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Detlef Schwarting

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Artificial Intelligence and Creativity

Can AI Ever Be Creative?

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1. Introduction (Panida Naowarat Nowa)

Artificial Intelligence or AI is the combination of science and engineering of creating intelligent machines and computer programs (McCarthy, 2007). AI aims to emulate what minds are capable of (Boden, 2016). Its task is thus similar to that of using computers to comprehend human intelligence (McCarthy, 2007). Many different techniques are employed by AI in order to address a variety of tasks, making it possible to be utilized in a wide range of areas (Boden, 2016).

As AI continues to grow, a multitude of fields and processes benefited significantly from its technology and development. Still, despite its increasing popularity and usefulness, AI also raises discord and concern in numerous areas in which it is applied, including the creative field.

Since its appearance, AI has been sparking several controversies among artists and non-artists alike (Metz, 2022; Roose, 2022; Shaffi, 2023; Sung, 2022). In more recent events, during the annual Colorado State Fair's art competition, Jason M. Allen of Pueblo West, Colorado, won first place with his AI generated piece "Théâtre D'opéra Spatial" (Metz, 2022; Roose, 2022). This caused backlash and debate on several social media platforms, as commenters expressed their disagreement with the outcome and the AI itself (Roose, 2022). While there are some who voice their displeasure due to misinformation, a majority of the comments address concern for the future of the creative industry. Furthermore, there are also some who claim that creating art through AI does not make one an artist, as the art piece is not created by humans, and it is the AI which is the actual artist (Metz, 2022; Roose, 2022). Besides, the ease of use has also led to the statements that creating AI art does not take any effort or creativity, which further distances the users from being included in the creative communities (Shaffi, 2023).

While many discarded the idea regarding creativity and artistry not being involved in the process of creating AI art, there are some who defended Allen's work and argued that the process of creation still requires human involvement and creativity by fine tuning, curating the results, and utilizing subjective art experience, especially due to the possibility of further editing or enhancing the outcomes to achieve even more desirable and derivative results (Metz, 2022; Roose, 2022).

Regardless of the backlash, Allen still got to keep the first-place ribbon and prize money, as a spokesperson, which oversees the state fair, stated that Allen had disclosed the involvement

of the AI used to create the work (Roose, 2022). Although it seems like 2 of the judges were not entirely aware that the piece was AI created due to not being familiar with the named program being an AI. According to their statement, they still would have awarded the first place to Allen's piece even if they had known (Metz, 2022; Roose, 2022).

The way AI is actually able to create art is by using algorithms to recognize or learn a specific aesthetic (Heikkilä, 2022). It needs a database, which it gets from training of multiple sets of images, that are then output into "models" for the AI to use afterwards (DreamStudio, n.d.). When using the AI, it creates the images by taking a prompt which is usually either a combination of keywords or a full descriptive sentence that describes the desired outcome, similar to a caption or title (DreamStudio, n.d.; Stable Diffusion, n.d.). Users may include or exclude certain prompts and further change settings of the AI to achieve different results (DreamStudio, n.d.).

For many of the models currently in use, this was done by using images from various platforms and artists, which is currently still one of the main points of controversy involving AI art, as many artists are displeased that their works were used to train the AI models without their knowledge and consent (Heikkilä, 2022; Penava, 2023; Shaffi, 2023; Sung, 2022).

Generally, many opinions are still split on the acceptance of AI generated images despite the great possibilities of AI art. All these points and controversies together lead to the research questions; Can AI be as fully creative as a human? Is the creativity of AI comparable or potentially superior to human creativity?

2. What is Creativity (Panida Naowarat Nowa)

As part of answering the questions outlined above, it is crucial to understand the nature, definition, components, and types of creativity.

According to Sääksjärvi and Gonçalves (2018), an essential component of new products and services is creativity. It is also a prerequisite for innovation, especially in today's competitive environment, where the need for creative ideas has never been greater. Various strategies have been developed and proposed to facilitate idea generation in order to keep up with the constant demand for new ideas.

In addition to being relatively trendy and popular, the term “creativity” can be considered very confusing and is often being misunderstood, therefore, defining the term can be somewhat challenging (Gabora, 2013; Kampylis & Valtanen, 2010). Creativity originates from the Latin word “creatus” which means “to make” or “to produce” (Kampylis & Valtanen, 2010).

