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Anthropomorphism, perceived learning for creation, and growth creative mindset as predictors of acceptance toward artificial intelligence creativity

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Despite the steady increase in art creations generated by artificial intelligence (AI), few empirical studies have examined public acceptance toward AI creativity and the factors influencing this acceptance. This study investigated the relationships among AI anthropomorphism, perceived AI learning for creation, creative mindsets, and acceptance toward AI creativity. I conducted an online survey comprising 505 participants. The results showed that AI anthropomorphism, perceived AI learning for creation, and growth creative mindset were positive predictors of acceptance toward AI creativity. Those with higher levels of AI anthropomorphism, perceived AI learning for creation, and a growth creative mindset were more likely to have stronger acceptance toward AI creativity. The findings of this study shed light on the mechanism of acceptance of AI creativity and provide an opportunity to understand perceptions of human creativity.

Keywords
artificial intelligence creativity, artificial intelligence-generated art, anthropomorphism, perceived learning for creation, growth creative mindset

Article Highlights

- Artificial intelligence anthropomorphism positively predicted acceptance toward artificial intelligence creativity.
- Perceived artificial intelligence learning for creation positively predicted acceptance toward artificial intelligence creativity.
- A growth creative mindset positively predicted acceptance toward artificial intelligence creativity.

Artificial intelligence (AI) is defined as "the science and engineering of making intelligent machines, especially intelligent computer programs" (McCarthy, 2007, p. 2). Since the term was first used (McCarthy et al., 2006), remarkable advancements have been made, especially in the field of art, which has long been considered a human realm to which AI could not extend. In 2018, an algorithm-made painting, the portrait of *Edmond de Belamy*, was sold for USD 432,500 at Christies, a fine art auction house. This was a symbolic case that marked the beginning of AI art trading in the art market. Since then, AI artworks in painting and drawing have steadily continued to appear, and the emergence of AI art has raised a big question in our society: Can AI be creative? *Creativity* is defined as "the ability to come up with ideas or artifacts that are new, surprising, and valuable" (Boden, 2003, p. 1). Despite the old premise that creativity is a human trait, AI can produce artistic paintings and images that are astonishing. Long before the emergence of AI art, Boden (2003) mentioned that computers can operate in a way that seems to be creative.

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However, AI being creative and people perceiving AI as creative are quite different matters. According to a report on creative AI, more than 50% of participants agreed that AI was creative, but there were still various neutral and contrary opinions (Moruzzi, 2020). Recently, a study found that accepting AI as creative had a positive relationship with participants' evaluation of music composed by AI; the authors explained that different attitudes toward creative AI can lead to different evaluations of AI-produced creations (Hong et al., 2020). This finding highlighted that individual perceptions of AI creativity vary and that different perceptions lead to different evaluations of AI creations.

There is no universal definition of AI creativity. Amabile (2020) defined *AI creativity* as "the production of highly novel, yet appropriate, ideas, problem solutions, or other outputs by autonomous machines" (p. 351). It is imperative to explore the public's perception of AI creativity as it is clear that we will encounter a variety of new creations produced by AI in the future. Recent studies reviewing AI and art (Cetinic & She, 2022), and AI technologies and applications in creative fields (Anantrasirichai & Bull, 2022) have discussed various research topics and issues regarding AI-generated art. However, little is known about public perceptions of AI creativity, and, to my knowledge, the predictors of individuals' acceptance toward AI creativity remain unexplored. Thus, in this study I investigated possible predictors, such as AI anthropomorphism, perceived AI learning for creation, and creative mindsets, through a review of the previous literature. Investigating public acceptance toward AI should broaden knowledge of approval mechanisms for AI creativity and help us understand the way we perceive human creativity.

