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AI-generated vs. Human Artworks. A Perception Bias Towards Artificial Intelligence?

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Abstract

Via generative adversarial networks (GANs), artificial intelligence (AI) has influenced many areas, especially the artistic field, as symbol of a human task. In human-computer interaction (HCI) studies, perception biases against AI, machines, or computers are generally cited. However, experimental evidence is still lacking. This paper presents a wide-scale experiment in which 565 participants are asked to evaluate paintings (which were created by humans or AI) on four dimensions: liking, perceived beauty, novelty, and meaning. A priming effect is evaluated using two between-subject conditions: artworks presented as created by an AI, and artworks presented as created by a human artist. Finally, the paintings perceived as being drawn by human are evaluated significantly more highly than those perceived as being made by AI. Thus, using such a methodology and sample in an unprecedented way, the results show a negative bias of perception towards AI and a preference bias towards human systems.

Author Keywords

Arts; Artificial Intelligence; AI; Authorship; Bias; CAN; Computational Creativity; GAN; Painting.

Introduction

For many years, technological progress has wrought profound changes in the creative industry, as in the fields of music (e.g., [18, 19]), parametric design (e.g., [41]), generative fashion design (e.g., [34]), and paintings (e.g., [23]). This has given rise to the emergence of new research fields: computational aesthetics [31], attractiveness computing (see Chu [14] for a literature review), Creative Adversarial Networks (CAN) [23] and computational creativity [16]. Computational creativity is a generic field of artificial intelligence (AI) that studies both artificial and human creativity [56] and has grown considerably. Indeed, in recent years, AI and especially its subfield machine learning (ML) have gained popularity [38] thanks to

research breakthroughs [37]. In 2014, Goodfellow and collaborators [27] proposed a new ML paradigm to generate synthetic data called a generative adversarial network (GAN)¹. Artists have appropriated these models have been in recent years to the point that they have become a new art market [20]. Thus, a first art painting generated by a GAN was sold for \$432,500 by Obvious [14]². With the increase in quality and ubiquity of creative systems such as GANs, studying these creativity support systems seems to be necessary [17, 29]. Evaluating the relevance of recently produced artistic works consists of assessing the perception of the public towards these artworks. To improve the algorithms, one approach is to try to understand user perceptions. There is also a need to understand the acceptance of works produced by AI [16]. Currently, this perception seems to be rather negative. Indeed, Gaut [26] has postulated a “negative value” towards machines or computers. Colton [15] is also concerned about the rejection of creative computers. Nevertheless, the evidence for such negative bias remains unclear. It seems crucial to study human perceptions of these AI-generated artworks. For this purpose, different methodologies exist. First, in many studies, a modified Turing test (TT) is used to analyze humans’ capacity to distinguish human or AI artworks (e.g., [23, 45, 51]). However, the TT seems insufficient. Indeed, this type of test does not make it possible to study audience perceptions. This method has also been criticized for encouraging imitation and pastiches of existing human artworks [46]. In parallel, to the best of our knowledge, few researchers have studied the differences in public perceptions between AI-generated or human artworks to understand the potential human bias. In their survey, Moffat and Kelly [40] found significant bias against computer-generated music. Other researchers have tried to reproduce these results with a small sample but without success [25, 42, 44]. In addition, Hong [32] has analyzed the differences in perceptions of computer art within focus groups. For the same piece of art is more considered to be “art” when it is perceived to be of human origin than AI origin. In the field of art and paintings, Elgammal [23] has found conflicting results with a positive bias towards machines. Despite this, the bias against computers is widespread and often cited [36]: “This suggests that there is much more to investigate about our relation with artificially generated art” ([20], p. 159).

With increasing exposure to “more high-quality computer generated artifacts,” the following research questions have become “more pressing” ([17], p. 276). Art is a symbol of an activity long regarded as a human task. Thus, AI raises important questions in terms of acceptability and human-and-machine relationships, which must be studied in the field of HCI. Can people distinguish computer-generated paintings? Do people prefer systems (or paintings) created by humans? Do people have a negative bias towards AI? Finally, we seek to learn how assumptions about the identity of the painters (AI or human) of the same artworks influences their evaluation. This paper presents a large-scale experiment to assess the existence of a potential human bias towards works generated by AI by using the technique of priming effect (e.g., [3, 55]). The priming effect represents the influence of a first stimulus (the primer) on the processing of a subsequent stimulus (the target). Thus, our study evaluates the influence of the exposure of the primer (i.e., the declared identity of the painter, AI vs. human) on the perception of artistic targets (i.e., AI-generated paintings vs. paintings drawn by humans).