In accordance with Oxford Learner's Dictionaries, creativity is “the use of skill and imagination to produce something new or to produce art” (Oxford University Press, n.d.-a). However, as one of the most complex human behaviors, creativity can be influenced by a wide range of social, educational, and developmental factors (Runco & Sakamoto, 1998). This results in different forms of creativity across a number of disciplines (Al-Ababneh, 2020; Runco & Sakamoto, 1998). There is creativity in fields as diverse as business, economics, science, technology, medicine, engineering, psychology, sociology, or even in education, and not just fine arts, literature, architecture, performing arts, music, and similar artistic domains (Al-Ababneh, 2020; Amabile, 1997; Cropley, 2020). Besides tangible objects like artworks, books, or music, its products spread beyond the physical to include ideas, processes, services, and methods (Cropley, 2020).

It is possible to achieve concrete results; for instance, creating works that are beautiful or imaginative, designing and developing new or existing equipment, machinery, buildings, structures, concepts, processes or systems, as well as abstract actions such as arousing aesthetic admiration, conveying a feeling, developing a new understanding of experience or existence (Al-Ababneh, 2020; Cropley, 2020). According to Al-Ababneh (2020), there is no consensus concerning where creativity lies. It can be located anywhere, in a process, in a

product, or in an individual. The amount of creativity can vary from a slight change to a complete transformation.

Aside from the definition in the Oxford Learner's Dictionaries, creativity has also been defined differently in several studies. Despite that, its definitions have been comparatively ambiguous and rather unclear.

In research by Stein in 1953, he was the first to define the term in an entirely unambiguous way, the definition that has later been specified as the standard definition of creativity (Runco & Jaeger, 2012). He described a creative work as "... a novel work that is accepted as tenable or useful or satisfying by a group in some point in time" (Stein, 1953, p. 311). Creativity has thus been concluded as a combination of novelty or originality, and usefulness or effectiveness (Runco & Jaeger, 2012).

Due to its complex nature, many researchers over the years have attempted to expand the definition further, by proposing many more dimensions, such as surprise (Bruner, 1962; Simonton, 2012), unexpectedness (Gero, 1996), un-obviousness (López-Mesa et al., 2009), worthwhileness (Cropley, 1967), elegance (Besemer & O'Quin, 1999), arousal (Horn & Salvendy, 2006), compellingness (Cropley, 1967), relevance (Cropley, 2020; Kneller, 1965), meaning (Sääksjärvi & Gonçalves, 2018), affect (Horn & Salvendy, 2009), cohesiveness (Chiu & Shu, 2012), ethicality (Cropley, 2020), and so forth. Contradictorily, some have also attempted to reduce the criteria to just originality (Corazza, 2016; Weisberg, 2015).

Nonetheless, the standard definition by Stein (1953), consisting of originality and effectiveness, is still the most commonly encountered and considered to be the most balanced in identifying the prerequisites for achieving creativity so far (Corazza, 2016; Gabora, 2013; Runco & Jaeger, 2012). Hence, this definition would serve as our point of reference in this report.

2.1 Creativity and Its Components

2.1.1 Originality

According to Oxford Learner's Dictionaries, originality can be defined as "the quality of being new and interesting in a way that is different from anything that has existed before" (Oxford University Press, n.d.-c). Additionally, many previous studies have also referred to originality as novelty (Runco & Jaeger, 2012). It is unquestionably essential to be original in

order to be creative (Al-Ababneh, 2020; Runco & Jaeger, 2012). A creative idea has to be unique, unusual, novel, and unheard of, making it stand out among similar ones of its kind (Amabile, 1996; Amabile, 2001; Corazza, 2016; Guilford, 1950; Sääksjärvi & Gonçalves, 2018; Stein, 1953). If it is unoriginal, then it is mundane, conventional, commonplace, and hence not creative (Runco & Jaeger, 2012).

Even though originality is essential for creativity, it is not solely sufficient (Guilford, 1950; Runco, 1988; Runco et al., 2005; Runco & Jaeger, 2012). The originality of an idea or product may be useless, as even a chaotic combination of words thrown together by an animal on a word processor can contain originality (Runco & Jaeger, 2012). Thus, a creative idea has to adapt to reality to a certain extent (Barron, 1955). Therefore, another criterion is then needed.

2.1.2 Effectiveness

To exclude unusual products or ideas that are accidental, random, or result from ignorance or deception, an element of effectiveness is required above simple originality for creativity to succeed (Barron, 1955; Cropley, 2020; Runco & Jaeger, 2012). Oxford Learner's Dictionaries defines effectiveness as "the fact of producing the result that is wanted or intended; the fact of producing a successful result" (Oxford University Press, n.d.-b). To be effective, an idea or product must address the problem and provide a real solution (Cropley, 2020; Sääksjärvi & Gonçalves, 2018).

