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Human, I wrote a song for you: An experiment testing the influence of machines' attributes on the AI-composed music evaluation

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ABSTRACT

This study examines the evaluation of musical performances of artificial intelligence (AI) and the acceptance of AI music generators as musicians. Relying on theoretical frameworks of anthropomorphism and creative machine heuristics, a 2 x 2 experiment is designed, where both the perceived anthropomorphism of AI (high vs. low anthropomorphism) and its autonomy of creativity (independent vs. dependent creativity) are controlled. The study found that humanlike traits of an AI music generator led it to be accepted as a musician. However, whether it was autonomous when creating songs did not influence its perception as a genuine musician. Also, the evaluation of its songs was done independently from its attributes. Still, people who perceived the AI music generator as a musician appreciated its songs more than those who did not. The implications of the expected findings are discussed.

1. Introduction

Machines are typically viewed as devices for increasing work efficiency by reducing time and effort for performing repetitive tasks. In the field of art, machines can be essential to foster user creativity by using them as training and assisting devices to inspire novel artworks (Coeckelbergh, 2017). Human artists are deemed as the creator of the artwork under this type of human-machine interaction, whereas machines are viewed as passive assisting entities (Moura & Maw, 2021). This traditional perspective regarding the roles of machines is widely accepted in artistic communities (Hertzmann, 2018). Previous studies outlined two primary factors behind this perspective, lack of intrinsic motivation, including emotions, in machine-generated art (Moura & Maw, 2021) and the presence of human artists behind the work (Hertzmann, 2018).

On the other hand, the rapid development of Artificial Intelligence (AI) technologies is expected to transform the traditional role and perspective of machines within the art community. A particular advantage of an AI is the degree of autonomy (Fernández & Vico, 2013); numerous artworks are created these days using fully automated algorithms, requiring no human input. As a result, the concept of AI-generated art has emerged as an alternative art form (Smith & Leymarie, 2017). However, the emergence of AI-generated artworks has presented potential conflicts regarding the authorship of the artwork. There have been discussions among scholars as to whether machines can also govern the creative process like human beings (Coeckelbergh, 2017). The discussion is also closely related to other social and legal issues associated with copyright (Ihalainen, 2018; Hristov, 2020) and human labor replacement (Frey & Osborne, 2017).

One example is the music industry. While the industry has a long history of using machines to aid in creating music, such as synthesizers, it is rapidly changing to acknowledge the potentials of AI-composed music. Presently, it is accepted that machines may have equivalent or exceeding capability for creating music than the actual musicians (Marr, 2019). Companies, from start-ups to large corporations, are developing music-generating AI in various aspects of the music industry, such as mastering, composing, and live performance (e.g., Google's Magenta Project). Musicians are finding significant value in AI-collaborated work by composing and performing with AI musicians, which helps them expand to new music categories (Chow, 2020). Related to the question of authorship, a music society has also moved forward in recognizing an AI virtual composer as the official author of its work (Kaleagasi, 2017).

Although these shifts are evident, our understanding of creative machines and their reception is still limited. Specifically, little is known

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regarding the perceptions or expectations of the general public towards art-generating machines, such as a music-composing AI, in terms of their capabilities and social roles. Among the few studies investigating this topic, Moura and Maw (2021) found a positive relationship between people's negative perception toward AI musicians and low purchase intention for AI music. However, participants' awareness of the composition process (i.e., whether the music was composed by a human composer versus an AI) had no significant impact on their perception of the music piece (e.g., affective response, general attitude, and meaningfulness). One possible explanation of this study's results was addressed in Hong et al. (2020). They found that people have different expectations and perspectives on AI's creativeness, influencing how they evaluate AI music. Specifically, they show that the acceptance of creative AI positively affects the assessment of AI-composed music.

While these studies are beneficial in understanding the general public's perception of creative AI and the evaluation of music quality, several unanswered queries still remain. First of all, there might be some features of AI that affect the perspectives and preferences on music composed by the machines. As noted above, autonomy is the most crucial factor differentiating current technology from the traditional usage of machines while composing music (Fernández & Vico, 2013). Hence, public evaluation of AI music may differ depending on the proportion of human involvement in composing the music. Another critical component is the humanlike appearance of the music composing machines, which may alter people's affection towards machine-created art (Weinberg & Driscoll, 2006b). Distinguished from those existing studies, the present study aims to broaden the AI music research field by exploring how different attributes of AI musicians' features (i.e., autonomy and anthropomorphism) influence the evaluation of machine-composed music. In addition to the assessment of music quality, we investigate the influence of these attributes of AI on the acceptance of the machine's musician role and how seeing machines as musicians influences the assessment of their music. The machine role perception and music evaluation are chosen to be examined because simply knowing how to create music does not make AI a musician. AI's musician role and performance should be admitted to becoming a legitimate musician. Overall, this article attempts to broaden our understanding of machines' creativity and social acceptance.

1.1. Machine-composed music

In 1957, a 17-s-long melody named "The Silver Scale" was generated by Music I, a sound synthesis software using stochastic models (Markov chains) (Hiller & Isaacson, 1957). This study represents the early works of the algorithmic composition of music. Since then, there have been more attempts to create music-generating machines as AI technology has developed (Sturm et al., 2019). Algorithmic composition is now a research field incorporating both partially and totally automated computational music composition. On the low-autonomy end, computer-aided algorithmic composition (CAAC) enables human composers to interact with a set of in-complete musical materials such as pitches, rhythms, equations, images, or meta-music descriptions and then feed the information through algorithmic tools (Fernández & Vico, 2013). The majority of algorithmic models aiming for the fully autonomous composition of original music contribute to creation tasks such as piano sheet music generation, digital vocoders generating a singer's voice, synthesizing timbres for various musical instruments, or directing one system to generate music incorporating all aspects, including melody, composition, timbre, and human singing (Dhariwal et al., 2020).

