Review Article

Is Artificial Intelligence Creative?

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ABSTRACT

Artificial Intelligence (AI) has been quickly popularized within the past few years, leading to a conversation on whether or not AI is creative. Human creativity is multifaceted, with many theories focusing on specific aspects of creativity with the measurement evaluating the originality and usefulness of ideas. AI generates its output by imitating and learning from data that it is given, which leads to problems within the product. Yet, AI does perform well at select creativity tests. We discuss various creativity theories and tests within humans and AI, and find that AI's lack of key factors, such as intentionality, differentiates it from human creativity. We argue that AI doesn't exhibit true creativity and instead only emulates it.

Keywords: creativity; artificial intelligence; creative technology; intellectual property; generative AI

INTRODUCTION

Creativity is the ability to create novel and useful ideas, allowing us to adapt to changes, solve problems, and express ourselves. It fuels invention and innovation, changing the convenience and quality of life, and helps us integrate different ideas into their thought process to have flexibility in thinking.

AI refers to computers that learn, create, and exhibit other forms of intelligence. In the past decade, AI's ability has been accelerating dramatically, transitioning from being able to perceive images to being able to generate them (20). With Chat Generative Pre-trained Transformer (ChatGPT)'s public release in 2022, AI is increasingly integrated into daily life. Microsoft's search engine Bing now utilizes ChatGPT, with Google using Bard– another GPT (25). With the traditional definitions of creativity, however – originality and effectiveness – it is hard to make distinctions between human and AI (21).

This popularization of AI leads to conflict on protection of intellectual property. Much of the AI's training is based on scraped data; data that is collected by a computer from the internet. Data scraping is legal if the data is publicly available, so currently creators are privy to their works being freely used for AI. Professionally, generative AI might lead to lowered jobs in creative fields. The concerns in the field are impactful, as shown in the 2023 Writers Guild of America strike which demanded contractual protection against AI. This clause intended to prevent corporations from using writers' work to train AI without consent or compensation (10). AI's creativity, or lack thereof, is critiqued heavily for its authenticity and

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Received September 1, 2024**; Accepted** October 4, 2024
https://doi.org/10.70251/HYJR2348.23105111

need for a human basis for its output. Overall, there has been a call for intellectual property laws to be extended to protect against AI.

The argument against regulation compares AI and human intelligence. AI uses data to create outputs and humans are influenced by other people. Creators either subconsciously or overtly take inspiration from other existing works, and it is argued that AI data processing should be treated the same. Therefore, AI doesn't infringe on intellectual property.

Therein lies a question: is there a fundamental difference to the way AI creativity and human creativity works? To start, however, we must evaluate how AI and human minds are creative, and then the similarities and/or differences in those processes. There are many theories of creativity, some encompassing humans and AI and some individual to each of them. There are various creativity tests, focussing on different aspects. In this paper, we will compare human and AI creativity by first establishing the content and benefits of different theories and tests, and also argue for a more qualitative comparison. We will highlight implications for the future such as: application of AI, the impact on creative fields, potential conflicts of privacy, and debate over intellectual property from the data-gathering process.

THEORIES OF HUMAN CREATIVITY

There are many existing theories and facets of human creativity, which makes it difficult to treat and test it as an entirely consistent concept. However, exploring a plethora of theories, as well as their merits and faults, helps build a comprehensive understanding.

Four P Model

The Four P model, proposed by Mel Rhodes (1961), divides creativity research into four categories: 1) Product, the measurement of the outcome by traditional standards, 2) Person, the personality of the creator, 3) Process, the means of creativity, and 4) Press, the outside influences that affect the creator (19). The Four P model sets a good baseline for the main topics covered throughout the theories of creativity.

Divergent Thinking

Many conceptualizations of creativity focus on divergent thinking, which refers to the ability to think of many different ideas and is strongly correlated with creativity. Divergent thinking attributes include flexibility, originality, and uniqueness (17), and is constrained to situations in which there is a goal. Therefore, it might be a good candidate for comparing human and AI creativity because generative AI is based on instructions. Divergent thinking has been tested through word fluency, the generation of new mathematical proof, painting pictures, and unexpected behaviors (24).

