Heightened Measures of Divergent Thinking and Cognitive Flexibility in Arts-Educated Students

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Creativity is key to human progress. We need creative solutions to the growing number of complicated human health, environmental, social, economic and political problems. When we think of an education system that fosters innovative, out-of-the-box problem solving, we may not automatically think of music, fine arts, theater or dance. Yet many studies have shown a linkage between an arts education and cognitive strengths, such as visual-spatial processing. Our study looks at a combination of objective and subjective measures of creativity: divergent thinking, cognitive flexibility and creative self-efficacy and self-identity. We hypothesized that students immersed in an arts-focused educational setting would demonstrate higher levels of creativity across each of these measures compared to non-arts students who attend a more traditional school. To test this hypothesis, we administered an anonymous survey to 100 high school students, half attending an arts conservatory ($n = 50$) and half non-arts students ($n = 50$). Based on answers to the survey, participants were scored on their divergent thinking, cognitive flexibility and creative self-efficacy. Although self-selection bias or other confounding factors may have been present, our results showed that the arts students in our study had statistically significantly higher creativity scores than the non-arts students ($p < 0.01$), which confirmed our hypothesis. While the study was not designed to test for causation, the results offer empirical evidence of a potential correlation between an arts education and creative, divergent, and flexible thinking. This suggests that an arts education may offer certain cognitive benefits that should be further explored and considered in the planning and funding of public education.

Introduction

National surveys indicate that access to arts education in America has been declining for the last 30 years in terms of instructional time, budget and resources [1]. An arts education does not directly contribute to economic and technological advancement nor does it provide practical skills for career paths or promote skills that can be measured in a standardized test [2]. It may also be viewed as lacking academic rigor and as not contributing to cognitive development. Indeed, there is relatively little causal evidence in the scientific literature showing that an arts-based education leads to better academic results [3].

However, the intrinsic value of an arts education may be in nurturing self-expression and discovery, teaching cultural awareness, and exercising parts of the brain that may not get as much stimulation in non-arts subjects. An arts education may offer a distinctive way of fostering creativity that a non-arts subject does not.

Human creativity plays a critical role in innovation, technological advancement and societal progress. According to the American Psychology Association Dictionary, creativity is "the ability to produce or develop original work, theories, techniques, or thoughts" [4]. We do not know why certain people are more creative than others or whether creativity is inheritable or mostly learned. However, education systems generally value creativity, whether it is demonstrated in crafting persuasive writing, designing scientific experiments through novel approaches, writing elegant mathematical proofs, or forming creative connections between seemingly unrelated historical events. Creativity ultimately leads to the type of thinking and problem solving that is needed to address the world's most challenging and intractable problems [1]. As there is no one measure of creativity, this study focuses on three measures of creativity: divergent thinking, cognitive flexibility and creative self-efficacy or self-identity.

One widely recognized measure of creativity is divergent thinking, which, according to the American Psychology Association Dictionary, is "creative thinking in which an individual solves a problem or reaches a decision using strategies that deviate from commonly used or previously taught strategies" [4]. Recently, researchers have come up with a reliable test of divergent thinking called the Divergent Association Task [5]. The DAT tests a person's ability to name unrelated words, which has been shown to reliably measure divergent thinking ability. The DAT is an open-ended task that evaluates one's ability to come up with solutions that are original. Specifically, the DAT requires the participant to think of 10 unrelated words, and the greater the semantic difference between the selected words, the higher the DAT score. The range of possible DAT scores is from 0 to 200, and most scores do not exceed 100. The scores are calculated based on an algorithm that was created and validated

against other tests of creativity[5].

One study conducted by Van Brockhoven and colleagues (2020) measured differences in divergent thinking of over 2000 undergraduate and graduate students, comparing those who were enrolled in an art field versus those enrolled in a STEM field. The results suggested that art students have significantly higher levels of divergent thinking than the STEM students[6]. A limitation of the study acknowledged by the researchers is that it did not address the context or environmental differences in which the students operated, which could have an impact on differences in creativity. Another study conducted by Hainselin and colleagues (2018) found that improvisational theater training led to improvements in divergent thinking, including originality and flexibility, in teenagers who were in the improvisation test group, as compared to teenagers who were in a sports control group[7]. A further evaluation of the students' cognitive and emotional profiles would be required to understand exactly how improvisation enhanced their divergent thinking.