Qualitative research has found that people disapprove of AI's capacity to be creative and create art because AI lacks typical human characteristics such as feelings, intentions, and autonomy (Hong, 2018). When measuring anthropomorphism, human attributes such as intention, emotion, and free will are used. However, if people perceive AI as having feelings, intentions, and autonomy, will anthropomorphism make a difference? *Anthropomorphism* refers to "attributing properties, characteristics, or mental states to real and imagined nonhuman agents and objects" (Epley et al., 2007, p. 865). Scientists and engineers have been trying to develop a humanized, creative AI with autonomy. The Art and AI Lab at Rutgers University introduced AICAN, a nearly autonomous AI artist that can create new styles by learning from past artworks (Mazzone & Elgammal, 2019). Previous research has confirmed that anthropomorphism occurs in various contexts in human–computer interaction. People anthropomorphize nonhumans and objects, such as gadgets (Epley et al., 2008), computers (Shin & Kim, 2020), smartphones (Wang, 2017), and AI assistants (Li & Sung, 2021). There is evidence that anthropomorphism improves individuals' evaluation of interactions with nonhuman entities such as robots (Waytz et al., 2010). A previous study showed that the anthropomorphizing of robotic artists has a positive association with the evaluation of computer-generated art creation (Chamberlain et al., 2018). These findings indicate that anthropomorphism positively affects the assessment of a computer's creative works of art. However, the relationship between AI anthropomorphism and acceptance of AI's creative capacity has not been directly explored.

Creative mindsets refer to "beliefs about the stable-versus-malleable character and the nature of creativity" (Karwowski, 2014, p. 62). People who hold a *growth creative mindset* perceive that one's creativity can be developed and changed through effort, whereas those who hold a *fixed creative mindset* believe that one's creativity is fixed and innate, and, thus, unchangeable (Karwowski, 2014). Previous research has indicated that a growth creative mindset is positively associated with insight problem solving (Karwowski, 2014), task-approach achievement goal (Puente-Díaz & Cavazos-Arroyo, 2017), and solution quality and originality in creative problem-solving tasks (Royston & Reiter-Palmon, 2019). In contrast, a fixed creative mindset is negatively related to insight problem solving (Karwowski, 2014), and to solution quality and originality in creative problem-solving tasks (Royston & Reiter-Palmon, 2019), but is positively linked to other-approach achievement goals (i.e., showing competence to others; Puente-Díaz & Cavazos-Arroyo, 2017). Creative mindsets are connected not only with creative performance, as shown in previous research (Royston & Reiter-Palmon, 2019), but also with the way people perceive other people's creative capacity. Paek and Sumners (2019) found that teachers with stronger fixed creative mindsets are more likely to perceive students as having less creative potential. What about our creative mindsets toward nonhuman agents, such as robots and AI? Are those with a fixed creative mindset more likely to perceive AI as less creative? To my knowledge, the relationship between creative mindsets and perception of AI creativity has not yet been explored.

When evaluating artwork, people focus on artists' intention and messages (Jucker et al., 2014), and also on their efforts to produce the art (Kruger et al., 2004). Kruger et al. (2004) suggested an effort heuristic exists, in which people use effort to infer quality: When artists' efforts are more strongly perceived, people tend to evaluate their artwork more positively. Xu and Hsu (2020) found that participants evaluate AI artworks more positively when they observe AI making an effort to produce art, as human artists generally do. To create an artwork, AI algorithms learn and train as human artists do. AICAN is a representative example of AI's learning capacity for artistic creation (Mazzone & Elgammal, 2019), and it is based on a creative adversarial network (CAN; Elgammal et al., 2017). While learning 80,000 images from 500 years of Western art history without curation, AICAN was trained under two opposing forces: one that pursued the styles of given images and one that punished to prevent AICAN from imitating pretexting styles, namely, those of artists from 15th to 20th centuries (Mazzone & Elgammal, 2019). This explains the way AICAN is trained and consequently learns to achieve novel outcomes. The survey results of the Australian public's understanding of AI show various insightful findings regarding people's public awareness of AI. One interesting result is that people perceive AI as having the ability of autonomous learning and self-learning, which permits improvement by itself based on programming (Selwyn & Gallo Cordoba, 2021). Another qualitative research study also pinpointed that people perceive AI's self-learning as one of its capabilities (Alizadeh et al., 2021).