Similar to originality, effectiveness can take a variety of forms and may also be identified as usefulness, appropriateness, fit, as well as utility (Runco & Jaeger, 2012). In the economic research on creativity, effectiveness takes the form of value, as it discusses how original and valuable products and ideas are affected by the current market, particularly the costs and benefits of contrarian thinking (Rubenson, 1991; Rubenson & Runco, 1992; Rubenson & Runco, 1995; Runco & Jaeger, 2012; Sternberg & Lubart, 1991).

2.2 Types of Creativity

According to Boden (1992), creativity can be classified into three categories; combinational creativity, exploratory creativity, and transformational creativity.

2.2.1 Combinational Creativity

Combinational creativity involves exploring unusual, improbable, original (novel) combinations of known ideas (Boden, 1992; Boden ,1998; Boden, 2003). This type of creativity can be achieved simply by linking together ideas that were indirectly related and had never occurred before (Boden, 1992; Boden, 2003). Hence, combinational creativity can be considered as the easiest of the three types to achieve by humans (Boden, 2003).

According to Ward and Kolomyts (2010), there are a number of elements that make up combinational creativity, including words, images, sounds, as well as more abstract elements like musical styles, artistic genres, and so on. Combinational creativity is usually achieved through noun-noun combinations (Han et al., 2017). Its results can range from visual collages, poetic images, scientific analogies, to new inventions like the "Apple Watch" that combines the concept and function of watch and mobile phone (Boden ,1998; Boden, 2003; Han et al., 2017).

2.2.2 Exploratory Creativity

Non-combinational creativity, however, involves the generation of original ideas through the exploration of conceptual spaces that are governed by certain rules (Boden, 1992; Boden, 1998; Han et al., 2017; Riedl & Young, 2006). Conceptual spaces are generally somewhat disciplined, culturally valued ways of thinking, such as writing and painting styles, music genres, choreography systems, couture habits, or even subfields of chemistry, biology, or mathematics (Boden, 1992; Boden, 2016). These stylistic rules are practically unconsciously applied and used to generate new original ideas (Boden, 2016).

Conceptual spaces contain a wide variety of thoughts, even if some of them never cross our minds (Boden, 1992). The process of conceptual space exploration can then help to uncover some of these thoughts. In addition to being original, the results of this process are also surprising in the way that we had no idea so much potential and possibility existed in this space (Boden, 1992; Boden, 2016).

This may involve a minor modification in dimensions or even addition of other superficial dimensions to the conceptual space (Boden, 1992). A clear example of this type of creativity would be an improvement on the existing object, such as inventing different flavors of a particular snack (Han et al., 2017).

2.2.3 Transformational Creativity

Transformational creativity, on the other hand, involves a transformation of conceptual space to create ideas in new thinking styles (Han et al., 2017). According to Boden (2016), transformational creativity can be seen as the successor to exploratory creativity and is typically encouraged by frustration with the limitations of the current style.

With this type of creativity, individual or multiple constraints are drastically changed, removed, replaced or added, in order to produce previously unattainable unique structures (Boden, 1998; Boden, 2016). The results are often immensely surprising as they seem impossible due to their incompatibility with the previously accepted paradigm (Boden, 2016). In extreme cases, a drastic transformation may make it difficult to discern the relationship between the previously accepted and the new conceptual spaces (Boden, 1998). Hence, the newly generated structures will be incomprehensible and most likely will be rejected. Nevertheless, in order for them to be accepted, they must be understandably close to the previous paradigm, and in some cases, this recognition process can take years to achieve (Boden, 1998; Boden, 2016). Picasso's masterpieces are thus great examples for transformational creativity (Han et al., 2017).

Altogether, exploratory and transformational creativity blend into one another due to the fact that exploring conceptual space can involve minor adjustment to relatively superficial constraints; both forms of creativity are, therefore, intertwined. An adjustment can be distinguished from a transformation to a certain extent, but the clearer the space is defined, the more distinct the distinction can be (Boden, 1998).

3. Can AI Ever Be Creative? (Mara Johanna Landwehr)

It is very hard to come up with an ultimate definition of creativity. To establish a universally valid definition would try to limit the unlimited field of creativity. But when the term creativity is not defined, it is rather unpossible to analyze if Artificial Intelligence (AI) can be creative (Käde, 2021).

And it is also not possible to define clear borders between intelligence and creativity. There can be intelligence without creativity, but no creativity without intelligence (Käde, 2021). It seems to be that creativity and intelligence maintain an uneven relationship. So can AI be creative, because it is considered intelligent?