In today's AI era of deep learning (DL) and deep reinforcement learning (DRL), fully automated algorithmic composition, now commonly called "music generation," has shown tremendous progress in advancing the boundaries of generative models (Briot et al., 2020). In deep learning, generative models are a set of algorithmic methods that aim to represent data distributions. Generative Adversarial Networks (GANs) have been a popular structure type for developing creative machines. They consist of a generator that tries to fool the discriminator into classifying the generated content as real, while the discriminator tries to identify not-real ones as accurately as possible. By contesting with each other, the generated content can become indistinguishable from the real content (Goodfellow et al., 2014). In music generation, MidiNet and MuseGAN are both based on GANs (Dong et al., 2018; Yang et al., 2017). While using GANs is a well-known method to develop music-composing machines, it is not the only one. The transformer model, which leverages attention mechanisms, has boosted language learning ability drastically, and it is found to be applicable for music generation tasks (Vaswani et al., 2017). Music Transformer (Huang et al., 2018) and MuseNet (Payne, 2019) use this model and produce music by predicting the next note based on hundreds of thousands of MIDI files. Apart from GANs and Transformer, a hierarchical recurrent neural network (HRNN), which Deep Bach uses, is based on pseudo-Gibbs sampling in order to produce notes in the style of Bach chorales, providing more techniques to create music (Hadjeres et al., 2017; Wu et al., 2020).

1.2. Creative Machine heuristics

This study assumed that people's perception of machines influences the evaluation of music composed by artificial intelligence based on the findings of previous research about how expectations toward AI creativity affected AI music evaluation (Hong et al., 2020). There may be some variations in terms of how people understand autonomous machines. Based on the MAIN model, however, it is argued that there is still a trend of belief, which is called machine heuristics (Sundar, 2008; Sundar & Kim, 2019). They claim that people tend to think machines are neutral, cold, and trustworthy because machines do not pursue a personal interest. However, other than expectations toward machines' *machinelike* traits, people might have a belief about their *humanlike* traits, including creativity. Unfortunately, there are currently not many empirical studies about the public perception of machines' creativity, which this study calls creative machine heuristics. The assessment of the qualification of machines' creative roles and their performance is anticipated to be based on creative machine heuristics. Both machine heuristics and creative machine heuristics are about how machines are viewed. However, unlike the classic machine heuristic generally examines *what* characteristics people expect from machines, the creative machine heuristic particularly focuses on *how* people think about machines being creative. The essence of the creative machine heuristic comes from its unique aspect of examining creativity, which has not often been associated with machines. Existing machine heuristic studies focused on *machinelike* performances of AI, mainly logical processes like news writing and advertising (Spence et al., 2019; Wu & Wen, 2021). Because AI performances are within people's expectations toward AI, the machine heuristic research asked people to evaluate them based on credibility coming from expertise level (Sundar, 2008). However, because creative performances are often meant to go against expectations, it violates people's expectation toward AI that the classic machine heuristic claims. This study presumes that the creative machine heuristic has a distinctive pattern compared to the classic one.

People may be skeptical about machines being creative like human beings in two ways. One is about *whether* machines can be creative. There are views that machines cannot fundamentally be creative since creativity only belongs to humans. The other is *to what extent* machines can be creative. This approach does not reject the idea that machines can be creative (Coeckelbergh, 2017; Hong & Curran, 2019). However, people with this perspective question similarities between human creativity and machine creativity. For instance, they may think AI can be creative but not as much as humans. Creative machine heuristics encompass both perspectives. The purpose of creative machine heuristic research is to seek attributes that influence the understanding of machine creativity. Next, this paper introduces studies about anthropomorphism and autonomy, which are key factors determining creative

machine heuristics.

1.3. Anthropomorphism and autonomy

Humans are inclined to anthropomorphize non-human beings, i.e., assign human traits to them. Many studies confirmed the influence of machines' anthropomorphic traits on human-machine communication. Lee et al. (2006) found that study participants treated robots and electronic media as living beings and preferred interacting with robots with personality traits complementary to their own. Horstmann et al. (2018) showed that participants hesitated significantly when trying to shut down a humanoid robot that was begging them not to be shut off. Additionally, humans are inclined to apply gender stereotypes to embodied robots with humanlike appearance (Eyssel & Hegel, 2012). Humanlike robots can also be perceived as authority figures; Cormier et al. (2013) showed that a small, child-like robot has enough authority to pressure a number of test subjects to participate in boring, repetitive tasks, even after indicating they wanted to abandon the task. Fussell et al. (2008) suggest that as people interact with robots on a more frequent basis, their conceptions of them will become even more anthropomorphic.

Anthropomorphism shows up in various contexts, and music creation by machines is one of them. Weinberg and Driscoll (2006a, 2006b) created an anthropomorphic robot percussionist called Haile that can imitate actions of other human players and inspire novel interactions and musical experiences. In the process, they define robotic musicianship as "a combination of musical, perceptual, and interaction skills with the capacity to produce rich acoustic responses in a physical and visual manner" (p. 28), thereby including humanlike shape in their conception of robotic music players. Cypess and Kemper (2018) explore the combination of humanlike bodies and mechanical systems in music-making further by juxtaposing contemporary anthropomorphic analogies with anthropomorphic musical devices.