Another measure of creativity is cognitive flexibility which, according to the American Psychology Association Dictionary, is "the capacity for objective appraisal and flexible action" which also "implies adaptability and fair-mindedness"[4]. Cognitive flexibility is important for creative problem solving. One dance study looked at how contemporary dance training over several months impacted cognitive flexibility of older adults[8]. The results showed that unlike motor training programs such as Tai Chi, dance training improved cognitive flexibility, suggesting that dance training may stimulate the prefrontal subcortical loops, or the parts of the brain associated with flexibility and switching.

In addition to cognitive psychology studies of creativity is a neuroscience study that looked at brain images and creativity scores using the Torrance Test of Creative Thinking to compare art majors (painters) to non-art majors[9]. The results showed that art majors had higher figural (i.e., non-verbal) creativity than non-art majors as well as significant differences in gray matter in their brains. These findings suggested that long-term training in the arts may affect brain functioning in a way that makes the brain think more openly or flexibly. In summary, the existing academic literature suggests a high correlation between various measures of creativity and arts training and education. However, these studies generally do not address self-assessments of creative confidence and identity.

Our study analyzes the relationship between arts education and creativity traits, in addition to measuring self-reported creativity. The central question of our study is whether students specializing in arts education have greater divergent thinking, cognitive flexibility, as well as creative self-efficacy and self-identity than students receiving an education that does not emphasize art. We hypothesized that arts students would exhibit stronger measures of creativity overall compared to non-arts students. To test this, we used objective measures of creativity, including the DAT, as well as more subjective measures including the cognitive flexibility scores and self-reported creativity scores. Although this study does not offer evidence of a causal relationship between an arts education and heightened creativity scores, we believe that the findings nonetheless may provide interesting insights to educators, policymakers, parents and students relating to arts education.

Results

This study looked at whether students specializing in arts education have greater levels of creativity than students not receiving an art-focused education. Participants in this study were evaluated according to three different tests of creativity: divergent thinking, cognitive flexibility, and self-reported creativity. For each experimental group (arts students and non-arts students), the measure of center was represented as a mean, the variation within the group was represented as a standard deviation, and we calculated the mean and standard deviation for each experimental group and for each of the three dependent variables (divergent thinking, cognitive flexibility, and self-reported creativity). A p-value was considered statistically significant if it was less than 0.05 ($p < 0.05$). The effect size was calculated as the difference in means of the two experimental groups divided by the average standard deviation of the two groups. First, regarding participants' divergent thinking ability, we found that the average DAT score was 81.97 for arts students ($SD = 3.60$) and 78.19 for non-arts students ($SD = 4.87$). An independent-samples t-test comparing the DAT scores of arts and non-arts students found that the arts students had significantly higher DAT scores ($p < 0.01$). The effect size was 0.89.

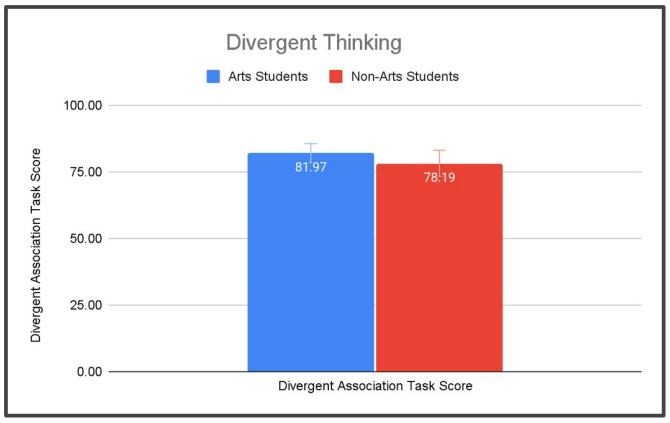

Fig. 1 Average divergent association task score based on a 100-point scoring rubric comparing Arts students and Non-Arts students ($*p < 0.01$ in a two-tailed, unpaired sample t-test).

