Intelligence, Creativity, and the Threshold Hypothesis

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Abstract

The creative processes that underlie achievements must be more fully understood if monumental advancements are to be made (Hennessey & Amabile, 2010). Eysenck (1995) revealed that creativity is often split between creative potential and creative achievement.

Intelligence is a powerful force that moves humans towards economic success (Burhan, 2014). Extensively regarded is the relationship between intelligence and creativity (Kaufman & Plucker, 2011). Although, after over 60 years of research has been dedicated to understanding the specific relationship between intelligence and creativity, their exact relationship remains unclear (Kaufman & Plucker, 2011). The threshold hypothesis states that high level intelligence is necessary for high level creativity (Guilford, 1967). The present study was conducted to determine the validity of the threshold hypothesis and to what extent intelligence correlated to both creative potential and creative achievement.

Introduction

Hennessey and Amabile (2010) stated that creativity is "the driving force that moves civilization forward." The creative processes that underlie and catalyze monumental achievements in the sciences, humanities, and arts must be more fully understood if greater achievements are to be made in the years to come. Only by having a firm grasp on the mechanisms of creativity, will the numerous problems within society, and the world at large, be sufficiently addressed and solved. Park, Lubinski, and Benbow (2007) stated that creativity, amongst other intangibles, as opposed to natural resources or physical capital, is the driving force behind modern global economies. It is a fundamental necessity to study creativity. There are many scientific periodicals dedicated to the study of creativity, such as *Journal of Creative Behavior, Creativity Research Journal, Psychology of Creativity, International Journal of Creativity and Problem Solving,* and *Journal of Thinking Skills and Creativity.*

Intelligence is a powerful force that moves humans towards economic success (Burhan, 2014). National average intelligence (IQ) has been shown to be the best measure of human capital and potential for increasing economic success across countries. It has been discovered

that life satisfaction shows a significantly negative relationship in inspiring economic growth resulting from national IQ. More specifically, higher life satisfaction decreases the desire to work for economic success. This may explain why many studies have found a significant correlation between intelligence and creative potential, although not intelligence and creative achievement.

Extensively regarded is the relationship between intelligence and creativity (Kaufman & Plucker, 2011). Guilford (1967), one of the first researchers to discover a correlation between intelligence and creativity, observed a positive correlation in the low to average IQ levels, although not above average IQ levels. Although, after over 60 years of research has been dedicated to understanding the specific relationship between intelligence and creativity, their exact relationship remains unclear (Kaufman & Plucker, 2011).

The 1950's ushered in the genesis of modern psychology's research of creativity (Hennesey, 2010). Creative personality and creative thinking techniques were the primary subjects focused on in the first three decades of investigations into the dynamics of creativity. Social psychology was the next topic to become of interest to creativity researchers. The 1990's brought about a wealth of new topics and strategies of study in the pursuit of the understanding of the mechanisms of creativity. A drastic difference between the advent of the psychology of creativity and the modern state of psychology is that the current investigators in one subfield frequently are oblivious to the advancements made in another subfield. A more systematic analysis of creativity must be developed and utilized due to the comprehensive nature of creativity. Numerous factors interplay with each other to contribute to what creativity truly is. Although, creativity, still must be viewed as significantly more than the sum of its parts. The more variables that contribute to the total of creativity are neurological, affect/cognition training, individual/personality, groups, social environment, culture/society, and systems approach. All these factors, and much more, work with and affect each other to create what is commonly known as creativity. The expression of creativity is often distinguished between Big C and little c. Big C refers to eminent creativity that comprises rare displays of creativity that drastically impact other people. Little c is described as everyday creativity that consists of everyday problem solving behaviors and the capability to adapt to change. In terms of the state vs. trait aspects of creativity, both are relevant to the subject. Trait-like (stable) factors are frequently observed in the psychological aspects of creativity. State factors are also evident, as individual creativity is often influenced by the social environment. Modern advanced technology has contributed enormously to the understanding of the role of the physical brain in creativity. Technology such as fMRI, PET, and EEG are just a few of the greatly valuable tools now available to researchers.

Eysenck (1995) revealed that creativity is often split between creative potential and creative achievement. Creative potential is defined as one’s ability to create something innovative and unique that is admired and received by a noteworthy audience (Sternberg & Lubart, 1999). Eysenck (1995) described creative potential as a normally distributed trait. Guilford and Christensen (1973) describe creative potential to be the capability to generate new ideas by combining information that one already possesses. Intelligence, on the other hand, comprises aspects of cognition and is considered to be related to numerous factors in the structure-of-intellect (SI) model (Guilford, 1967).

Creative achievement differs from creative potential in that it requires the actual physical manifestation of innovative and appreciable products that, according to some theories, are the realization of creative potential components (Carson, Peterson, & Higgins, 2005). Creative achievement is revealed by scientific discoveries, novel writing, architectural designs, etc. Tests that measure creative achievement typically consist of self-reports that ask the participant to reveal their achievements across varied domains (e.g. visual arts, architecture, humor). The Creative Achievement Questionnaire (CAQ; Carson et al., 2005) is frequently used to measure and analyzed creative achievement due to it high validity, reliability, and ability of the CAQ scores to be significantly predicted by intelligence.