Epley et al. (2007) identified three determinants that can help explain when humans are likely to anthropomorphize, i. e attribute human characteristics or behaviors to non-lifelike artifacts like robots. Their conceptualization of anthropomorphism predicts that people use available anthropocentric knowledge structures to make sense of unfamiliar agents and reduce uncertainty. Epley et al. (2007); Epley et al., 2008) claimed there are two motivations behind anthropomorphizing non-human entities: effectance motivation and social motivation. Effectance motivation comes from an intention to better understand and take control of a non-human agent, while social motivation is due to the need for social connection. It is expected that people anthropomorphize machines based on the same motivations. Fink (2012) found that anthropomorphic designs that imitate humans or animals in appearance, behavior and interactions with humans contribute to robot acceptance and can elicit social responses. Furthermore, as mental models that people form about systems come to resemble their existing mental models of humans or animals, the way humans relate to robots may change, for instance in terms of their expectations about the robot's capabilities.

Building on these literatures, we propose a study that aims to investigate the role of anthropomorphism in music creation systems, i.e., the effect of anthropomorphism on the ratings of AI-composed music.

H1. People who are presented with an anthropomorphized AI music creator will give higher musical quality ratings to AI-composed music than people who view a non-anthropomorphized AI interface.

H2. People who are presented with an anthropomorphized AI music creator are more likely to accept the AI music generator as a musician than people who view a non-anthropomorphized AI interface.

Machine's autonomy is another crucial factor when assessing its qualification as a musician. The existence of machines' independent creativity is still disputable, mainly because the machine's creativity is often attributed to its programmer (Elgammal, 2019; Ribeiro, 2020). For instance, if an AI music generator creates a song, some people might think the AI generator should possess its copyright, while others believe it should be given to the programmer. The answer to the question depends on the level of machines' independent creativity. The perceived creativity of AI was found to even alter people's evaluation of AI-created artworks (Hong & Curran, 2019; Hong et al., 2020). The study showed that people who accept machine creativity tend to rate AI-created artworks higher than those who do not. In other words, people perceive AI creating art as the performance of its own creativity. Based on that finding, this study presumes that the level of autonomy during creative performance affects its evaluation. Specifically, knowing that AI requires interventions from human experts when creating music will negatively influence people's acceptance of AI musicians and the assessment of AI-composed music.

H3. AI-composed music created solely by AI without human inputs will receive higher musical quality ratings than the music composed by AI with human inputs.

H4. The AI music generator with independent creativity is more likely to be accepted as a musician compared to the one with dependent creativity.

1.4. Role theory

As machines substitute human labor, their roles in society should be considered. Should people see a machine music generator as a musician if it creates music genuinely by itself? In terms of the role, what is the difference between machine music generators and human musicians? Role theory, which accounts for positions or statuses individuals have in social structure, can answer the questions (Hunter, 2015). It explains how social positions and expectations determine characteristic social behavior patterns and focuses on performances or behaviors in a given setting when defining roles, not the performer's attributes (Biddle, 1986; Solomon et al., 1985). Based on this approach, being a machine should not be a restriction to become a music composer. What should rather be considered to see machines as music composers is how they create songs. If a machine does not make music autonomously with its own creativity, it means that the machine relies on human inputs in order to be creative. In this case, people will see this machine less as a musician but rather as a musical instrument, such as software that electronic dance music (EDM) musicians use. However, it is challenging to define the threshold of human involvement that determines when to accept AI music generators as musicians. Based on current AI technology, machines cannot create music if there is no human involvement at all. In other words, machines are not yet eligible to motivate themselves to create music. Even though there are music pieces composed by autonomous machines, some people may regard them as products of a programmer's intention to create songs.

It is unclear whether machines can develop the behavioral intentions they need to authorize creative performances. However, autonomy during music creation can be clearly distinguished. The current AI music generators can compose music pieces without any inputs from programmers once they are trained enough with data given by experts (Zulić, 2019). The only thing they need is the kind of music their users want. It should be noted that there is no significant difference between humans and machines when it comes to creativity because both generate innovative ideas from old ones (Jackson, 2017). In other words, the machine's creativity is akin to the human's creativity because a similar cognitive process for inventions can be found in both machines and humans. Autonomy may matter more than intentions in terms of understanding machine creativity because computer creativity often sparks debate about intellectual properties, such as copyright (Ihalainen, 2018). Therefore, this study defines autonomy during music composition as the machine's independent musical creativity.

H4 of this study presumes that perceiving an AI music generator's autonomy during music writing, which shows its creative independence,

leads to the acceptance of its role as a music composer. It is because roles require autonomy since it enables individuals to justify their social behaviors (Giovagnoli, 2018). If the hypothesis is supported, AI music generators with independent creativity are more likely to be seen as musicians that can take responsibility for their music than ones with dependent creativity. This study further speculates that perceiving the AI music generator as a musician will influence the evaluation of its music. People engage social interactions by conforming to role expectations (Lynch, 2007). For those who accept the AI music generator as a musician, its music composition will be regarded as fulfilling attributed role responsibility, which incurs positive attitudes toward AI-composed music. On the other hand, people who do not see the AI music generator as a musician will doubt the legitimacy of AI-composed music and not appreciate it.

H5. The acceptance of the AI music generator as a musician leads to higher musical quality ratings.