¹ Generative Adversarial Network (GAN) [25] consists in train jointly two separate models: a generator and a discriminator. The generator is train to generate the most realistic data (e.g., images, text, signal) and to fool the discriminator. The discriminator is train to discriminate real data (i.e., data from the training dataset) and fake data (i.e., data from the generator).

² <https://obvious-art.com/>

Method

Participants

565 participants (M = 32.80 years; S.D. = 9.91; 234 females and 331 males) were involved. The participants were recruited without specific criteria on Amazon Mechanical Turk (AMT) in order to select more diverse profiles and obtain a larger sample [11]. The reward paid to each worker was \$0.75.

Measures

As Amirshahi [1] has recommended with lead subjective tests, many proprieties related to the paintings were studied. Inspired by the works of Berlyne [5], Jordanous [33], and Elgammal [23], many dimensions were evaluated: liking ("I like this painting"), beauty ("This painting looks beautiful"), novelty ("This painting seems novel"), and meaning ("I perceive the meaning of the painting"). To evaluate subjective dimensions, questionnaires with Likert scales are used in this survey. The optimal number of rating bars seems to be seven [13]. For these four dimensions, participants were asked to indicate how much they agreed according to seven-point Likert scales (1 = totally disagree; 7 = totally agree). Each Likert had antagonist anchors without labels between.

Material

Following Pasquier [44], the selection of pieces of art was influenced by their similarity in order to conceal their authorship. For this purpose, 40 impressionist-style paintings made by Piet Mondrian, Claude Monet, Robbie Barrat, and the collective Obvious were selected³ (see **Erreur ! Source du renvoi introuvable.** for examples).



Figure 1. Examples of used art paintings (Human: The Stroller - Claude Monet; AI: Madame De Belamy - @obvious_art)

Protocol

An online survey was used to control the experimental conditions in this type of study [1]. The participants who accepted the task on AMT were redirected to the SurveyMonkey platform. A mixed-subject design was used; see **Erreur ! Source du renvoi introuvable.** Similar to [25],

³ Due to space limitation, the complete list of paintings is not presented. Please contact the first author for details.

participants were randomly assigned to one of the two conditions (i.e., Human or AI condition, the between-subject variable). Thus, participants saw one of the two primings and instructions presented in **Erreur ! Source du renvoi introuvable.** All participants saw portraits and landscapes actually made by humans and AI (within-subject design).

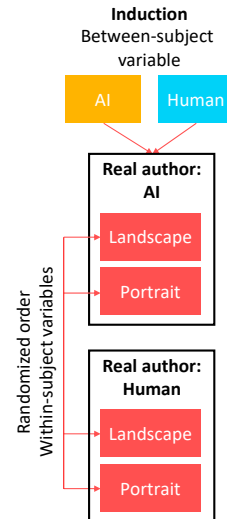


Figure 2. Experimental design

The artworks were randomly selected from 40 paintings (10 portraits by AI, 10 landscapes by AI, 10 portraits by humans, and 10 landscapes by humans) to improve the generalization of the results, to reduce experiment duration, and to avoid the repetition of painting styles. Next, for each painting, participants had to complete several items (i.e., liking, perceived beauty, novelty, and meaning). Finally, in order to ensure the effectiveness of the priming of the declared author type (i.e., AI or human), and following previous studies (e.g., [42]), an item of manipulation check was introduced (i.e., "At the beginning of the study, the identity of the painters was defined. Do you remember the identity of the painters?"). Afterward, it was explained that the origin of the painting had been manipulated. Participants then had to guess the origin of four paintings (one painting was randomly selected from each category). This modified TT was proposed at the end of the study to avoid any bias in evaluation and the priming effect. Lastly, two demographic questions about age and gender were asked.

Instruction: AI condition

8 paintings created by some Artificial Intelligence will be presented. You will be asked to rate them. There are no right or wrong answers. Only your opinion counts. Please respond spontaneously according to your feelings.

Instruction: Human condition

8 paintings created by some artists will be presented. You will be asked to rate them. There are no right or wrong answers. Only your opinion counts. Please respond spontaneously according to your feelings

Table 1: Instructions

Results

Mixed model analyses were used for each dependent variable. Thus, the participant and the paintings⁴ were considered random factors. The induction condition was considered a between-subject factor. The type of paintings and the real authors were considered within-subject factors. The statistical analysis was performed using R [47], lme4 [4], and afex [52]. The effect sizes were based on [10] (measured as d).