Interestingly copyright does not require a certain degree of intelligence to create a copyright. Creating a copyright on something is only a matter of establishing a personal, intellectual creation (Käde, 2021), no matter how intelligent its creator might be considered. Right now there is no clear answer, if AI should be able to achieve copyright for its creations and the legal circumstances around this question are very different in every country.

Assuming that AI can be truly creative, what about the worth of human creativity? In fact the notion of creative AI undermines the idea of a genius human artist and their unique ability to create originals (Zeilinger, 2021). If AI could be creative, its creativity would be as worthy as a human's creativity.

But how can AI itself really be creative, when even the most sophisticated machines, that produce art, are human made? These machines are an execution of a human will to create (Engenhart & Löwe, 2022). According to that, every AI-created artwork must imply the existence of an AI-author (Zeilinger, 2021). So is there even a technical way to be machinally creative without the impact of a human?

When thinking about this there is a given theoretical perspective. When asking if AI can be creative it is always a comparison with human creativity (Engenhart & Löwe, 2022). So the question is more pointed to if AI can be creative in a way humans are or do humans have special features, a machine can not recreate.

To approach the question, if AI can ever be creative, the two main criteria of creativity, as Mark A. Runco and Garrett J. Jaeger define them in their definition of creativity, will be utilized. Those criteria of creativity are originality and effectiveness (Runco & Jaeger, 2012).

In the following, with the help of originality and effectiveness, creative Artificial Intelligence and human creativity will be set in contrast.

3.1 Originality with AI

For creative work the term originality might express the need for something unusual or unique (Runco & Jaeger, 2012). As previously mentioned, the definition of originality in the Oxford Learner's Dictionary is it being the quality of something being new and interesting in a way that is different from anything that has existed before (Oxford University Press, n.d.-c). According to this, AI can only be creative, if it is able to produce true originals that have never existed before, are interesting and unique.

A lot of programs that attempt to be creative use generative grammar. Generative grammar consists of a set of rigid production rules, which it needs to follow when it is creating a creative output. Such generative grammar based programs are therefore limited within the options of their output (Rowe & Partridge, 1993). Using generative grammar, a program is not able to break through its production rules, as a human could randomly do. Because of that there naturally seems to be a wider range of options for human creations in comparison to machine creations.

Another point to the hypothesis, that Artificial Intelligence can not be as creative as humans, lies in the genesis of an idea. It contains the author's engagement with the subject, which may be shaped by his or her own experiences, accessible knowledge, emotions and feelings, but also by his or her consciousness and self-awareness. And not at least by their intelligence and creativity (Käde, 2021). For sure, AI can access a lot of knowledge, much more than a human ever could and there may also be a way to translate experiences into information, AI can understand and use. But can it really understand the dimensions of emotions and self-awareness? There is no way a machine can feel in a way a human does. So there might be certain details in a creative production or the creative output itself, that occur randomly because of unplanned human emotions or influences through the authors surrounding. Could AI recreate that random influence?

> *"To my mind, influence, imitation, copying, and reusing are at the core of all artistic practice and (human) creativity" (Zeilinger, 2021, p.21)*

In this quote Martin Zeilinger states that humans don’t actually come up with original ideas nobody ever thought of before. In his opinion it is the other way around: the surrounding and

its influences have a rather great impact on a human's creative output. A human does unintentionally, but naturally imitate, copy and reuse elements he has already seen before while he is influenced by his surroundings. Therefore a human can not create more original art than an AI could, so AI could be as creative as a human author.

We often think that every human is naturally creative, but humans do learn methods like brainstorming to be creative as well. The same methods could also be used by machines. If creativity is understood as a method, not as a form of random inspiration, machines can be creative (Engenhart & Löwe, 2022). And if machines and humans use methods to be creative, none of the output can be more original than the other.

It is very much definable, how AI is able to create at its current development state. There are three types of creativity that can be done by machines: Combinational creativity, which is combining old things to create something new. Exploratory creativity, that finds new forms of expression with existing design rules. And transformational creativity, which is breaking design rules and coming up with quite unexpected solutions (Boden, 2016). None of those types create random originals without any sign of reference, which indicates that a machine can not be truly creative.

3.2 Effectiveness with AI

For creative work the term effectiveness might take the label of value (Runco & Jaeger, 2012). If an output is created in a very effective way its worth is therefore assumed rather high. As previously mentioned, the Oxford Learners Dictionary defines the word effectiveness as the fact of producing the result that is wanted or intended or the fact of producing a successful result (Oxford University Press, n.d.-b). According to that, AI would have to create a wanted, successful considered output in order for it to be assessed as creative.