2. Methods

To test the hypotheses, a 2 x 2 experiment was designed and conducted, where both the perceived anthropomorphism of AI (high vs. low anthropomorphism) and its creative autonomy (independent vs. dependent creativity) were controlled. This study's dependent variables are music evaluation, the acceptance of AI music generators as music composers, and the attitude toward using AI music generators. Attitudes toward autonomous machines and music genres served as covariates.

2.1. Participants

Power for any given study is recommended to be at least 0.80 (Cohen, 1988). In order to determine sample size for this study, the G*Power OS application version 3.1.9.3 was used and set to test family "F test" and using the statistical test input "ANCOVA: Fixed effects, main effects and interactions" (Faul et al., 2007). With an effect size of f = 0.2, 4 groups and 2 covariates, G*Power suggests a total sample size of 199 participants. Amazon Mechanical Turk (MTurk) was used to recruit participants. Individuals voluntarily joined the study after reading its purpose. Participants who failed an attention test (e.g., In the audio, what did the instructor say after the music ended?) were excluded, leaving 222 participants from the 430 who were initially recruited (high anthropomorphism & independent creativity group: n = 68; high anthropomorphism & dependent creativity group: n = 50; low anthropomorphism & independent creativity group: n = 43; low anthropomorphism & dependent creativity group: n = 61). The youngest participant was 20 years old, while the oldest was 73 years old (M = 36.14, SD = 11.89). In terms of gender, 128 people identified as male, 93 people as female, and one person as others (see Table 1).

Table 1
Survey 1 sample statistics.

	Min	Max	Mean
Age	20	73	36.14
Income	Less than $20,000	$100,000 or more	Approximately $40,000
Education	High school graduate	Graduate degree	College Degree
Other		**Total**	**%**
Gender	Male	128	57.66
	Female	93	41.89
	Others	1	0.45
Race	Hispanic/Latino(a)	24	10.13
	White/Caucasian	134	56.54
	Black/African American	16	6.75
	American Indian/Alaska Native	3	1.27
	Asian	56	23.63
	Native Hawaiian/Pacific Islander	2	0.84
	Other	2	0.84
Region	Rural	69	31.08
	Urban	153	68.92

Note. Frequencies for race add up to more than 222 because of multiple selections.

2.2. Procedures

Four AI-composed music pieces with different genres (rock, EDM, classical, and country) were used for this study. The genre of music was taken into account because multiple studies about music preference considered it as a factor (see Christenson & Peterson, 1988; Delsing et al., 2008; Ferrer et al., 2013; Schäfer & Sedlmeier, 2009). Multiple genres of music were used because a single genre of the song may not represent other genres of AI-composed music. Evoke Music, a company providing songs created by their AI musician, approved the use of their music for this study.

During an experiment using an online survey, participants who consented to participate were first asked to report their attitudes toward autonomous machines. They were then randomly assigned to one of the four types of mock news articles introducing an AI music generator based on the 2 (high vs. low anthropomorphism) x 2 (independent vs. dependent creativity) design. Machines' anthropomorphic traits, claimed by Nass et al. (1995), were included in the high anthropomorphism version article, such as hearing, seeing, understanding spoken words, and feeling emotions. Also, this version of articles had an image of an embodied music generating robot playing an instrument. On the other hand, the low anthropomorphism version article depicted that the AI music generator did not have such features and showed an image of music producing software. The independent creativity version said that the AI music generator produces music autonomously without human inputs. However, in the dependent version, the AI music generator was depicted to rely on human inputs when creating music (see Appendix 1).

Once the participants finished reading the article about the AI musician, researchers randomly assigned one of the four songs and asked them to listen to it. The participants were informed that the songs were created by AI in the article. They were not able to move on to the questions until the song ended. After listening to a given song, participants were asked to report their assessment of a given musical piece and the acceptance of AI musicians.

2.3. Measures

Attitudes toward Autonomous Machines. The negative attitudes toward robots (NARS) Scale (Nomura et al., 2006) was used to measure attitudes toward autonomous machines. The term "robot" in the scale was altered to "autonomous machine" as it is more compatible with this study's topic. The seven-point Likert scale ('Strongly disagree' to 'Strongly agree') consisted of fourteen items (e.g., I feel that if I depend on autonomous machines too much, something bad might happen). Higher scores indicated more positive attitudes toward autonomous machines (α = 0.86).

Evaluation of music. A nine-item scale for evaluating music asks questions regarding their musical qualities. It was used in the previous AI-composed music study (Hong et al., 2020). The measurement was developed from the 'Rubric for assessing general criteria in a composition assignment,' a scale measuring various components in musical composition (Hickey, 1999). Components of the scale were aesthetic appeals (e.g., this AI composed music piece presented a strong aesthetic appeal), creativity (e.g., the music piece included a very original musical idea), and craftsmanship (e.g., this AI composed music had a clear beginning, middle, and end). Higher scores indicated a more positive assessment of musical quality (α = .91).

Acceptance of AI as a musician. A scale that measures participants' attitudes toward the AI music generator in the article as a musician was

created and distributed. The seven-point Likert scale ('Strongly disagree' to 'Strongly agree') consisted of three statements: 1) I think the AI music generator should be regarded as a music composer, 2) I think the AI music generator qualifies to become a music composer, and 3) I think people should accept the AI music generator as a music composer. Higher scores indicated more acceptance of AI as a musician ($\alpha = 0.94$).

The full scales are attached in Appendix 2.

