IB Extended Essay in Psychology

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Unnatural tendency

A compilation of research studying the origins of human creativity

Can creativity be fostered in humans, or can it only be genetically inherited?

3903 words

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Introduction

Contrary to societal views, creativity is not exclusively attributed to artistry. Confining creativity to arts and language contradicts its very essence. Discussing the tendency to "artify" creativity, Stefan Mumaw defines it as problem solving with relevance and novelty (Mumaw, 2012). He suggests that creativity cannot be present without a problem to solve (Mumaw, 2012). Simply painting makes a painter artistic, he says, but painting while creating limitations such as using a limited number of paints involves being artistic and creative. "It is the problem that defines creativity, not the art" (Mumaw, 2012). Dr. Nancy Andreasen connects science to creativity: "Lots of us in science have the same experience. Most of us work 16 hours a day and we often work seven days a week because we so much want to solve all these problems" (Andreasen, 2006).

Creative people seem to be characterized by certain traits. According to Andreasen, they have persistence: people who are creative force themselves to work, keep going despite the pain of rejection, push limits, and think ahead of the curve (Andreasen, 2006). The relationship between intelligence—which has been deemed hereditary according to studies like Bouchard et al. (1990)—and creativity is undetermined. It is also undetermined whether or not creativity requires intelligence or if intelligence requires creativity. Andreasen wrote that creativity is an intellectual capacity that is not directly related to intelligence (Andreasen, 2006). She believes that all people have creative capacities but not all have the outlets to express them (Andreasen, 2006).

This essay compiles six research studies including Cropley (2000), Zhang (2018), and Land (1968) to come to conclusions about the origins of creativity and its ability to be fostered

versus its tendency to be innate. Some studies demonstrate that creative people have certain personality traits, indicating that they were born creative. Some research demonstrates that, in fact, uncreativity is learned more than creativity; creativity is demonstrated to have a tendency to diminish as people age due to an increasingly restrictive societal mindset. Contrasting studies found that environment and teaching creativity fosters it, thus proving creativity to be nurtured in addition to being innate. Some research in this paper suggests that there are ways to foster creativity through environment, training, and rewards, while other research demonstrates that creativity is primarily innate.

Human creativity contributes to everything from scientific discoveries to the production of art. It is a part of evolutionary psychology, proving crucial to the development and survival of the human species. Creativity could be considered more valuable than intelligence: intelligence allows people to understand the rules, but it is creativity that allows people to bend the rules—to innovate. Without the capacity to innovate, one could not stand out in the workforce, which might lead to an unsuccessful career and low salary. Money is a catalyst for human survival, and without sufficient creative characteristics, people cannot be successful enough to survive in a world dominated by innovative business and will be less capable of raising a family due to affordability. Essentially, creative people have an advantage in being successful and are thus more capable of reproducing than those that lack creativity. Creativity is essential to survival.

Understanding the origins of creativity, therefore, is important in understanding success. Knowing that creativity can be fostered would allow school systems to modify their curriculums in order to foster creativity in children from a young age. Knowing that creativity is genetic might change the future of medicine by providing researchers with the motivation to discover

which genes produce creativity, and to ultimately devise a genetic modification that would induce creativity.

Ultimately, this essay aims to answer the following: **Can creativity be fostered in humans, or can it only be genetically inherited?**

Creativity as Innate

According to Mumaw, problem-solving abilities can be learned through practice in the same way one can learn to play an instrument or learn to speak another language. He suggests that if one is presented problems consistently and chooses to solve those problems with relevance and novelty, he can improve his creativity. Mumaw suggests that every one of us possesses the ability to be creative, regardless of the suppression that ability has endured over time (Mumaw, 2012). Dr. Andreasen agrees that people can learn ways to be more creative. She finds that people have to have the capacity to begin with and can improve their creative abilities through practice (Andreasen, 2006).