The threshold hypothesis states that high level intelligence is necessary for high level creativity (Guilford, 1967). Predominantly, an IQ of 120 is utilized as the threshold for intelligence (Jauk, Benedek, Dunst, & Neubauer, 2013). Conversely, many studies have concluded that the threshold effect is invalid (Kim, 2005; Preckel, Holling, & Wiese, 2006).

In an investigation of the threshold hypothesis, Jauk et al. (2013) discovered that creative potential is significantly correlated to intelligence, although creative achievement was not found to be significantly correlated to intelligence. Other studies have come to a similar conclusion (Park, Lubinski, & Benbow, 2008; Keri, 2011). Conversely, Kim (2005) revealed, in a meta-analysis, that creative potential and intelligence are not significantly correlated.Jauk et al. (2013) proposed that the varied conclusions regarding the relationship between intelligence and creative potential is the result of many different tests and measures utilized to analyze creative potential. Commonly, creative potential is analyzed with tests that measure divergent thinking ability, the ability to think across many different factors to come to a specific conclusion. Therefore, tests that measure divergent thinking consist of problems for which there are multiple possible solutions (e.g. brick- build a sculpture, perform a karate demonstration, and/or use as a tombstone for a doll). Discriminative validity of the scoring methods for these tests has been shown to be illegitimate, primarily as a result of ideational fluency confounding summative originality scoring. More recent scoring methods have improved discriminative validity by dividing originality by fluency or measuring a constant number of ideas, to control for fluency.The present study was conducted to address the following questions: 1. Is the thresholdhypothesis valid? and 2. Are both creative potential and creative achievement significantly correlated to IQ, in regards to a specific intelligence threshold? The present study consisted of two hypotheses: 1. That the threshold hypothesis would be manifest in that participants with IQ scores above 120 IQ would exhibit high creativity scores and that participants who exhibit IQ scores below 120 IQ would exhibit low creativity scores. 2. That creative potential would be significantly correlated to intelligence and that creative achievement would not be significantly correlated to intelligence. More specifically, creative potential scores would exhibit a significant positive linear relationship to IQ scores, with 120 IQ being the threshold that would significantly categorize low creative potential below 120 IQ and high creative potential above 120 IQ.

Methods

19 undergraduate psychology student took part in the present study with the incentive of receiving extra credit from their instructor. Following completion of questionnaire review it was discovered that one of the participants had not completed an intelligence questionnaire. Therefore, the final number of participants was 18, with 14 females comprising the majority.

A within-subjects design was utilized to examine the correlation between intelligence and creativity. Prior to administration of the questionnaires, an informed consent form was signed by each participant. The Miller Mental Ability Test (MMAT; Miller, 1921) Examination Form A, Test 1 was used to measure intelligence due to it requiring participants to rearrange words in one's mind. Miller (1921) describes a formula to compute raw MMAT scores to IQ, although the formula takes into account the total points obtained from Form A, Tests 1 and 2. Therefore, the present study modified the formula by multiplying the suggested formula by 2. The modified IQ formula is as follows: IQ = ((2((MMAT)(3))+80)/192)(100). To ensure a sufficient time frame for testing, the present study only administered Test 1. As Tests 1 and 2 are similar in difficulty, multiplying the suggested formula by 2 did not produce any confounds. Since the MMAT was developed in 1921 and has been standardized, tested, and utilized in paper form, more so than computerized, each participant completed the MMAT in paper form at the onset of the study.

The Creative Personality Scale (CPS; Gough, 1979) was used to acquire creative potential scores from the participants. The CPS is comprised of thirty items; 1 point is given each time one of the 18 positive items is checked, and 1 point is subtracted each time one of the 12 negative items is checked. The theoretical range of scores is therefore from -12 to +18. The original CPS study revealed a mean score of 8.98 The CPS was found to be positively and significantly ($p < .01$) related to other creativity measures but surpasses them in its correlations with the criterion evaluations. Results indicate that the CPS is a reliable and moderately valid measure of creative potential. The CPS was not modified in any way and was administered in its original form.