As already discussed, many programs that attempt to be creative, use generative grammars. Those are limited because of the rigidity of their rules. You could give AI the permission to openly rewrite the rules to bring in more options, but it is nearly impossible to define rules for rewriting rules that keep randomness, but not only produce rubbish (Rowe & Partridge, 1993). According to that, trying to create true originals by implementing the possibility to openly rewrite grammar rules might not be considered effective, if the output is not considered a successful result.

But there are other perspectives that tend to the conclusion that humans and AI can be equally creative. Lisa Käde assesses the human creation process as an analogy to a machine creation process, where required action steps are already predefined or machines can add capabilities through learning algorithms (Käde, 2021). If humans and machines use the same methods and go through the same process to achieve creative output, there is a high possibility that they can create results that are equally successful. The current state of technology does even allow algorithms to learn and benefit from its learnings, similar to human brains.

Jon Rowe and Derek Partridge state that there are five necessary characteristics of machinal creativity. First, the knowledge needs to be organized. This maximizes the number of possible associations, which can also be understood as a form of creative potential. Second, multiple meanings in representations must be tolerated. It should be possible to link a situation to different concepts. Third, there is a need for multiple representations. It should be possible for a concept to be indexed to many situations. Fourth, the usefulness of new combinations should be assessable. And the fifth characteristic is that any new combination needs to be elaborated to find out their consequences in a process of verification (Rowe & Partridge, 1993). Those characteristics are quite similar to the human brain and its ability to sort and link information. Furthermore there is also the possibility to evaluate different concepts and connections. Through the similarities of humans and machines it seems plausible that both can create wanted and successful output, which is referred to as effective output.

4. Conclusion and Discussion (Mara Johanna Landwehr)

The debates around AI and its phenomena are currently very relevant and there is a lot of contemporary literature around it. In this elaboration the topic of creativity in Artificial Intelligence with the help of the questions “What is creativity?” and “Can AI ever be creative?” were discussed.

> *"... when an AI system isn’t just understood as a tool used by human artists, but as an agential entity capable of “creative” expression, this then problematizes not only aesthetic assumptions regarding the nature of creativity and author ship, but by extension also socio-economic and legal assumptions regarding the ownership or, indeed, the very “ownability” of such expressions" (Zeilinger, 2021, p.26)*

In this quote Martin Zeilinger sums up a main problem in the current debate around creativity in Artificial Intelligence. If AI is not only understood as a creative tool, which helps artists but isn’t an author itself, but as a creative author, legal aspects around copyright and authorship need to be changed. But there is no clear answer yet, if AI can be truly creative and seen as an independent creative author.

You always need to keep in mind that the theoretical perspective on this topic used in this elaboration is a comparison between creativity in humans and machines (Engenhart & Löwe, 2022). Also it is rather hard to generate an ultimate definition of the term creativity (Käde, 2021), so the definition of Mark A. Runco and Garrett J. Jaeger was used to get an introduction to the topic.

When asking if AI can truly be creative, a core question of originality is: Are even humans really capable of random originality in an effective way or do humans use specific methods and patterns to be creative, just as machines do? If humans can not create true originals, the answer to the research question would be: Yes, Artificial Intelligence can be as creative as humans can be. They both used certain methods to achieve a creation that is influenced by different factors. But if humans could create true originals, a machine could never be creative on the same level, as it always needs to use some kind of reference within creative methods.

The second criteria referred to when discussing the creativity of AI was effectiveness. Can machines be as effectively creative as humans can? Can they create an output that is considered successful? If humans and machines use the same paths and methods to be creative, like Lisa Käde (2021) assumes, but human creations are considered more successful

than machine made creations the answer to the research question would be: No, Artificial Intelligence can not be as humans.

But machines do not necessarily create output, that is considered unsuccessful. With a way of sorting and evaluating concepts and information (Rowe & Partridge, 1993) a machine could create valuable output.

All in all, it would need clarification on mainly two topics to definitely answer the question, if Artificial Intelligence can be creative. On the one hand is the very relevant question, if humans can create originals. On the other hand there is the question, what the criteria for an effective, wanted and successful creative result are. If those two questions can be answered there is a good possibility to also answer the question, if AI can ever be creative.
For now AI can not be considered as creative, as a human, because it lacks every form of feelings, self-awareness and other human characteristics that a machine can not duplicate yet.

An interesting question that could be investigated in the future is, if the fact of a human not knowing everything, unlike an AI that has nearly unlimited knowledge, is an important factor for true creativity.

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