When measuring cognitive flexibility with the cognitive flexibility scale (CFS), we found that the average cognitive flexi-

bility score was 4.47 for arts students ($SD = 1.36$) and 4.04 for non-arts students ($SD = 1.27$). An independent-samples t-test comparing the CFS scores of arts and non-arts students found that the arts students had significantly higher CFS scores than the non-arts students ($p < 0.01$). The effect size was 0.32.

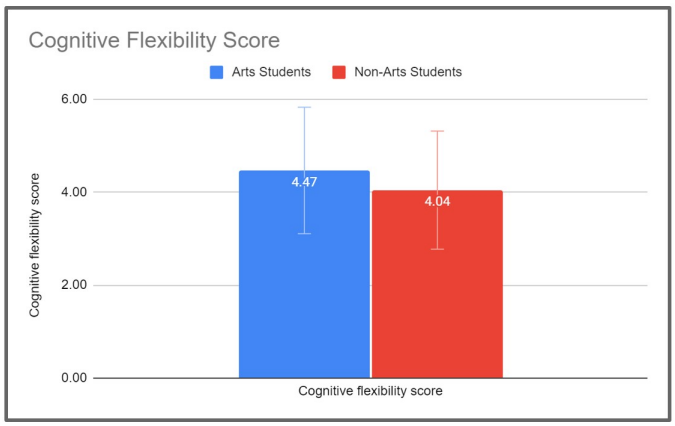

Fig. 2 Average cognitive flexibility score based on a 6-point likert scale comparing Arts students and Non-Arts students ($*p < 0.01$ in a two-tailed, unpaired sample t-test).

In the Short Scale of Creative Self (SSCS), the average self-reported creativity score for all 11 questions was 4.43 for arts students ($SD = 0.67$) and 3.51 for non-arts students ($SD = 0.98$). An independent-samples t-test comparing the SSCS scores of arts and non-arts students found that the arts students had significantly higher SSCS scores than the non-arts students ($p < 0.01$). The effect size was 1.12.

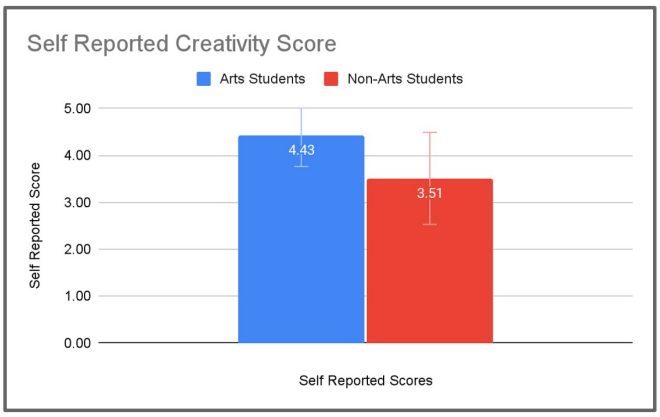

Fig. 3 Average self-reported creativity score based on a 5-point likert scale comparing Arts students and Non-Arts students ($*p < 0.01$ in a two-tailed, unpaired sample t-test).

Discussion

Research Question

The primary objective of this study was to assess and compare creativity traits among high school students who are immersed in an arts education versus high school students who are not focused on the arts. We hypothesized that students who are immersed in an arts education would exhibit elevated levels of divergent thinking, cognitive flexibility and creative self-efficacy and identity, as compared to non-arts students who attend a more traditional school and play sports. To gather comprehensive data, we employed three distinct tools: the DAT, the CFS, and the SSCS.

Analysis of Results

Overall, the results showed that arts students score significantly higher on all three measures of creativity than non-arts educated students, which was consistent with our hypothesis. The effect size of the DAT and SSCS scores was large, while the effect size of the CFS score was small to medium. This suggests a correlation between an arts education, on the one hand, and divergent thinking and cognitive flexibility, on the other, but many other unexplored factors could be at play that explain some of the differences as further described below.

It is important to note that while clear differences were found between arts-educated students and non-arts-educated students across our three selected measures of creativity, we cannot conclude a causal relationship between an arts education and higher levels of creativity. This was not a controlled experiment nor was it longitudinal in design.