3. Results

To verify the efficacy of the manipulations, responses from measures asking the anthropomorphism level of the AI music generator and whether it had autonomous creativity were analyzed and compared between different scenarios with an independent samples *t*-test. Three questions were asked for each anthropomorphism level ($\alpha = 0.90$) and autonomous creativity ($\alpha = 0.88$). The manipulation effects of human-like traits (e.g., The AI music generator is humanlike) showed a significant difference between high anthropomorphism ($M = 5.18$, $SD = 1.12$) and low anthropomorphism ($M = 3.09$, $SD = 1.44$) scenarios; $t(220) = 12.10$, $p < .001$. Also, the manipulation effects of autonomous creativity (e.g., The AI music generator is creative enough to compose music without any help from humans) also showed a significant difference between independent ($M = 5.15$, $SD = 1.30$) and dependent ($M = 3.33$, $SD = 1.69$) versions; $t(220) = 8.94$, $p < .001$. These results confirmed that the stimuli induced intended reactions toward the music generator.

A two-way analysis of covariance (ANCOVA) was conducted to test H1 and H3, which claim that the anthropomorphism and the autonomy of an AI music generator influence the evaluation of AI-composed music. Its covariates were attitudes toward autonomous machines and music genres. Levene's test was conducted to assess the equality of variances, and rejected the homogeneity of variances [$F(3, 218) = 0.45$, $p = .72$], meaning that the ANCOVA was appropriate to conduct. AI-composed music ratings showed an insignificant result for the anthropomorphism [$F(1, 216) = 2.62$, $p = .11$], the autonomy [$F(1, 216) = 0.15$, $p = .70$], and the interaction effect between the anthropomorphism and the autonomy [$F(1, 216) = 0.01$, $p = .92$]. Table 2 shows its descriptive statistics.

Another two-way ANCOVA was conducted to test H2 and H4, which claim that the anthropomorphism and the autonomy of an AI music generator influence the acceptance of it as a genuine musician. The attitudes toward autonomous machines and music genres were considered as covariates. Levene's test was conducted to assess the equality of variances, and rejected the homogeneity of variances [$F(3, 218) = 0.03$, $p = .99$]. There was a statistically significant effect of anthropomorphism on accepting an AI music generator as a musician [$F(1, 216) = 7.75$, $p = .006$, $\eta p^2 = 0.04$]. The level of acceptance was higher for the anthropomorphized AI music creator ($M = 4.76$, $SD = 1.64$) than the non-anthropomorphized AI interface ($M = 4.21$, $SD = 1.61$). However, no significant results were found from the autonomy [$F(1, 216) = 0.31$, $p = .58$] and their interaction effect [$F(1, 216) = 0.48$, $p = .49$]. Table 3 shows its descriptive statistics.

To test H5, which predicts a positive relationship between the acceptance of the AI music generator as a musician and the evaluation of AI-composed music, a simple linear regression was conducted with the attitudes toward autonomous machines as a control variable. A significant and positive effect was found [$F(2, 219) = 74.20$, $p < .001$], with $r^2 = 0.40$ ($\beta = 0.64$).

Table 2
Descriptive statistics for ANCOVA regarding AI-Composed music evaluation.

Anthropomorphism	Autonomy	M	SD	N
Low	Low	4.99	1.16	61
	High	5.06	1.22	43
	Total	5.02	1.18	104
High	Low	5.21	1.13	50
	High	5.28	1.00	68
	Total	5.25	1.05	118
Total	Low	5.09	1.15	111
	High	5.19	1.09	111
	Total	5.14	1.12	222

Note. The scale ranges from 1 (strongly negative) to 7 (strongly positive).

Table 3
Descriptive statistics for ANCOVA regarding AI musician acceptance.

Anthropomorphism	Autonomy	M	SD	N
Low	Low	4.19	1.61	61
	High	4.24	1.62	43
	Total	4.21	1.61	104
High	Low	4.62	1.66	50
	High	4.86	1.62	68
	Total	4.76	1.64	118
Total	Low	4.38	1.64	111
	High	4.62	1.64	111
	Total	4.50	1.64	222

Note. The scale ranges from 1 (strongly negative) to 7 (strongly positive).

4. Discussion

The purpose of this study was to examine people's evaluations of AI music generators and AI-created music and how their assessments shift based on the attributes of AI musicians. The results suggest that the assessment of AI-composed music is affected by neither anthropomorphism nor autonomy of an AI music generator. However, while the autonomy of an AI music generator does not influence admitting it as a genuine musician, having anthropomorphic aspects, including being embodied and having human capacities, leads to the acceptance of its musician role. The results indicate that evaluating AI-composed music and accepting AI's musician role require different cognitive processes. In other words, the AI music generator's characteristics affected the AI musician evaluation but did not lead to the change of music evaluation. It may be similar to some people seeing EDM artists as musicians while not preferring the EDM genre itself. Therefore, creative machine heuristics seem to apply only to actors, but not actions. The findings align with recent AI artwork studies that found an insignificant influence of artist identities (human vs. AI) on creative performance evaluations (Hong & Curran, 2019; Xu et al., 2020). When only focusing on the acceptance of the AI music generator as a musician, the findings suggest that anthropomorphic characteristics affect creative machine heuristics. However, the influence of autonomy still remains questionable.