In an experiment by Gopnik (2016), researchers showed four-year-old children and college undergraduates a small toy that does a series of actions, causing the toy to either make music or not make music. The experimenter would squish the toy, squeeze the bulb, and pull the ring, and the toy would make music; or the experimenter might pull the handle, squeeze the bulb, and pull the ring, and the machine would make music. The participants saw ten different sequences of three actions like this, and sometimes it made music and sometimes it did not. After watching ten sequences, the participants were asked to use the toy themselves to make it play music. The obvious solution is to pick a sequence that worked and copy what the experimenter

had done, however the more creative solution is to find the pattern: really, the first action didn't matter; all that needed to make music was to squeeze the bulb and pull the ring. The four year olds found the more intelligent solution while undergraduates replicated what the experimenter did (Gopnik, 2016).

In a second condition, the researchers did this experiment slightly differently: this time the experimenter directly showed the participants how the toy works, acting like a teacher demonstrating something to the child. In this condition the children never got the creative intelligent solution: they imitated exactly what the experimenter had done. Seeing a teacher demonstrating had the effect of narrowing the range of possibilities that the children were willing to consider. While most teaching methods enable children to get to the solution more quickly, it may keep them from exploring more widely (Gopnik, 2016). The findings suggest that it is children's natural tendency to be creative problem solvers. Direct and instructive attitudes narrow the range of solutions they found, evidencing decreased creativity. The findings suggest that creativity is hereditary in all children and that variance in creativity at older ages is due to fostering uncreativity over time through instructive experiences.

Evolutionary biology suggests that children are more creative than adults because the function of childhood is exploration. Gopnik explains that humans have an exceptionally long period of childhood and protected immaturity for exploring creativity:

> We don't have the pressures of actually going out into the world and making things happen. If we just want to get to the solution as quickly as possible we should do the obvious and simple thing. If we want to find solutions we've never

> found before, we should explore. Childhood is for this kind of learning. (Gopnik, 2016)

Gopnik suggests that the biological purpose of childhood is exploration, and that all children are born with creative capacities.

Gopnik (2016) benefits from the advantages of young participants. Young age correlates to less exposure to and therefore influence by cultural factors and learned behavior. Because they have been living for a shorter time, they have not had as much time to be influenced by social and environmental factors, so their behavior is primarily biological. This is important in this study because it supports the origins of creativity as chiefly biological. A limitation of Gopnik (2016), however, is the lack of ecological validity in its method. The study separated instruction from exploration in an unrealistic sense: in real life situations, there is a combination of guidelines with room for creativity. It is important to study the differences of behavior in these mixed situations rather than in completely creative and uncreative situations.

A study by Zhang (2018) examined correlations between isoenzymes of serotonin-related tryptophan hydroxylase (TPH) genes—TPH1 and TPH2—and creative insight performance. Zhang defines insight as the "sudden (non incremental, unexpected) awareness of the solution to a problem which often occurs when a solver restructures or reorganizes the original mental representation of the previously intractable problem" (Zhang, 2018). TPH is a serotonin-related gene; serotonin is a neurotransmitter that controls memory and learning. Zhang reported that previous research—he cited Baas, De Dreu & Nijstad, 2008; Isen, Daubman, & Nowicki, 1987; Gao et al., 2012, Gatt, Burton, Williams & Schofield, 2015; and Gizatullin, Zaboli, Jönsson, Asberg, & Leopardi, 2006—have shown that insight benefits from greater positive mood and

reduced anxiety, and that TPH has been implicated in mood regulation and mood disorders. He also reported that insight is closely related to cognitive control which has been associated with TPH—he cited Chu & MacGregor, 2011; Osinsky et al. 2009; Reuter et al., 2008; Reuter, Ott, Vaitl, Hennig, 2007; Ruocco et al., 2016; and Strobel et al. 2007. Zhang also reported that TPH was found to be related to divergent thinking, which is critical to insight problem solving—he cited Murphy, Runco, Acar, & Reiter-Palmon, 2013; Reuter, Roth, Holve, & Hennig, 2006; Runco et al., 2011; and S. Zhang & Zhang, 2017. Zhang explained how insight relates directly to creativity:

> Creative insight performance has been long and widely used as a criterion measure to study creative cognition, and it taps the two main components of creative cognition: divergent and convergent thinking. To find the correct solution for an insight problem, it typically requires unexpected and unusual approaches to restructure the information of a presented problem, as well as the ability to engage in constrained search processes to identify the correct solution. (Zhang, 2018)

A limitation to studying the effects of genetics is that "the effects of individual genetic variants are too weak," requiring large sample sizes to detect them (Zhang, 2018). Zhang's study, however, did use gene-based analysis, a "statistical method for analyzing multiple genetic variants simultaneously to determine their joint effect," making this study strong:

> Such aggregation has the advantage of considerably reducing the number of tests that need to be performed and makes it possible to detect effects consisting of multiple weaker associations that would otherwise be missed in single

> single-nucleotide polymorphism (SNP) analysis when the sample size is small. (Zhang, 2018)

The participants consisted of 425 Han Chinese college students with a mean age of 18.92 years. The study lacks population validity with participants of only one culture and one age group. To study the connection between insight and TPH, genomic DNA was extracted from participant blood samples and genotyping was performed. A strength of this study was their test for accuracy: "For quality control, 5% random DNA samples were genotyped twice [...] to calculate genotyping error. The genotyping accuracy was 100%" (Zhang, 2018). Participants solved ten insight problems. They were given two minutes for each problem. After the test, participants were instructed to report if they previously knew any problems and solutions (the average number of familiar problems was .34) and performance scores were calculated on unfamiliar problems. The average accuracies were found to be 27.5% (Zhang, 2018). They found that only TPH2 was associated with creative insight performance and no association of TPH1 with creative insight performance was detected (Zhang, 2018). However, it is possible that TPH1 played a role in creative insight and that the lack of association might be due to the relatively small sample size. It is also possible that presence of other genes may interact with TPH1 to influence creative insight performance, but Zhang did not study this. Zhang's association was only nominally significant at a threshold of .05, but nonetheless, Zhang's study provides evidence for the involvement of a gene in creative insight (Zhang, 2018).

A study by Land (1968) demonstrates that uncreativity is learned more than creativity. There is increasing pressure to push schooling younger, so that first grade looks like second grade used to and kindergarten looks more like elementary school. Research suggests this is the

opposite of what children should do to learn creativity (Gopnik, 2016). Land conducted a research study to test the creativity of 1,600 children ranging in ages from three to five years old. He re-tested the same children at 10 years of age, and again at 15 years of age. The results showed that when the participants were 5 years old, they earned a 98% in creativity. When they were 10 years old, they earned a 30%, and at 15 years old, they earned 12%. When the test was given to 280,000 adults, the average result was a 2%. Land's study provides evidence that all children are born with creative capacity, and that it is not creative behavior that is learned, but non-creative behavior that is learned (Land, 1968).

However, Land's study is limited culturally. He studied only American participants, so the trend of increased non-creativity is limited to the American culture. The study might be less limiting if Land studied creativity in people from other cultures. If the results are the same across all cultures, it might indicate that creativity decreases with age rather than as a result of culture.

Creativity as Fostered

A study by Cropley (2000) showed that students' creativity increased when they were trained to be creative. At the beginning of a course in engineering innovation, 64 male undergraduate engineering students attended three lectures on creativity. All the students took a creativity test at the beginning of the course. Thirty-seven of the students were individually counseled on the basis of their scores and a control group of 21 students took the test but were not individually counseled. Six weeks later, the students retook the test. The counselled students were more innovative than the control group. In addition, machines constructed by the counselled students were more creative than those who just attended the lectures. Students who

were counselled were more innovative, not simply in a paper and pencil test situation, but also in practical exercise. A concern with Cropley's study is the subjectivity of scoring creativity. It is very likely that knowing which students were counselled impacted how they were scored on the second test.