However, more important than simply knowing that AI can learn is the fact that people have different opinions about AI learning capabilities and its outputs. For example, Hong and Curran (2019) found that participants' evaluations of human-generated artworks and AI-generated artworks are not significantly different, regardless of their knowledge of who created the artworks. However, among various assessment criteria, when it comes to development of personal style, participants evaluate human-generated artworks more positively than they do AI-generated artworks (Hong & Curran, 2019). Therefore, it seems that people tend to believe that humans outperform AIs in terms of development of personal style. The finding implies that people have different levels of perception of AI's capabilities for creating something new. Developing its own styles is closely related to AI's capacity for creative works based on algorithm learning. In sum, some people might believe that AI's learning ability is restricted to merely recombining data or imitating human creations, while others might think that meaningful development and learning occur through algorithm learning, seeing AI learning as a foundation for meaningful creation. Therefore, it seems that individuals' perception of whether AI can produce artistic creations based on its own creative capacity depends on how much they believe in AI's learning capacity. In this study *perceived AI learning for creation* was operationally defined as the perception of AI algorithm learning as a process of learning preexisting data to create meaningful creations. It is assumed that perceiving an AI's learning capability might influence one's acceptance of AI creativity. Even though AI, machine learning, and deep learning (a subset of machine learning) are becoming more prevalent concepts in our society, few studies have explored people's understanding of AI's learning capacity, and, more precisely, whether people believe that AI is capable of actual learning and not just mere computation.

Aim of the Study

Taken together, the primary aim of my study was to investigate the predictors of individuals' acceptance toward AI creativity. Although there have been numerous studies on AI creativity, ranging from discussions of its more abstract concepts (Amabile, 2020; Boden, 2003) to examining technological implementation (Elgammal et al., 2017; Mazzone & Elgammal, 2019), few have investigated public acceptance toward AI creativity. I sought to provide empirical evidence of how individuals, as technology users, understand AI creativity, by focusing on AI anthropomorphism, perceived AI learning for creation, and creative mindsets. AI creativity is a broad concept that encompasses more than just the realm of art. Therefore, it should be noted that in this study I focused only on examining the acceptance of AI creativity in the context of visual art, where notable cases and discussions have emerged.

Method

Participants and Procedure

This study was approved by Ajou University's Institutional Review Board (IRB No. 202104-HB-003). Participants were recruited through an online research company's panel in South Korea and I obtained informed consent from them. This study aimed to explore public perceptions, which meant excluding art experts through asking filter questions: (1) "Have you ever received visual art-related degree(s)?" and (2) "Are you working in visual art-related fields?" The participants who were not screened out on this basis were provided with a series of questionnaires. The sample comprised 505 nonart experts, who received a participation fee of KRW 5,000 (~USD 4.00). Of the participants, 252 (49.9%) were men and 253 (50.1%) were women. Regarding age, 128 (25.3%) participants were aged in their 20s, 126 (25.0%) were in their 30s, 125 (24.8%) were in their 40s, 94 (18.6%) were in their 50s, and 32 (6.3%) were in their 60s. The mean age was 41.12 years (SD = 12.20).

Measures

Acceptance toward AI creativity was measured using the Attitudes Toward Creative Artificial Intelligence Scale (Hong et al., 2020), which assesses understanding of creative AI. The three items are "I think AI can be creative on its own," "I believe AI can create something new by itself," and "Products developed by AI should be respected as creative works," which are rated on a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*). Higher mean scores indicate stronger acceptance of AI creativity. Cronbach's alpha in Hong et al.'s (2020) study was .86. Cronbach's alpha in this study was .90, indicating high reliability.

AI anthropomorphism was measured using the five items developed by Epley et al. (2007). This measurement has been widely used to assess nonhuman anthropomorphism in human interaction contexts, such as gadgets (Epley et al., 2008), computers (Shin & Kim, 2020), and smartphones (Wang, 2017). The items (e.g., "AI has intentions") assess respondents' evaluation of the extent to which AI has intentions, experience, emotion, free will, consciousness, and a mind of its own. Items are rated on a 7-point Likert scale (1 = *not at all*, 7 = *very much*). Cronbach's alpha reported in a previous study was .81 (Epley et al., 2008). Cronbach's alpha in this study was .96, indicating high reliability.

Creative mindsets were measured using the Creative Mindset Scale (Karwowski, 2014), which comprises 10 items divided across two subscales: growth creative mindset (e.g., "Everyone can create something great at some point if they are given appropriate conditions") and fixed creative mindset (e.g., "You either are creative or you are not; even trying very hard you cannot change much"). Each subscale has five items rated on a 5-point Likert scale (1 = *definitely not*, 5 = *definitely yes*). Cronbach's alphas for the growth creative mindset and the fixed creative mindset were .65 and .76, respectively, in the study by Karwowski (2014). In this study, Cronbach's alphas were .79 and .82, respectively, which indicate good reliability.