Dual Pathways

Divergent thinking doesn't encompass all of creativity and solely focusing on it leaves out crucial elements, such as convergent thinking which is defined as the prioritization and evaluation on the value of ideas (11). The dual pathway of creativity model focuses on both flexibility and persistence. Flexibility is often associated with divergent thinking, and persistence associated with convergent thinking. Creativity requires out of the box thinking and finding new pathways to problems, which is represented with the concept of flexibility. Persistence is vital as it embodies the focus and determination needed to get to a solution. (28). This collaboration between the two factors shifts the emphasis from generation of ideas to the quality and relevance of the ideas. This theory of creativity focuses on the practicality of the output which can be measured with tests like the Alternative Uses Task (8), which prompts the testee to think of unique uses of common items.

Big-C and little-c Model

The Big-C and little-c model distinguishes between large goal-oriented creativity and more nondescript instances of creativity. Big-C is defined as clearly defined creative achievements. Measuring Big-C creativity involves the measurement of impact and achievements; For example, measuring the length of a creative's Encyclopedia entry. Little-c on the other hand, is more discrete day-to-day forms of creativity, leaning away from analytical ability and more so free and imaginative thinking (23). This model similarly to the dual pathways model takes intentionality into account, but also emphasizes more the difference in impact. However, the Big-C and little-c model doesn't consider the importance of one over the other, unlike the importance of flexibility and persistence's interaction.

Componential Model

The concept of little-c serves as a basis for the componential model of creativity, due to the componential model being based on everyday tasks. The componential model is driven by three variables: expertise, creativity skills, and intrinsic motivation. Expertise is knowledge,

technical skills, and specialized talent while examples of creativity skills are non-rigid thinking, self-discipline and risk-taking (1). Measuring creativity with the componential model involves existing skills and talents that could be applied when being creative. For example, contributions to patents, papers, and other professional works show skill and innovation.

Neuroscience of Human Creativity

When mapping the brains of different types of creatives (literary, visual, musical) using fMRI and PET, Chen and colleagues (2020) observed that there was activation present of certain brain areas specific to the type of artist. In this study, the participants were given various tasks to do in the scanner (e.g. creative writing, creating cover illustrations, and musical improvisation). In musicians across various musical tasks, they observed greater activation in the left inferior frontal gyrus and supplementary motor area, and the brain regions essential for musicianship are highly developed, particularly those involved in understanding musical semantics (3).

Across the different types of artists, all participants showed activation in the pre-supplementary motor area, left dorsolateral prefrontal cortex, and right inferior frontal gyrus. Due to the overlap, the authors concluded that these areas are associated with creative processes. These conclusions support the componential theory of expertise and creativity skills by demonstrating that, despite exclusive activity to different types of creativity, there are general patterns of brain activity associated with creation.

Socio-Cultural

Outside experiences such as the culture and society affect creativity in a multitude of ways. Social influences like movements (artistic or intellectual) can also influence the creativity of the period. The Enlightenment (1685 - 1815), for example, was focused on science which was reflected in the rapid innovation in technology and science. The Enlightenment wasn't without its opposition and was soon contrasted with the Romantic Movement (1798 - 1837). Romanticism is well known for its artistic pieces and poetry, and there are many similar themes throughout pieces of the time (11) such as power of nature and the soul. The shift in ideologies and the subsequent change in creative output shows the power of movements in creativity.

Different cultures also find contrasting importances in creativity, and therefore influencing perception and expression. Eastern countries often appreciate morality, contribution to society, and traditionalist elements (16). These societal influences impact people's goals and perceptions in creative tasks, for example, those in a more individualistic society might express their creativity with less consideration to the benefits to society.

Glăveanu (2020) proposes a theory that outlines how these socio-cultural differences also affect creativity. This theory focuses on the creativity involved in developing solutions in conflict situations . The central idea revolves around differences between social groups or other factors in the environment. The perception of being surrounded by difference, such as differences in perspectives, creates the need of creativity to solve the dissonance. Therefore diversity "[works] as an engine for our creative expression." (6, p. 343)

Measurement of Human Creativity

Taking all these theories into account, there is no definitive agreement on how to measure and define human creativity. There are many proposed methods of being able to test creativity. For example, the Alternative Uses Task, as previously explained, is useful for practical creativity. However, this test and similarly goal-oriented tests only assess creativity in finding solutions, and do not encompass the type of creativity that has no functional usage (4). Another approach is self-surveys, where participants rate themselves on their creativity, while this method is reliable, it doesn't provide an objective way to compare humans to AI (22).