Shalley et al. (2000) examined the effects of work environment on the facilitation or limitation of creativity. The research method employed was a survey: 2,200 participants completed a survey rating statements on a scale of 1 to 4 (1 = very true, 4 = not at all true), for example, "My job requires me to be creative." They also rated their work from -1 (routine, concrete, organized work) to +1 (abstract and creative work). The results correlated characteristics of autonomy, complexity, and high demand with high levels of creativity requirements in jobs; concrete, organizational work was "negatively associated with high creativity requirements" (Shalley, 2000). This suggests that environment and demand effect creative output.

A limitation in Shalley's research was its method: surveys would likely only be filled out by individuals who have strong reactions to their work environment. For example, one person might feel highly creative while another person might feel extremely limited, prompting their desire to complete the survey in the first place. This results in skewed and unrepresentative data. The survey questions in Shalley's research were also closed, comprised of rating statements on numerical scales. Absence of open-ended responses limits the validity of the research by reducing experience to quantity rather than quality.

Another way creativity is fostered is through reward. Eisenberger & Rhoades (2001) studied fifth-graders of varied socioeconomic backgrounds and similar reading levels

(determined by standardized test scores). Eisenberger and Rhoades defined creative performance as concerning the generation of original behavior that meets a standard of quality or utility—he cited Guilford, 1968; Maltzman, 1960; Shalley, 1991; Wallach & Kogan, 1965; and Winston & Baker, 1985. This study also concerned divergent thinking, an important component of creative performance, involving "producing varied responses to a problem or question that has multiple alternative solutions" (Eisenberger & Rhoades, 2001). The participants were divided into two groups, a rewarded group and an unrewarded group. All children were presented 18 names for common objects. To control for any differences in difficulty, the objects were presented in reverse order for half the participants in each condition. The participants were read words for everyday objects, then asked to state an unusual use for the object, for example, if showed the word "book," they might reply that "you could use the book to hold open a door" (Eisenberger & Rhoades, 2001). Following each creative use given by the children in the rewarded group, five pennies were given to the child. No pennies were given to the children in the unrewarded group. Their findings indicate that creativity "can be increased by repeated reward presentation" (Eisenberger & Rhoades, 2001).

Implications of this study include predisposition to reward:

> Within each school, participants often came from classes in which other children had previously taken part in the experiment. Teachers told us they sometimes heard one student tell another of receiving money in the study. This communication no doubt led some children to expect a monetary payment, perhaps reducing the effectiveness of the promise versus no-promise manipulation. Therefore, the strong positive effects of promised reward on

> creativity, found following either divergent-thinking training or explicit task instructions, may have underestimated the actual size of the positive relationship between promised reward and creativity. (Eisenberger & Rhoades, 2001)

Additionally, no significant effect of reward on creativity was found among participants who did not receive initial divergent-thinking training or who were not explicitly told that creative performance was required.

Discussion

An overall limitation of creativity is operationalization. Many studies focus on outcome rather than process, accounting for innovations and products rather than the thought process because it is the most convenient to measure.

Another limitation is defining creativity. How a study defines creativity alters how and what is studied. For example, Eisenberger & Rhoades (2001) defined creative performance as generation of original behavior that meets a standard of quality or utility, while Zhang (2001) defined creativity according to creative insight performance. Shalley wrote, "the level of creativity required and the importance of creative activities should differ depending on the job in question" (Shalley, 2000). Shalley's statement suggests that the way creativity is measured differs in every situation. In technological settings, for example, creativity is defined as technological innovation, whereas in artistic settings, creativity is defined as artistic innovation. Without a clear and singular definition of creativity, it is impossible to study it.

The definition of creativity differs culturally. According to Sternberg, in Hinduism, creativity is seen as a spiritual expression rather than as an innovative solution to a problem,

suggesting that Hinduism has a lesser emphasis on originality than Western cultures. In Eastern cultures, he says, “creativity seems to involve the reinterpretation of traditional ideas—finding a new point of view—whereas in the Western approach, creativity involves a break with tradition” (Sternberg, 1999, p. 340). “The Western definition of creativity as a product-oriented, originality-based phenomenon can be compared with an Eastern view of creativity as a phenomenon of expressing inner truth in a new way or of self growth” (Sternberg, 1999, p. 347).

