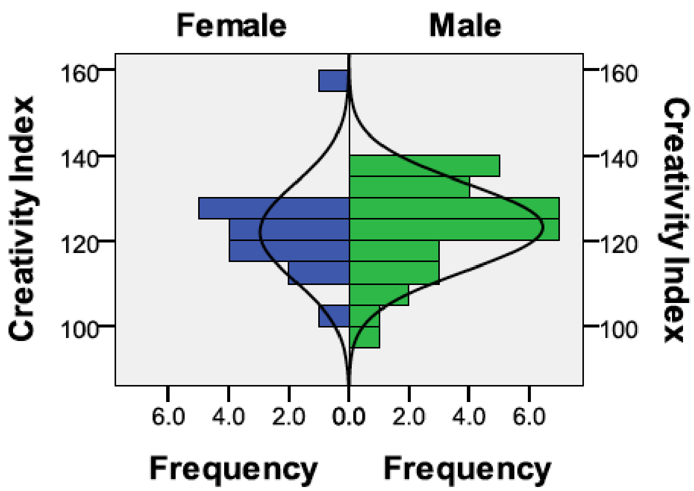


Table 2 shows the Pearson correlation matrix for Brown total T-score and its subscores, SAT Math, SAT Verbal and SAT Total scores, Creativity Index and the sub constructs of TTCT test, and GPA in engineering courses, non-engineering courses, and total. Engineering courses were those offered by the School of Engineering and non-engineering courses were those offered by other schools and departments at the University of Connecticut. There was a statistically significant positive correlation between the Brown total T-score and Creativity Index ($r$=.45, p<.01) of the participants. Among Brown subscale scores, *attention* was found to have the largest correlation with the Creativity Index ($r$=.38, p<.01). There were positive significant correlations between the Creativity Index and all of the Brown subscales except for memory. The Brown scores were found to have positive significant correlations with three of the TTCT sub-categories; *fluency* ($r$=.33, p<.05), *originality* ($r$=.32, p<.05), and *resistance to premature closure* ($r$=.40, p<.01).

Initial analyses indicated that a significant negative correlation existed between GPA and total Brown score ($r$=-.30, p<.05); however, only the negative correlations of *attention* ($r$=-.36, p<.01) and *memory* ($r$=-.28, p<.05) to GPA were significant. The five questions from the Brown ADD Scale instrument were identified as the best predictors of Creativity Index.

There was a significant correlation between SAT total score and engineering and non-engineering GPAs ($r$=.328, p<.05 and $r$=.398, p<.05, respectively), indicating that the SAT Total scores are a good predictor of GPA in both engineering and non-engineering courses. However, this correlation is only significant when comparing engineering and non-engineering GPAs to the SAT Verbal scores ($r$=.383, p<.05 and $r$=.489, p<.05). The lack of correlation of SAT Math score with GPA may be due to the limited range effect, as students who are admitted to engineering programs tend to have higher SAT Math scores.

## Discussion

The gender neutrality of Creativity Index and Brown is satisfactorily observed in Figures 2 and 3, which suggests that female engineering students are as creative as male engineering students. The Brown test scores reliably represent ADHD and non-ADHD populations. This provides reliable data and results for a thoughtful discussion to take place.

Data suggests that there is a significant positive correlation between the level of ADHD-related impairments and creative potential of engineering students. This supports the first hypothesis of the project. For the studied group of engineering students, there are no significant correlations between Creativity Index and GPA or the Creativity Index and SAT scores, indicating that SAT scores and GPA are poor predictors of creativity. Because creative potential is not reflected in the current evaluation methodology, the most creative engineering students may not be at the top of their class, so their unique potential may be underappreciated in engineering programs. This observation indicates the urgent need to revisit the student evaluation is performed in the current engineering education. Potentially low GPA of highly creative engineering students may become an impediment for their recruitment for jobs that are high demand for creative ideas.