On the other hand, the Torrance Test of Creative Thinking (26) tests creativity with a verbal section and a nonverbal section. The answers in each section are evaluated to produce scores in three factors: Fluency, Flexibility, Originality. The criteria also imply conceptual importance of these mental characteristics in creativity. The Torrance Test isn't purely focused on divergent thinking, and it also takes into account personality and intelligence. It has good reliability and validity (12), providing a strong basis for developing ways to evaluate human and AI creative output.

MECHANISMS OF AI CREATIVITY

How does AI process data? Generative adversarial networks (GANs) models, such as ChatGPT, are based on training and feeding data into a generative algorithm and analyzing and imitating patterns (14). GANs consist of two components: a generator that creates synthetic data and a discriminator that attempts to distinguish between real and synthetic data. This iterative process fine-tunes

the generator, improving its ability to produce realistic results (7).

PROBLEMS WITH AI CREATIVITY

Breaking the Pattern

GANs don't understand given inputs, but instead predict the answer in an algorithm., which can lead to many problems with image generation. An amusing example is the "Chopstick Dilemma." When asking ChatGPT to create a photo of ramen, ChatGPT struggles to create the photo without a pair of chopsticks. This is mainly due to training data bias –photos of ramen usually have chopsticks in the frame– and lack of understanding of what chopsticks are, showing that AI lacks awareness and comprehension (2). With simple image generation there aren't outstanding consequences, but with artistic and creative outputs the inability to break out of the pattern leads to claims that AI works aren't transformative. Within AI generated works, there is also the dilemma of bias within patterns. With a lack of understanding and mindfulness, AI often regurgitates implicit biases within results (15).

Hallucinations and Inaccuracies

Furthermore, GANs such as ChatGPT are subject to hallucination: the creation of inaccurate content. Emsley (2023) recounts trying to consult ChatGPT for help on research, and receiving not only false information but also false references. Suspicious, "I questioned ChatGPT about previous studies whose content I was familiar with, including my own, as a test of accuracy. Some of the answers provided were patently incorrect. The problem therefore goes beyond just creating false references. It includes falsely reporting the content of genuine publications…the veracity of any content inputs provided by ChatGPT cannot be trusted" (5, p. 1). Within research and academic works these hallucinations shouldn't be a problem as it is against most academic policies to use AI, but despite these policies there is concerning evidence of mass use of Large Language Models (LLM, e.g. ChatGPT) within the scientific community. Words that LLMs use at a higher frequency than humans –pivotal, intricate, showcasing, realm– has seen a drastic increase in scientific papers after the launch of ChatGPT (13).

Alternative Models

Alternatives are being developed to solve these problems; hallucinations and lack of awareness, such as the AICAN model at Rutgers. This model tries to emulate the way artists observe existing works when the artist creates their own style. The AICAN focuses on using stylistic ambiguity to try and create originality (14). Similarly the researchers are working to create an AI with an reasoning approach: an approach that focuses on making AI that can think like humans by having the ability to comprehend it's inputs. With this AICAN model, AI could be generalisable as well as be intentional.

MEASUREMENT OF AI CREATIVITY

Turing Test and its Problems

One of the most popular and long standing measurements of computer intelligence is the Turing Test (TT) was developed by Alan Turing in 1950, where he states that a computer would be considered intelligent if it can mimic humans. A common set up for the test is for an interrogator to have a conversation with a human and a computer. If the interrogator cannot tell which is which, then the computer is intelligent (27). AI models imitate human intelligence effectively, but the TT has been called into question if it still should be used in the context of AI and creativity. The problem with the TT is that creativity isn't just based on distinguishability. The Turing Test fails to take into account the processes behind human creativity that are missing within AI, as well as the lack of intentionality within emotional expressions such as art. Creativity cannot be evaluated purely on its results. There are many other problems with the Turing Test: it penalizes different expressions, doesn't factor in context, and rewards lack of substance (18).

Alternative Tests

Pease & Colton (2011) proposes two alternatives to the Turing Test:

1) The FACE model factors in various concepts, such as the way a piece of art is created, the aestheticism, the expression of ideas, and more. In short, it takes into account the intellectual value of the elements in the output, which is then weighed against the execution of the concept. In short it scores based on if the concept is complex and if the execution realizes the concept.
2) The IDEA model outlines how to quantify impact of creativity, by polling an audience on different factors such as cognitive effort, well-being, and other emotions/thoughts. These concepts are quantified into one singular value.

These models emphasize the ideas within art and how those ideas are expressed. The FACE model evaluates the

thought process and intentionality of the elements within the work to determine artistic merit. The IDEA model evaluates the emotional impact on the audience, but might be more inconsistent due to differences in tastes. However, it can serve as a good indicator of the effect the artist's personal expression has to the viewer.