Gopnik (2016) and Eisenberger & Rhoades (2001) demonstrate the effects of reward, where Gopnik (2016) shows intrinsic motivation and Eisenberger & Rhoades (2001) shows extrinsic motivation. In Gopnik’s study, children were “rewarded” for their creativity when the toy played music. The children did not earn anything materialistic, rather the music brought them the internal satisfaction of knowing that they were creative enough to find the solution. This gave them encouragement to continue this behavior, thus fostering creativity. Unlike in Gopnik’s study where the motivation arose from within the children, Eisenberger & Rhoades (2001) found that external reward fostered creativity in the participants. Thus, whether or not creativity is genetic, reward can foster it, however, it is less likely that intrinsic motivation will occur if creativity is not genetic.

It is interesting to note that both Zhang (2018) and Land (1968), two studies investigating genetics, limited their participants ethnically, and thus, genetically. Perhaps limiting ethnicity increased the internal validity of the studies because the sample was uniform, eliminating the confounding variable that ethnicity affects creativity. However, it is important to consider the population validity of these studies, for the findings cannot necessarily be generalized to other ethnicities. It is possible that an innate characteristic, such as a gene, affects one ethnic

population differently than it affects a different ethnic population, for it is common for genes to be only activated when another gene or characteristic is present. This is seen, for example, in a study by Caspi & Moffitt (2006), where participants with one or two copies of the short allele of the 5-HTT gene were more prone to depression, but was only activated under stressful life events, and vice versa; the study provides evidence of a gene-by-environment interaction, in which the combination of the gene and environmental factors contributed to a behavior rather than a singular factor. In the case of Zhang (2018) and Land (1968), limiting the ethnicities of the participants neglects the effects of cultural environment on creativity in addition to genetics.

The research methods of Cropley (2000) and Shalley et al. (2000) limit the validity of their findings. The possibility of bias and subjectivity in the rescoring of the creativity tests in Cropley (2000) makes it possible that creativity did not change as much as was reported. The combination of closed questions with possible participant bias in the surveys of Shalley et al. (2000) limits the validity of the connection between environment and creativity; it is possible that only people who felt that their creativity was affected by environment completed the surveys, leaving unaffected people unaccounted for, thus creating a false correlation.

Taken together, studies that investigated creativity as fostered supported the theory in a variety of ways, correlating rewards, environment, and training to the fostering of creativity. The research for fostered creativity, however, does not support a single explanation. The studies that investigated innate creativity supported the influence of only two factors—age and genetics—creating a more focused argument. However, the studies supporting creativity as innate neglected to consider the effects of culture on creativity.

Conclusion

It is questionable whether creativity can even be measured as it is currently impossible to measure the thought process quantitatively. As a result, creativity is often measured by IQ, but whether or not intelligence and creativity are homogeneous is commonly disagreed upon. The definition of creativity is also up to question and is always changing.

Knowing whether creativity is genetically predisposed or affected by external factors emphasizes the importance of schooling in fostering creativity. According to Shalley et al. (2000), environments of autonomy, complexity, and high demand fosters creativity much more than concrete and organized environments. According to this study, curriculums should form education around conditions that allow for autonomy more than rule-based concreteness. Eisenberger & Rhoades (2001) shows schooling should incorporate reward to encouraging creativity. Zhang (2018) shows that genetics can predispose people to creative characteristics, suggesting the future possibility of inducing creativity in children through a medical procedure.

The neglect to account for cultural and environmental factors makes the correlation between reward, environment, and training to creativity stronger than that of age and genetics to creativity. Thus, while it is evident that innate characteristics predispose children to creativity, environment, training, and reward essentially activate creative behavior in children already predisposed, but creativity is likely not limited to people with genetic predispositions.

The studies evidence that creativity can be genetically predisposed, however environment, training, and rewards have greater impact on creativity than genetics. Thus, being creative is not solely determined by heredity, but can be fostered in the right conditions.

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