**Table 2**
*Pearson Correlation Values and Significance Levels*

| | | Brown Total TScore | Activ. TScore | Atten. TScore | Effort TScore | Affect TScore | Mem. TScore |
|---|---|---|---|---|---|---|---|
| Brown Total TScore | Pearson Corr. | 1 | .864** | .879** | .899* | .757** | .779** |
| | Sig. (2-tailed) | | .000 | .000 | .000 | .000 | .000 |
| | N | 54 | 54 | 54 | 54 | 54 | 54 |
| Activation TScore | Pearson Corr. | .864** | 1 | .770** | .743** | .805** | .596** |
| | Sig. (2-tailed) | .000 | | .000 | .000 | .000 | .000 |
| | N | 54 | 54 | 54 | 54 | 54 | 54 |
| Attention TScore | Pearson Corr. | .879** | .770 | 1 | .692** | .648** | .731** |
| | Sig. (2-tailed) | .000 | .000 | | .000 | .000 | .000 |
| | N | 54 | 54 | 54 | 54 | 54 | 54 |
| Effort TScore | Pearson Corr. | .899** | .743 | .692 | 1 | .632** | .661** |
| | Sig. (2-tailed) | .000 | .000 | .000 | | .000 | .000 |
| | N | 54 | 54 | 54 | 54 | 54 | 54 |
| Affect TScore | Pearson Corr. | .757** | .805 | .648 | .632 | 1 | .673** |
| | Sig. (2-tailed) | .000 | .000 | .000 | .000 | | .000 |
| | N | 54 | 54 | 54 | 54 | 54 | 54 |
| Memory TScore | Pearson Corr. | .779** | .596 | .731 | .661 | .673** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | .000 | .000 | |
| | N | 54 | 54 | 54 | 54 | 54 | 54 |
| SAT Score, Math | Pearson Corr. | -.099 | -.126 | -.180 | .031 | -.027 | -.055 |
| | Sig. (2-tailed) | .508 | .400 | .226 | .834 | .856 | .976 |
| | N | 47 | 47 | 47 | 47 | 47 | 47 |
| SAT Score, Verbal | Pearson Corr. | -.144 | -.169 | -.311 | .036 | -.218 | -.156 |
| | Sig. (2-tailed) | .336 | .256 | .033 | .811 | .141 | .295 |
| | N | 47 | 47 | 47 | 47 | 47 | 47 |
| SAT Score Total | Pearson Corr. | -.081 | -.048 | -.213 | .077 | -.012 | -.071 |
| | Sig. (2-tailed) | .573 | .737 | .133 | .593 | .933 | .620 |
| | N | 51 | 51 | 51 | 51 | 51 | 51 |
| Creativity Index | Pearson Corr. | .449** | .335 | .380 | .355 | .362** | .275 |
| | Sig. (2-tailed) | .001 | .017 | .007 | .012 | .010 | .053 |
| | N | 50 | 50 | 50 | 50 | 50 | 50 |
| Non-Engineering GPA | Pearson Corr. | -.209 | -.073 | -.226 | -.162 | -.044 | -.223 |
| | Sig. (2-tailed) | .140 | .609 | .111 | .257 | .761 | .115 |
| | N | 51 | 51 | 51 | 51 | 51 | 51 |
| Engineering GPA | Pearson Corr. | -.311* | -.200 | -.354 | -.221 | -.113 | -.274 |
| | Sig. (2-tailed) | .031 | .173 | .014 | .132 | .444 | .060 |
| | N | 48 | 48 | 48 | 48 | 48 | 48 |
| Total GPA | Pearson Corr. | -.296* | -.175 | -.357 | -.184 | -.104 | -.284* |
| | Sig. (2-tailed) | .033 | .215 | .009 | .190 | .465 | .041 |
| | N | 52 | 52 | 52 | 52 | 52 | 52 |

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

The negative correlation between the GPA and the level of ADHD-related impairments suggest weaker academic accomplishment of students with ADHD characteristics. This supports the second hypothesis of the project. GPA is significantly negatively correlated with the Brown Attention ($r$=-.36, $p<.01$) and Memory ($r$=-.28, $p<.05$) subscale scores. Thus, the attention and memory are the main ADHD-related impairments that affect GPA, which can speak for the current typical course structure of engineering classes relying highly on memorization and lecture-based teaching. We suggest that the lack of attention of students in classes is associated the way engineering material are presented in lecture-based passive classes. Individuals with ADHD are well-known for their ability to deeply focus on tasks and activities that are interest provoking. This talent of these individuals is known as hyperfocus that is the experience of deep and intense concentration. Thus, difficulties of students in engineering programs are more associated with uninteresting design of current engineering education. Unfortunately, this aged and faulty engineering education system puts all the blame on students with ADHD for not being attentive in classes; it even goes further to extreme and label them "disables" that may be qualified for "special accommodations." The same argument may be valid for the observed the adverse impact of the impairment of memory on academic performance in engineering programs. This is an indication that the current engineering heavily relies on memorization of subjects. On the other hand, it is agreed upon that innovative engineering products are resulted from implementation of concepts, than utilization of memorized information. Therefore, emphasis of the current engineering education on memorization of the information does not cater to innovation and technological advancement of our nation.

## Conclusion

Both hypotheses prior to the experiment were supported by the results. There is a statistically significant association between creative potential and ADHD characteristics for engineering students. There was also an observable difference between academic performance in students with strong and weak ADHD characteristics. Memory and attention were the ADHD characteristics that a significant negative affect GPA. These results suggest that creativity is underappreciated in engineering programs and the current structure of engineering programs does not allow the unique potential of ADHD students to thrive.

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