Still, it does not imply that the acceptance of AI musicians and the evaluation of AI-composed music are entirely distinct from each other. The study found that people who saw AI music generators as musicians tended to give higher ratings to AI-composed music. The findings support role theory, considering activity as conforming to assigned roles, as people's attitudes toward machine's roles determine their performance evaluation. It is an extension of role theory into the realm of human-machine interaction. The theory was first developed to explain the role of humans and did not consider machines at the time (Biddle, 1986), obviously because AI agents started to substitute human positions quite recently. This study has extended the application of role theory to include human-machine relationships in social groups, which will become more prevalent. Role theory will become more valuable for human-computer interaction (HCI) research if AI agents have roles that involve power as they become more humanlike and efficient (Fast & Schroeder, 2020).

Overall, it is an intriguing finding because accepting AI musicians and evaluating their music were correlated, while factors that affected one variable did not extend to the other variable. It may suggest that there was a cognitive point where the evaluation of music was disconnected from the perception of its creator. Our assumption is that they involve different cognitive processes — qualifying AI as a musician is a logical process, but music assessment relies on emotional processes.

Then, why are they still correlated? It may be due to a priming effect, i.e., activation of instant stereotypes that an individual already possesses (Dixon, 2006). Participants may have already held these subconscious beliefs while answering questions about the qualification of the AI music generator as a musician. If a person rejects that AI can become a musician, then the highest score that the person can give will be lower than those who support it. Because it is an assumption from unexpected findings, rigorous future research is needed to confirm it.

This study has a few limitations. First, the participant might have thought anthropomorphic machines are more developed than non-anthropomorphic ones because of more functions they have, even though they are not directly relevant to creating music. Future studies should explicitly indicate that there is no relationship between the features that an AI agent has and its performance. Also, we measured creative machine heuristics by asking their opinions about accepting an AI music generator as a musician. It was because researchers thought that creativity is the most crucial attribute of a musician. However, people may prioritize a different attribute to accept it as a musician. Clearly and directly asking their thoughts about machines having creativity might have provided different outcomes.

One aspect of the results of this study, which AI music industries should be aware of, is that the brand "AI-created" may not be as strong as expected. While people may be attracted to AI-composed music at first, they do not consider who wrote the song when they started to listen to it. So, adding humanlike traits to an AI musician, particularly autonomy, may not lead to the appreciation of its song. In short, what matters the most for AI-composed songs is their quality, not how they are made. Therefore, the AI music industry should consider people's expectations about AI-composed music and how to fulfill them instead (Hong et al., 2020).

On the other hand, this study should be considered from an academic perspective. This study suggested creative machine heuristics that particularly focus on the perception of machine creativity, which is an extension of machine heuristics. While AI has been expected to be developed for logical tasks, it is now creating its own products, including paintings, movie scripts, music, and poems (Köbis & Mossink, 2021; Hong & Curran, 2019; Hong et al., 2020; Xu et al., 2020). When developing creative AI, understanding how audiences react is crucial, which involves knowing what expectations and biases people have toward AI and its creativity. Because the creative machine heuristic examines the relationship between people's preexisting attitudes toward creative AI and the assessment of its performance, it is anticipated to be helpful to understand how people perceive AI's innovative performances, not only limited to art but also suggesting ideas that humans have not yet devised.

Also, this study expanded the question about creative AI agents and asked what roles those machines serve by employing role theory. While role theory is somewhat new to the HCI field, the theory is expected to be in more demand as machine agents permeate social groups, particularly where HCI and organizational communication intersect. Social role has been a key to manage social organizations and communities efficiently (Gleave et al., 2009; Takagi et al., 2013). Therefore, communications between humans and machines will be facilitated when their roles are shared and understood well. Because social interactions between humans and machines are new, more studies in this field are needed. It can be claimed that this study made theoretical contributions to such research by introducing a new idea developed from a well-known concept and showing how a theory that may seem unfamiliar can be applied to the better understanding of new human-machine interactions.

Finally, it should be noted that this study is one of few empirical studies about how people listen to AI-composed music. While there is an increasing number of human-AI interaction studies, most of them still focus on the effect of communication, both verbal and nonverbal. Through the presented study, this paper claims that there are more diverse ways to interact and form a relationship with machines, including music. Just as individuals have different ways to interact with other people, human-machine interactions should be done and analyzed in different ways and perspectives. For instance, AI has been developed to provide music that decreases anxiety, relieves insomnia, and improves mental performance by retrieving and analyzing responses from listeners (Creighton, 2016). This type of effort can be devised and made when researchers think outside the box of a traditional definition of communication. It is hoped that this study contributes to the relevant fields having wider application by providing a broadened perspective of human-machine communication.

Credit author statement

Joo-Wha Hong: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, and Project administration. Katrin Fischer: Formal analysis, Investigation, Writing – original draft, and Writing – review & editing. Yul Ha: Formal analysis, Investigation, Writing – original draft, and Writing – review & editing. Yilei Zeng: Investigation, Writing – original draft, and Writing - Review.

Appendix 1

Stimulus articles

[Anthropomorphism & Autonomy]

NEWS ARTS & LIFE MUSIC SHOWS & PODCASTS SEARCH

TECHNOLOGY

Introducing new artificial intelligence that can compose music

5:34 PM ET, January 24, 2020

Yael Gunter

Shimon, an AI music composer, is creating a new song for the upcoming album
Hollie Adams/Getty Images

Shimon is an AI music composer with humanlike traits that can create music and play together with human musicians. It has an eye to see, an ear to listen, a mouth to sing, and arms to play instruments.

Shimon's ability to listen and respond to questions from its human team players while also reading and interpreting their facial expressions really sets it apart from other robotic musicians. Interacting and collaborating with others like human musicians in this way enables Shimon to create unique musical experiences.