The two experimental groups were different in more ways than just the fact that one school is an arts conservatory and the other is not. Participants in the experimental group who attend a performing arts school consisted of students who have had a dedication to their chosen art for many years, many of whom are already represented by talent agents and working professionally or are intending on pursuing a career in the arts. These arts students spend over 10 hours of the school week taking high-quality arts conservatory classes with frequent opportunities throughout the year for exhibits, performances and showcases. In contrast, participants in the non-arts experimental group do not attend a performing arts school and all but one participant was deeply involved in high school athletics, participating on sports teams without a particular focus on the arts. There are likely to be many other important differences in the size, culture, learning environment, educational method and philosophy and teaching staff in the arts school versus the non-arts schools.

The correlation between arts students and higher levels of creativity could be attributable to self-selection bias, whereby innately creative students are more inclined to choose an arts-oriented school, as compared to less creative students. Moreover,

the experience of attending an arts high school is distinctive not only in the emphasis and time devoted to arts classes and practice but also distinctive in the unique culture of creative expression and freedom and an academic learning environment that is more exploratory and inquiry-based.

The inclusion of all three tools in our survey served the purpose of obtaining multiple dimensions of creativity and innovative thinking in order to help validate the results that were obtained. While the DAT is a more objective test than the self-reported creativity survey, it only measures one type of creative thinking and relies heavily on verbal ability. The CFS is relatively subjective and only measures a component of creative cognition. The SSCS is also a subjective test and relies on a participant's self-awareness and self-identification.

Recognizing the potential for bias in self-reporting, particularly among arts students who may be more inclined to identify with their creative abilities due to their educational environment, we aimed to balance subjectivity with objectivity. The DAT, for example, does not rely on self-reporting, but rather, is a more objective performance task. In summary, our study incorporated a combination of these three survey tools to further validate our findings regarding the differences between our two experimental groups.

Additional Limitations

A potential experimental bias was in the way that our survey was administered to the arts students as compared to the non-arts students. Most of the arts students completed the survey during a club lunch meeting at school or during lunch hours, where they were answering questions about creativity in a community of fellow artists. Most of the non-art students completed the survey in response to an email or text message solicitation that was sent to their phones. This discrepancy in the conditions in which the survey was conducted could cause a bias toward ideal results. Future studies would ensure that the survey is administered to each participant under relatively similar conditions, time and place. Additionally, the arts students, when told that the surveys were part of a study on creativity, may have been more inclined to report answers that favored ideal results, given the respect for creativity in the arts school environment.

A potential confounding variable was the age of the participants in the two experimental groups. The arts students were on average older than the non-arts students. Older students may inherently score higher on divergent thinking tasks and cognitive flexibility criteria. To eliminate this potential confounding variable, even numbers of students in different grade levels could have been recruited to participate in both experimental groups. In addition, the arts students were from a number of different art disciplines (such as instrumental music, voice, acting, dance, creative writing, and fine arts), where there could be variances in divergent thinking and cognitive flexibility across the disciplines. This study did not seek to control for alternative factors in the learning environment that affect divergent thinking and cognitive flexibility but that are not specifically attributable to an arts education. The differences found between arts students and non-arts students could therefore be attributed to differences in instructional quality, extracurricular activities, age, gender, or parental involvement, none of which were controlled for in this study.

Future Direction

In future studies, we would be interested in evaluating any changes in creativity as participants get older from 9th grade to 12th grade to explore a hypothesis that an arts education nurtures and develops creativity over time. Future longitudinal studies could investigate whether there is any causal relationship between an arts education and the heightened creativity scores of arts students. We would also like to look at how an arts education could have potential cognitive benefits for people with disabilities, given the increasing use of art therapy in the treatment of neurological and mental health disorders.

Relevance

As a society, we want our education system to nurture innovative thinking, adept problem solving, and the ability to tackle new challenges with bold and creative thinking. Creativity is multidimensional, and it includes, for instance, critical thinking, divergent thinking, innovative problem solving, and risk-taking, which are skills that are often nurtured in educational pathways such as in STEM[2]. This study highlights the heightened creativity characteristics of students immersed in an arts education, which suggests a correlation between an arts education and creative measures and therefore, a potential advantage of studying the arts. Although further studies would need to be conducted to draw any causal conclusions, the findings of this research shed light on how arts students stand out from their non-arts peers in creativity traits or skills, which is likely related to the fact that they are trained or educated in the arts. The relevance of our research is that it offers interesting data that may help educators, policymakers and parents to advocate for increased public funding of arts education, especially in times when such resources are scarce and where the focus on arts is diminishing in favor of STEM education, for example.