DISTINCTIONS BETWEEN AI AND HUMAN CREATIVITY

Quantitative Comparisons

Generated Ideas. When taking the Torrance Test, AI got within the top national percentile for fluency (the amount of relevant and useful ideas) and scored similarly high in every other factor. AI's originality score showed a performance that was impressive and on par with humans (9). AI therefore can create ideas with fluency, originality, and flexibility to the same degree or higher than humans can, and often is very good at achieving the task assigned to it by the Torrance Test.

Utilization and Adaptability. AI can be stuck in learned patterns, as seen in the Chopstick Dilemma, but humans can also be stuck in their former knowledge. For example, functional fixedness refers to the tendency of being unable to use a tool beyond its conventional purpose. While we might expect AIto be creatively restricted, AI has scored significantly higher than the control group in flexibility (9). AI is much more versatile than humans in some aspects; a singular AI image generator is able to switch though a variety of styles and generate outputs at a much higher rate.

Product or Process?

Differences in creative processes still lend to AI not being truly creative. While AI is fast and performs well, the GAN model is lacking in many concepts that ultimately set it apart from human creativity. When talking about non-goal oriented creativity, human works have cognitive process and intentionality within emotional expression. As for goal-oriented creativity, conscious decisions lead to a deeper understanding and efficiency of the solution. Despite these quantifiable justifications of AI creativity, we argue that the processes behind the product are more important than the product itself.

Consciousness and Intentionality. Human consciousness understands context and purpose when drawing inspiration or creating works. AI isn't a conscious system and has no way of thinking about the reasons behind its generated works. People can have different perspectives of one work, which reflects in the subsequent interpretations. While GANs are powerful tools there is absence of intentionality in the result. They lack self-awareness and the ability to understand or reflect on the reasons behind the outputs they generate. They operate based on patterns in data rather than any form of intentional thought. (14).

Traditional definitions of creativity often emphasize originality. Since AI operates by recognizing and replicating patterns found in existing data, it raises questions about how original its outputs truly are. While human creators may use patterns as well, it can be interpreted as stylistic choices purposefully to evoke specific feelings or ideas. Patterns in art are not inherently negative, when human artists use patterns it is often thought through or due to personal preferences. AI just doesn't have the capacity to break out of its patterns. The absence of intent in AI outputs can make it difficult to claim those outputs as genuinely creative.

Identity and Socio-Cultural Factors. The Four P model previously discussed established that the Person, identity and personality, is one of the instrumental elements in creativity (19). AI has no personal identity and life to pull emotion from, and lacks many of the elements present in the four P models. Those factors are important in evaluating creativity and meaning. AI and human created outputs might seem indistinguishable, but due to AI not having most of the components of the four P model, we maintain that it doesn't produce creative works.

AI is impacted by socio-cultural factors differently than humans. It learns from data sets that humans create, and would also be influenced by cultural influences within the data. The problem with this is that AI does not share the full human experience and can't draw from a personal experience with culture. Instead it consolidates a large amount of different data points, making it unclear the exact cultural influence of the work. AI also doesn't represent culture in its fullest due to this amalgamation and lack of distinction.

CONCLUSION

The variety in human experience, identity, and thought leads to creativity. The art and writing that AI is able to generate doesn't transform its data in a meaningful way. There are fundamental differences to the way human creativity works, which introduces a person's own intentionality within the art that isn't available in AI models. AI is useful and can lead to wonderful improvements to the quality of life, but the issue arises when we treat AI and human creativity in the same light. AI is not creative in the same way humans are, but instead

should be considered generative.

Concerning the distinctions between AI and humans is the problem of intellectual property. The data used to train AI is hard to trace down and identify, so errors and problems are hard to isolate and fix.With the way AI models are trained, it is difficult to give credit for the original creator especially within popular and efficient GPT models. This is due to the fact that they're trained on such a massive amount of data, making the sources hard to trace. So rather than accreditation being required, it is more practical to require the consent of the data owner and/or compensation for the data being used. Another problematic aspect about AI is the privacy concerns: the accumulation, storage, and use of personal information without consent. In order to protect privacy and intellectual property, generative AI needs to respect the sensitivity of its data by not using data with personal information or accumulate potentially sensitive data without consent(15).

AI as a tool has the capacity to make life easier and more efficient, however due to numerous conflicts it's important to regulate the data collection process and not conflate AI generation with human creativity.

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