Perceived AI learning for creation was measured by asking the extent to which individuals believe that AI algorithm learning is a process involving the actual learning of preexisting data aimed at meaningful creation. AI learning ability was assessed using three items I developed, which are measured on a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*): "I think AI algorithm learning can be the foundation for creation," "I think AI algorithm learning is just a recombination of data," and "Creations generated by AI are nothing more than an imitation or copy." Items 2 and 3 were reverse coded. Cronbach's alpha in this study was .63, indicating acceptable reliability.

Results

SPSS 26.0 was used for the data analyses. The means, standard deviations, and correlations among variables are summarized in Table 1. Perceptions toward AI creativity were positively related to AI anthropomorphism, a growth creative mindset, and perceived AI learning for creation. In contrast, a fixed creative mindset was not significantly related to an individual's acceptance of AI creativity.

Table 1. *Correlations Among Variables*

Variables	*M*	*SD*	1	2	3	4	5
1. Acceptance of AI creativity	3.26	1.52	1				
2. AI anthropomorphism	3.53	0.65	.65**	1			
3. Growth creative mindset	2.96	0.77	.21**	.13**	1		
4. Fixed creative mindset	3.90	1.06	.03	.10*	−.27**	1	
5. Perceived AI learning for creation	3.93	1.44	.54**	.55**	.01	−.09*	1

Note. AI = artificial intelligence.
* $p < .05$. ** $p < .01$.

Before conducting the regression analysis, the following assumptions were made: Normality was checked using skewness values (−.38 to .40) and kurtosis values (−.57 to .28), confirming a normal distribution of the data. The assumption of independence of the residuals was checked, and the Durbin–Watson value was 2.01, which was close to 2.0, indicating no autocorrelation. The assumptions of linearity and homoscedasticity were checked by examining plots, which indicated acceptable patterns. Finally, the tolerance values were greater than .10 (.89–.98) and variance inflation factors (1.02–1.12) were less than 10, confirming no multicollinearity problem. Stepwise multiple regression was performed using perception toward AI creativity as the dependent variable and AI anthropomorphism, growth creative mindset, fixed creative mindset, and perceived AI learning for creation as independent variables. The results indicated that three variables were significant predictors, whereas a fixed creative mindset was excluded from the model. According to the multiple regression analysis results, AI anthropomorphism was entered at Step 1, accounting for 42% of the variance, $R^2 = .42$, Adj. $R^2 = .41$, $F(1, 503) = 357.42$, $p < .001$. In Step 2, perceived AI learning for creation was entered, accounting for an additional 5% of the variance, $R^2 = .47$, Adj. $R^2 = .46$, $\Delta R^2 = .05$, $F(2, 502) = 218.20$, $p < .001$. In Step 3, growth creative mindset was entered, accounting for an additional 2% of the variance, $R^2 = .49$, Adj. $R^2 = .48$, $\Delta R^2 = .02$, $F(3, 501) = 157.33$, $p < .001$. As shown in Table 2, AI anthropomorphism was the strongest predictor of perception toward AI creativity, and perceived AI learning for creation and growth creative mindset were also significant predictors of perception toward AI creativity.

Table 2. *Stepwise Regression Analysis Results Predicting Acceptance Toward Artificial Intelligence Creativity*

	Step 1				Step 2				Step 3			
Predictors	*b*	*SE*	β	*t*	*b*	*SE*	β	*t*	*b*	*SE*	β	*t*
AI anthropomorphism	0.61	0.03	.64	18.91***	0.47	0.04	.50	12.71***	0.45	0.04	.47	12.19***
Perceived AI learning for creation					0.36	0.05	.27	6.83***	0.38	0.05	.28	7.24***
Growth creative mindset									0.32	0.07	.14	4.42***

Note. AI = artificial intelligence.
*** $p < .001$.