It is appropriate to say Shimon has its own independent creativity. Shimon takes charge on new music creations and easily takes on a composer's role. It can write its own songs autonomously, without input from humans, and then present them to his team to perform together. In other words, musical decisions that Shimon makes are independent from human interferences.

[Anthropomorphism & No autonomy]

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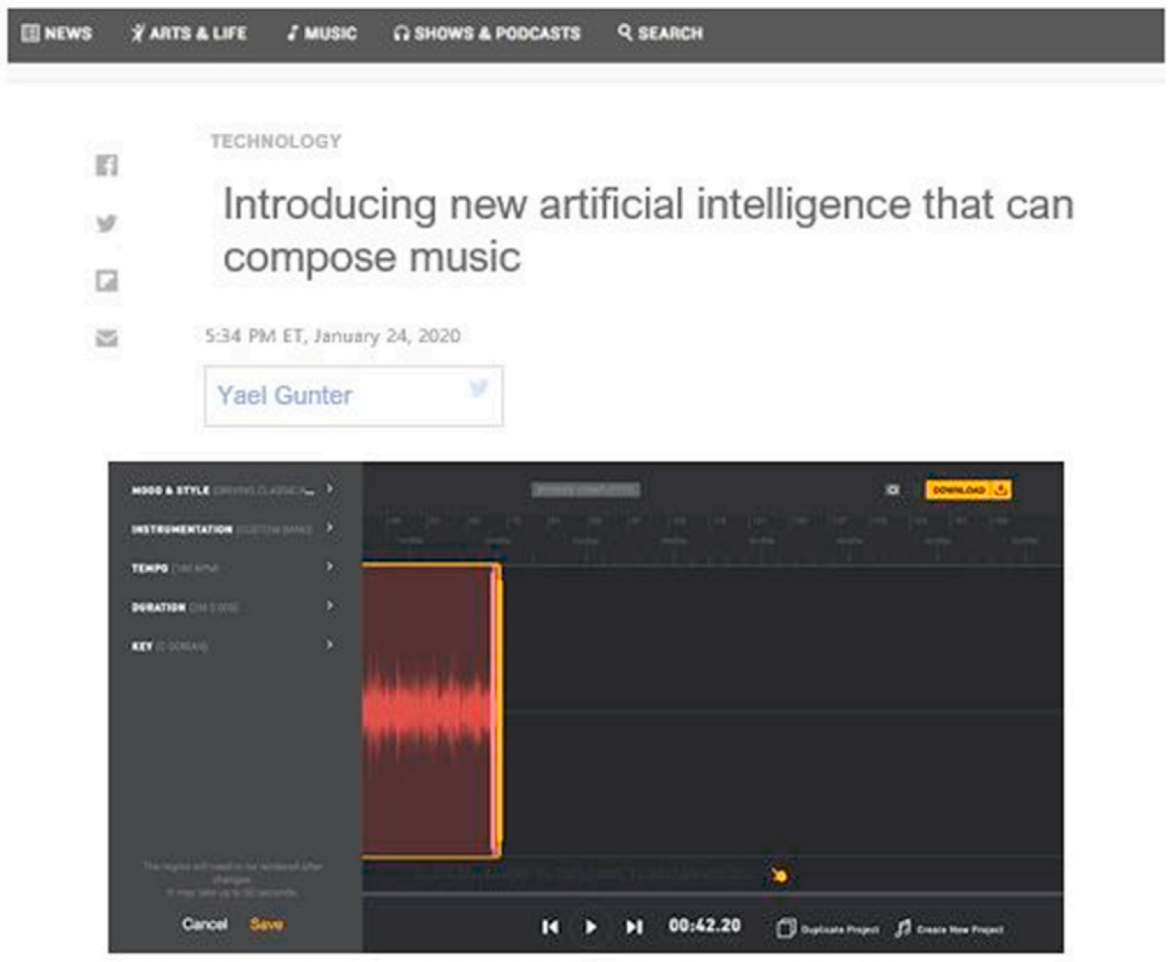
Shimon's ability to listen and respond to questions from its team players while also reading and interpreting their facial expressions really sets it apart from other robotic musicians. Interacting and collaborating with others like human musicians in this way enables Shimon to create unique musical experiences.

Yet, it is "not" appropriate to say Shimon has its own independent creativity. Shimon still relies on specific inputs from humans in order to compose new songs as it is not autonomous and sophisticated enough to independently create music. In other words, musical decisions that Shimon makes are yet dependent to human interferences.

[No anthropomorphism & Autonomy]