Participants who responded "I don't know" to the manipulation check were excluded (i.e., 79 out of 565 participants, or 13.98% of the sample). Moreover, for "Human condition" and "AI condition," 82% and 62%, respectively, of participants remembered their type of induction. Thus, to control the effect of this variable, answering correctly or incorrectly on this item was introduced as a random factor similar to [1].

The effects of the induction condition, the type of paintings, and the real authors were evaluated on declared liking, perceived beauty, perceived novelty, and meaning. All descriptive statistics are presented in **Erreur ! Source du renvoi introuvable.**, **Erreur ! Source du renvoi introuvable.**, Table 4, and Table 5.

Concerning *declared liking* (see **Erreur ! Source du renvoi introuvable.**), the analyses show a main effect of induction ($F_{1,481.25} = 17.67$, $p < .001$, $d = 0.06$), the type of painting ($F_{1,30.74} = 26.69$, $p < .001$, $d = 0.15$), and the real authors ($F_{1,30.74} = 82.44$, $p < .001$, $d = 0.25$).

	Human	AI
Induction	5.12 (1.56)	4.80 (1.66)
	Human	AI
Real Authors	5.18 (1.44)	4.72 (1.76)
	Land	Portrait
Painting type	5.35 (1.39)	4.55 (1.74)

Table 2. Descriptive statistics for *declared linking*. Land = landscape

⁴ To consider the variability between paintings, the painting is included as a random factor. Thus, the variability in perception between the paintings is absorbed in the model fitting.

Regarding *perceived beauty* (see **Erreur ! Source du renvoi introuvable.**), the analyses show a main effect of induction ($F_{1,481.23} = 17.74, p < .001, d = 0.05$), the type of painting ($F_{1,32.14} = 22.18, p < .001, d = 0.16$), and the real authors ($F_{1,32.14} = 64.81, p < .001, d = 0.27$).

	Human	AI
Induction	5.12 (1.53)	4.81 (1.67)
	Human	AI
Real Authors	5.20 (1.38)	4.71 (1.78)
	Land	Portrait
Painting type	5.37 (1.36)	4.54 (1.73)

Table 3. Descriptive statistics for *perceived beauty*. Land = landscape

In terms of *perceived novelty* (see Table 4), the analyses show a main effect of induction ($F_{1,481.28} = 13.31, p < .001, d = 0.11$), the type of painting ($F_{1,25.72} = 16.33, p < .001, d = 0.08$), and the real authors ($F_{1,25.72} = 3.47, p = .074, d = 0.04$).

	Human	AI
Induction	4.90 (1.46)	4.63 (1.59)
	Human	AI
Real Authors	4.87 (1.47)	4.63 (1.58)
	Land	Portrait
Painting type	4.81 (1.48)	4.70 (1.58)

Table 4. Descriptive statistics for *perceived novelty*. Land = landscape

Concerning *perceived meaning* (see Table 5), the analyses showed a main effect of induction ($F_{1,481.34} = 15.09, p < .001, d = 0.13$), the type of painting ($F_{1,28.81} = 19.61, p < .001, d = 0.10$), and the real authors ($F_{1,28.81} = 52.96, p < .001, d = 0.16$).

	Human	AI
Induction	4.81 (1.56)	4.48 (1.69)
	Human	AI
Real Authors	4.80 (1.52)	4.47 (1.74)
	Land	Portrait
Painting type	4.90 (1.50)	4.37 (1.73)

Table 5. Descriptive statistics for *perceived meaning*. Land = landscape

Lastly, participants had to distinguish paintings made by humans from generated-AI paintings. The analyses show an effect of the painting type on the recognition rate ($F_{1,1717.44} = 17.67, p < .001, \eta_p^2 = 0.34$) and the author's type ($F_{1,1717.44} = 64.41, p < .001, \eta_p^2 = 0.34$): see Table 6. Thus, paintings drawn by humans (compared to AI-generated paintings) and the portraits (compared to the landscapes) are the best-recognized artworks with the lowest percentage of recognition errors.

Type of Paintings / Real authors	Recognition rate
Landscape	53 %
Portrait	69 %
Human	66 %
AI	56 %

Table 6. Recognition rate (in percent) according to painting type and author type