Methods

Participants

We recruited high school students in Orange County, California to participate in the survey ($n = 100$). Half of the student participants ($n = 50$) were from a specialized public charter

school focused on the arts (grades 7-12). The students attending this school must audition and be selected for a particular arts conservatory, such as music, dance, theater, film, fine arts, visual arts and literary arts. The other half of the student participants ($n = 50$) were from high schools that had large athletic programs and no arts conservatory training. Informed consent language appeared at the beginning of the survey, whereby participants were informed of the purpose of the survey and that their responses would be anonymous.

On average, the arts students were older than the non-arts students. The average grade level of the arts students was 10.7 whereas the average grade level of non-arts students was 9.6. A majority of the arts students were in 11th grade, whereas a majority of the non-arts students were in 9th grade. In addition, only four of the arts students ($n = 4$) participate in high school sports, whereas nearly all non-arts students ($n = 49$) participate in at least one high school sport.

Materials and Measures

We used three different surveys that have been used in the past by researchers to measure components of creativity: (1) Divergent Association Task (DAT), (2) Cognitive Flexibility Scale (CFS), and (3) Short Scale of Creative Self (SSCS). All three surveys were combined into a single online survey utilizing Google Form survey administration software. The survey was organized to include the CFS questions first, then the SSCS questions next, and the DAT question last.

Divergent Association Task (DAT)

The DAT portion of the survey instructed participants to think of and type 10 words into the survey that are as different from each other as possible, with the following additional parameters: only single words, only nouns, no proper nouns, no specialized vocabulary, and thinking of words on your own. After these words were collected from participant surveys, we submitted a spreadsheet containing the DAT responses (i.e., the 10 words) from each participant into a website developed and maintained by the founders of the DAT. Upon submission of the spreadsheet, the website generates scores for each of the DAT responses, using an algorithm that calculates the average semantic distances between the 10 words. The full algorithm code is available online. A participant's score can range from 0 to 200, with average scores between 75 and 80[5]. Higher scores indicate higher measures of divergent thinking.

Cognitive Flexibility Scale (CFS)

The CFS portion of the survey included 12 statements that measure cognitive flexibility, which required participants to select an answer based on how much they agree with the statement[10]. The answers were assigned a score based on a six-point likert scale, with six points assigned to "strongly agree," five points for "agree," four points for "slightly agree," three points for "slightly disagree," two points for "disagree" and one point for "strongly disagree." The higher the number of points, the greater the cognitive flexibility score.

Examples of two of the 12 statements included "I have difficulty using my knowledge on a given topic in real life situations," or "I can find a workable solution to seemingly unsolvable problems." The CFS measures mental flexibility and adaptability.

Short Scale of Creative Self (SSCS)

The SSCS portion of the survey included 11 statements that measure creativity taken from a publicly available survey tool[11]. This survey required participants to decide to what extent the statement described them. The answers were assigned a score based on a five-point likert scale, with five points assigned to "definitely yes," four points assigned to "somewhat yes," three points assigned to "neither yes or no," two points assigned to "somewhat not," and one point assigned to "definitely not." The higher the number of points, the greater the creativity score. The SSCS is a widely-used instrument to measure creative self-efficacy and creative personal identity. It has been validated for consistency and correlation against other scales, as well as reliability of measurement over time[11].

Examples of two of the 11 statements included "Being a creative person is important to me," or "I am good at proposing original solutions to problems." The SSCS measures creative self-efficacy and creative personal identity.

Procedure

Our two experimental groups are referred to as "arts students" and "non-arts students." Surveys were distributed to participants over a period of three months. URL (uniform resource locator) links or a QR (quick-response) codes to the survey were distributed through text messages, emails, or at club meetings during school lunch hours. The first four questions of the survey asked participants to indicate their high school grade level, whether they attend an arts conservatory high school, whether they play high school sports, and whether they have been significantly involved with high school arts. These introductory questions were followed by CFS questions, SSCS questions and DAT questions.

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