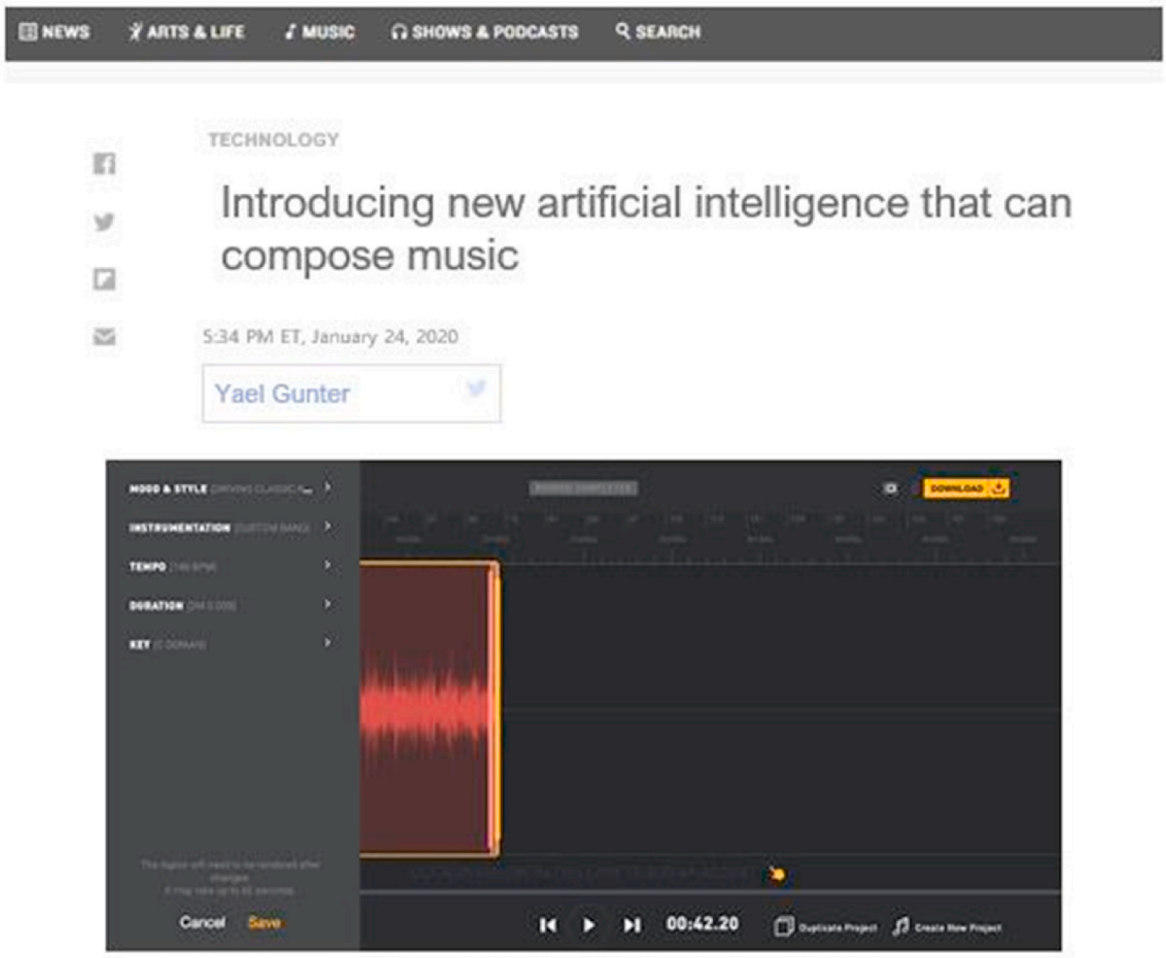
A newly developed AI-music generator is creating a new song for the upcoming album
Hollie Adams/Getty Images

This AI-music generator has made great strides in its ability to participate in creative music making. Working invisibly behind the scenes, its machine learning engine is a powerful force in creating music.

However, its lack of embodiment means it cannot perform these compositions itself. Neither can it interact with human players, for instance to collect their verbal feedback, register nonverbal reactions or answer textual questions about the composition. The software does not have humanlike traits other than its musical cognitive process.

It is appropriate to say the AI-software has its own independent creativity. This AI-software takes charge on new music creations and easily takes on a composer's role. It can write its own songs autonomously, without input from humans, and then present them to his team to perform together. In other words, musical decisions that this AI-software makes are independent from human interferences

[No anthropomorphism & No autonomy]



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Appendix 2

Survey items

Attitudes toward Autonomous Machines

First, you will answer a survey asking your opinion on autonomous machines. Please read each statement carefully and indicate as accurately as possible your degree of agreement or disagreement with each statement.

1. I would feel uneasy if autonomous machines really had emotions.
2. I would feel uneasy if autonomous machines really had emotions.
3. I would feel relaxed talking with autonomous machines.
4. I would feel uneasy if I was given a job where I had to use autonomous machines.
5. If autonomous machines had emotions, I would be able to make friends with them.
6. I feel comforted being with autonomous machines that have emotions.
7. The word "machine" means nothing to me.
8. I would feel nervous operating an autonomous machine in front of other people.
9. I would hate the idea that autonomous machines were making judgements about things.
10. I would feel very nervous just standing in front of an autonomous machine.
11. I feel that if I depend on autonomous machines too much, something bad might happen.
12. I would feel paranoid talking with an autonomous machine.
13. I am concerned that autonomous machines would be a bad influence on children.
14. I feel that the future society will be dominated by autonomous machines.

Evaluation of music

You will now be asked to assess the AI-composed music you just listened to. Please read the questions carefully.

1. Many listeners would enjoy this AI-composed music piece.
2. This AI composed music piece keeps listeners interested.
3. This AI composed music piece presented a strong aesthetic appeal.
4. This AI composed music was creative.
5. The AI composed music piece included very original musical idea (range, dynamics, timbre, tempo texture, rhythm, melody).
6. The AI composed music piece included unusual imaginative musical idea.
7. This AI composed music had a clear beginning, middle, and end.
8. This AI composed music appeared well-organized, not random.
9. This AI composed music had a good completeness overall.

Acceptance of AI as a musician

Now, we will ask how you think about accepting the AI music generator as a music composer. Please read the questions carefully.

1. I think the AI music generator should be regarded as a music composer.
2. I think the AI music generator qualifies to become a music composer.
3. I think people should accept the AI music generator as a music composer.

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