Discussion

A phase with a manipulation check was proposed to participants to verify the relevance of the proposed induction. The responses suggest that a large majority of participants believed and remembered their type of induction (i.e., AI or human condition). These results seem consistent with those of Friedman [25]. In their first experiment, 83.87% and 65.27%, respectively, believed in the assertion in "Human Condition" and "AI condition." Unlike in the previous studies, here, the use of a large sample (565 participants), combined with the introduction of the answers in the manipulation check as a random factor, resulted in precise statistical analyses. Indeed, the results show significant effects of both the induced and real author. More specifically, the artworks presented as AI-generated paintings were significantly less liked and were perceived as less beautiful, novel, and meaningful than paintings presented as drawn by a human. The same pattern, with significant effect, is also apparent for the real type of authors of the artworks presented. Indeed, AI-generated paintings were less well evaluated (in terms of liking, beauty, novelty, and meaning) than paintings made by humans. These results support the first results obtained by Moffat and Kelly [40] on the perception bias towards computer-generated music. To the best of our knowledge, these results had never been replicated on a large sample, with the previous methodological precautions presented. Moreover, the modified TT, in which participants have to guess the real author of the paintings, showed a better recognition of human paintings (66%) than AI-generated paintings (56%). These results are consistent with Burnett [12] for composed-computer music and are opposed to results of Moffat and Kelly [40]. In Elgammal [23], 75% of respondents thought that the AI-generated paintings were made by humans. These differences could be explained by the improvement of the techniques in computational creativity, especially with the emergence of GAN. In parallel, it should be noted that participants are better able to identify the origin of the author for portraits (69%) than for landscapes (53%). Similar to Boden [8], with a recognition

rate close to chance (50%), people have difficulty distinguishing the type of authors. These results may suggest that the technical proprieties of AI-generated paintings are currently more advanced for the generation of landscapes than portraits. A possible explanation of the existing bias against AI-generated paintings could be that participants evaluated the pieces of art with an intergroup bias. AI may be anthropomorphized and thus considered as the out-group [21]. Intergroup bias can be defined as the tendency people have to evaluate their own group (i.e., the in-group) in a more positive manner than another group (i.e., the out-group) [6, 30]. Social changes relative to the out-group may bring a sense of threat and negative feelings that reinforce the intergroup bias [9, 24, 30]. The aim of the out-group devaluation is to maintain a positive social identity and superiority in some areas of competence [54]. To further explain the existence of a negative perception bias towards AI, several concepts can be cited, such as technophobia ([43]; see [49] for meta-analysis), anxiety towards machines, and reactive devaluation [50]. AI can be seen as a potential source of danger because it could replace humans in many areas [43]. To combat this bias, some authors have raised the question of framing information on user perceptions [7, 15, 35, 48, 53]. Indeed, “[f]raming information might be useful to help humans understand an agent who is unlike them; but this remains to be tested” ([36], p. 28:24), even if the experimental results seem to be unclear [39]. Thus, for Lamb ([36], p. 28:24), “a more subtle question is if humans are biased toward familiar and humanlike forms of creativity,” which could be linked to the previously mentioned intergroup bias.

Future works

Within this paper, a general bias against AI-generated artwork can be highlighted. In future works, the interaction effects across different parameters (e.g., induction and painting type) may be explored. Moreover, it may be interesting to include a measure of self-reported expertise in Art. Hekkert and Wieringen [28] have analyzed the differences in the art evaluation among experts and non-experts; they found a correlation between perceived originality and quality that was significantly higher among experts than non-experts. In the same way, Moffat and Kelly [40] have found a bias against computers that was significantly higher in musicians than non-musicians. Nevertheless, in a modified version of the TT, non-musicians were surprisingly better than musicians at recognizing music generated by computers or humans. In parallel, in order to make our results even more generic, the evaluation of a general bias against AI-generated artworks could be made with different styles of paintings (e.g., [23]) or types of art (e.g., music, poem). In this paper, public perception bias is questioned based on dichotomic human or AI priming. However, the frontiers between AI and human-generated artworks may appear more and more faint. For Elgammal [22], AI has even blurred the definition of artists. More generally, this raises the issue of authorship: “Can an Artificial Intelligence make Art without artists?” [2]. An initial answer could be in the eye or mind of the viewer.

Conclusion

The idea of a negative perception bias against machines, computers, and/or AI is widely shared, particularly in computational creativity. However, there has been a lack of experimental proof that demonstrates evidence of this bias. Unlike previous studies, the current large-scale experiment with 565 participants focused on AI and AI-generated paintings with different methodological precautions (large sample, randomization, manipulation check as random factor, etc.). In addition to the large sample, the main contributions of this paper are the methodological precautions and the robustness of the results, which seem to represent significant progress in the field of HCI and computational creativity to demonstrate the existence of a negative perception bias towards AI at the expense of human-made systems. Thus, depending on the perceived identity of the author (Human vs. AI), the same artworks were evaluated differently. Moreover, the results show that real artworks made by humans are also evaluated more highly than real AI-generated artworks. Alongside technological advances in AI, this paper paves the way for other studies to further consider perception bias in computational creativity and to analyze the impact of AI on human representations.

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