The Creative Achievement Questionnaire (CAQ; Carson et al., 2005), one of the most commonly used creative achievement tests, has been shown to be reliably produce creative achievement scores that are significantly predicted by intelligence scores (Carson, Peterson, & Higgins, 2003). The CAQ was modified due to its lack of intermediate questions indicating completion of lessons in the subject. A question was added to the subjects of Music, Dance, Humor, Inventions, Scientific Discovery, Theater and Film, and Culinary Arts to give participants an option to indicate lessons completed in the subject. The Visual Arts subject already contained an option to indicate lessons taken in the area, although “taken” was changed to “completed” to coincide with the other questions added and to infer a more valid indicator of “achievement,” as opposed to merely “taking” a lesson. To control for the modification of the weights of each score, a weight conversion formula was developed and used to make the modified CAQ scores of equal weight to the original

CAQ. The original CAQ contained a total of 28 possible points for each topic. There was a total of eight possible responses, ranging from 0 to 7. The modified questionnaire added a question to each topic, except Visual Arts. Therefore, those topics resulted in containing 9 possible responses, ranging from 0 to 8. To reweigh the scores to coincide with the scoring of the original CAQ, the score of each possible response was transformed into a percentage of the total possible points (e.g. 1 = 2.8% of 36). These percentages were then multiplied by the total possible points of the original test, 28, to determine their percentage weight within the original scoring system. The formula is a follows: W=n%*28 (W = new weight, n% = percentage of new score within new total possible points). The theoretical range of scores is from 0 to 352.

The CAQ and the CPS were transferred into a Google Form and prepared for test administration. When participants completed the MMAT they were instructed to follow the internet link to the Google Form where they completed the creativity measures. Following the testing session, the MMAT tests were collected and the Google Form was utilized to tabulate the participant responses. Based on statistical analysis conducted by Jauk et al. (2013), a multivariate analysis of variance (MANOVA), performed with SPSS software, tested IQ as the independent variable, Creative achievement and creative potential as the dependent variables.

Results

The 18 participants exhibited a mean IQ score of 113.278 (*SD* = 13.43, Min = 92, Max = 139). The mean creative achievement score was 9.175 (*SD* = 8.794, Min = 0, Max

= 29.44). The mean creative potential score was 3.526 (*SD* = 4.563, min = 0, max = 12). A MANOVA with, IQ as the independent variable and creative potential and creative achievement as the dependent variables, revealed no significant effect of IQ on either creative potential or creative achievement ($F(18,14) = .947$, $p = .551$).

Conclusion

The results did not support both hypotheses, 1. That the threshold hypothesis would be manifest in that participants with IQ scores above 120 IQ would exhibit high creativity scores and that participants who exhibit IQ scores below 120 IQ would exhibit low creativity scores. 2. That creative potential would be significantly correlated to intelligence and that creative achievement would not be significantly correlated to intelligence. There was no significant effect of intelligence on creative potential. Furthermore, intelligence was revealed to exhibit no effect on creative achievement. The threshold hypothesis was not supported due to intelligence showing no effect on any type of creativity.

Although this study does not support the conclusions by Guilford (1967), Jauk et al. (2013), Park, Lubinski, and Benbow (2008), and Keri (2011) it does support the conclusions by Kim (2005) and Preckel, Holling, and Wiese (2006). The results of this study further perpetuate the ongoing debate of whether or not intelligence is significantly correlated with creativity. And if intelligence and creativity are correlated, then are there subtypes of creativity and/or intelligence than are more significantly correlated to each other than others? Knowing the answers to these questions will certainly aid in the proliferation of great advances in all fields.

Scientific and technological advancements can be greatly perpetuated when an investigator can predict, based on their intelligence scores, who has a significant potential to generate extraordinary results. These same predictions can be made in the arts, as well. As technology advances and computers become more and more a necessary part of everyday life and business, the need for expert designers, of both software and hardware, will become greater and greater. Hardware and, especially, software designers must be very intelligent to be competitive in today's job markets. In the computer fields, intelligence is a necessity. Other fields of creativity may not require as high of a level of intelligence to be competitive. Future studies may reveal significant results should they compare the intelligence and creativity scores across college majors and industries. A good example is to compare the intelligence and creativity of software engineers to artistic painters. Another idea is to compare scores between different types of artists, such as sculptors and musicians.

This study's lack of significant results may be due to the small sample size of 18. It may also be due to the large majority of females compared to males. Future studies should investigate sample sizes of at least 100 participants to ensure a significant sample size. This study investigated a sample that consisted of an overwhelming majority of full-time undergraduate psychology students. Future studies would greatly benefit from comparing and contrasting intelligence and creativity scores across undergraduate and graduate students.

Since Guilford proposed the threshold hypothesis in 1967, the world has changed enormously. The enormous advances in civil rights, intelligence tests are no longer as biased toward majority groups, specifically the Caucasian, middle-class. Creativity is no longer limited to that which this class finds to be creative. The boundaries of both variables have widely expanded. With this expansion comes a pressing need for the development of new measures that are proven to produce valid and reliable results in the modern world and in the world to come. By taking into account the tremendous wealth of knowledge at the world's fingertips, through the internet and other international commerce, new tests can be produced that are able to make a valid assessment of intelligence that is the result of the synthesis of the wealth of available knowledge.

More specific definitions of intelligence and creativity are also necessary to achieve a clearer understanding of the true nature of their relationship. Advanced technology certainly adds a tremendous variable to this task. Brain imaging technology may now give a clear physical picture of what intelligence is in terms of physical neuronal structures. By utilizing cognitive, behavioral, and neuroscientific analyses, investigators will be capable of making larger steps than ever before to unraveling the mystery of intelligence and creativity.

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