Discussion

In this study I examined the predictors of perception toward AI creativity. The results show that AI anthropomorphism, perceived AI learning for creation, and a growth creative mindset positively predict acceptance toward AI creativity. A fixed creative mindset, in contrast, is not significantly related to acceptance toward AI creativity. Among the independent variables, AI anthropomorphism has the strongest effect on the dependent variable. Those with higher AI anthropomorphism scores show a stronger level of acceptance toward AI creativity. This result is similar to previous findings (Hong, 2018). People who reject the idea of AI creating art believe that AI lacks human attributes, such as feeling, spirit, and effort (Hong, 2018). My results indicate that people have a strong tendency to infer human

characteristics when they perceive the existence of creativity. This finding is theoretical and has practical implications. For example, at an art auction, providing information about AI artists' anthropomorphic features might increase art consumers' positive attitude toward AI creativity, consequently influencing purchase intention as well.

Perceived AI learning for creation is another positive predictor of acceptance toward AI creativity. Those who have a more positive perception of AI learning exhibit stronger acceptance toward AI creativity. This finding implies that when people perceive AI algorithm learning as a basis for the creation process and the generation of something meaningful, they tend to approve more strongly of AI's creative intelligence. People believe that artists learn through following painting styles from the past to eventually create their own styles and genres. This assumption seems to apply to AI-generated art, as it does to human artists. There could be a huge gap between recognizing AI as a simple computing machine and as a self-learning entity. My result suggests that, regardless of the AI's actual learning capabilities or its excellence, how people perceive AI algorithm learning capabilities can play an important role in their evaluation of AI's creative intelligence.

A growth creative mindset is also a positive predictor of acceptance toward AI creativity. Those with growth creative mindsets are more likely to show stronger approval and acceptance levels toward AI creativity. It seems that individuals who believe that creativity is changeable via effort and practice show a higher level of acceptance of AI's creative capacity. How we view creativity can mold how we value AI's creative intelligence. As creative collaboration between humans and AI may gradually increase, creative mindsets will be a significant variable in explaining individuals' decision making in creative, cooperative situations with AI. Another interpretation of this result can be linked to the different reactions of each creative mindset when facing challenges. A recent study suggested a remarkable insight into the relationship between our mindsets toward human minds and responses to mindful robots, which are nonhuman entities considered to have high levels of minds (indicating one's mental capacities; Dang & Liu, 2022). Dang and Liu (2022) found that those who have a growth mindset regarding human minds display more positive responses toward mindful robots. A growth mindset toward human minds refers to beliefs about the potential development of human mental capacity. Researchers have explained that different reactions occur based on the different mindsets individuals adopt toward challenges. People who regard the human mind as fixed may be threatened by robots' possibility of dominating the world. On the other hand, people who consider human minds to be malleable might believe that robots offer possibilities for improving their human minds (Dang & Liu, 2022). The findings of my study partially reaffirm that individuals' mindsets about the human mind play an important role in forming their attitudes toward robots. Similarly, people who believe that creativity is changeable through effort might regard AI creativity as an opportunity to enhance their own creativity. However, the belief that creativity is unchangeable has no significant relationship with recognizing AI's creative capacity. Qualitative research is needed in the future to fully clarify the reasons for the different responses driven by different creative mindsets. Nevertheless, this finding broadens knowledge of the importance of creative mindsets in human–AI interactions.

This study has several limitations. First, the sample comprised only South Korean adults. Attitudes toward technology and individual perception can be influenced by cultural context. In a cross-national study, U.S. and Chinese participants exhibited different perceptions toward AI-generated content versus human-made content. The researchers discussed the findings in terms of different cultural contexts (Wu et al., 2020). To increase the generalizability of the findings, research could be conducted on technology users with more diverse samples from different countries. Second, this study examined AI creativity in the context of visual art. AI creativity encompasses not only art, but also various other fields. Future research could investigate the comprehensive meaning of AI creativity in various fields, such as business or education. Finally, I focused on examining ordinary people's attitudes toward AI creativity, excluding art experts' opinions. Art experts may have different opinions on AI technology and creativity in terms of art creation. Future research could investigate art experts' attitudes and opinions to provide a more diverse and balanced public perception of AI creativity. Despite the abovementioned limitations, the findings of this study deepen understanding of the process of acceptance toward AI creativity.

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