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On the Human-AI Metaphorical Interplay for Culturally Sensitive Generative AI Design in Music Co-Creation

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Abstract

This research revolves around the potential challenges, opportunities, and strategies associated with human-centered generative artificial intelligence (AI) in the music compositional practice, emphasizing the role of metaphorical design in shaping musicians' expectations toward the adoption of generative AI in their everyday creative activities. Through a human-computer interaction (HCI) lens, this paper aims to discuss the cultural implications of the human-AI metaphorical design space for the seamless integration of intelligent algorithmic experiences in a manner that aligns with cultural values and realistic expectations of music creators while promoting informed policies, sociotechnical imaginaries, and culturally sensitive generative AI design strategies with focus on user-friendly interfaces that resonate with diverse music creation groups.

Keywords

culture, human-AI co-creativity, human-centered generative AI, metaphors, music creation

1. Introduction

Rapid advances in generative artificial intelligence (AI) capabilities have been seen across many domains and the evolving nature of research has brought novel human-centered approaches to the informed design of sociotechnical algorithmic systems in cultural production by means of mixed-initiative co-creative interfaces [1]. For instance, generative AI has had a remarkable influence on the way as music is produced and mixed. As a result, novel forms of interaction with generative AI models and applications have been gaining increasing interest among researchers studying the development of sociotechnical spaces intended to support creativity and composition activities [2]. As such applications see wider deployment, we need a better idea of the implications of human-AI co-creative processes at an individual and collaborative level through an in-depth examination of music interactions beyond the algorithms to mitigate the sociotechnical harms of inappropriate AI implementations being currently in use to aid music production. From representational harms such as stereotyping or even erasing social

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groups, to societal harms where marginalization and inequalities are likely to be reproduced through the use of AI-backed assistants [3], designing for cultural diversity assume a particular relevance in creating more inclusive and culturally sensitive human-AI co-creative experiences in line with the user expectations, goals, and cultural differences.

Expectation theories such as the expectation-confirmation model (ECM) [4] have demonstrated a close relation between the initial user expectations towards a system and the actual experience of using it with influence on their satisfaction and acceptance. In general terms, the adoption of a system can fail if users expect more than the system can actually provide and thus lead to decreases in user satisfaction and subsequent rejection [5]. Thus, from a user experience (UX) perspective, it is increasingly important to manage the end-user expectations of AI-powered products and their complexities [6]. In fact, mental models act as functional representations of how a system actually works from the user's point of view [7], including emotional states, objects, sequences of events, and actions supported by the environment [8]. This can also be scaled to human-AI teams in the form of shared mental models [9]. Since these representations are built based on the user's own real-world experiences [10], they tend to be socially situated and reflect the user expectations in the form of mental maps.

Among the many strategies available to operationalize the way as users structure their mental models and produce novel ideas, metaphorical design [11] has assumed a particular role in revealing novel perspectives and extending existing known ones in systems design [12]. Seen from a human-computer interaction (HCI) lens, metaphors can play a multifaceted role in illustrating and rationalizing the meaning of an interactive artifact [13, 14] and thus explain abstract concepts while coping with novelty [15]. However, it is worth noting that the metaphors' efficacy is many times difficult to forecast in the user-centered design process and more research is needed to fully comprehend the contribution of metaphors to frame the design of AI-based systems and enhance the experiences of humans interacting with AI in co-creative activities. Of importance seems to be an increasing need of adopting a novel set of design metaphors for shaping the human-AI design space since "conventional interaction design methodologies cannot fully encompass the redefined relationships between humans and increasingly intelligent technology" [16]. This is in line with Shneiderman's [17] call for action stressing the heightened value in proposing a novel set of metaphors for human-AI interaction and encouraging the HCI and AI research communities to further scrutinize the current design metaphors on AI-powered products, for example, from autonomous or intelligent agents, social robots, teammates, and autonomous systems to AI-infused tools, active appliances, tele-bots, and control centers, respectively. Once again, expectation theories play a vital role here since these new metaphorical lenses can contribute to shape expectations and attitudes towards more appropriate ways of assimilating the empowering and augmenting abilities of generative AI-driven solutions when considering the inherent complexity of creative tasks. Instead of alleviating the concerns around generative AI and its threats, an opposite effect can be seen to some extent if the user perceives the AI as potentially harmful.

By framing the design space in a familiar and meaningful way considering the end-user knowledge associations between generative AI actions and real-world entities in music production activities (including their multiple usages), metaphors are culturally shaped and can act as analogical "gateways" to reduce the cognitive load associated with the user understanding of the functions and internal operations of the generative AI tool being used while making music. Examples of metaphors reported in the literature range from seeing AI as a "social glue"

using deep generative AI interfaces [18] or as a “steering tool” with positive effects on the musicians’ sense of creative ownership when using human-AI music co-creation interfaces [19]. However, despite the potential applicability of metaphorical design [20], there is still a lack of a formal and objective investigation on the use of metaphors in the human-AI music making space as an approach that can be applied by system developers and interface designers to create more culturally sensitive experiences and facilitate the learning and adoption process for novice users in navigating novel interactive AI-infused applications. The above discussion and the absence of research works dealing with this multifaceted problem led to the questions of how metaphors are being used in different ways in human-AI music creation research and whether cultural sensitivity is a subject that could be handled differently in the characteristically uncertain space of generative AI for music production.

2. ‘Seeing Metaphorically’ in Human-AI Co-Creative Music Production

From ‘crate digging’ [21] to drum programming, sample slicing, vocal processing, beat layering, among other compositional practices, music producers are faced with a completely new set of challenges and requirements to be addressed when considering the possibilities provided by generative AI. Research on the intersectional space of AI and music can be traced back to the 1980s [22], or even earlier if we consider the first known music composition experiences using algorithms in the 1950s [23]. As a result of many efforts along more than six decades of research, a growing body of work has been recently devoted to proposing systems that act as co-creative “partners” with therapeutic [24] or just personal expression purposes [25]. Some scholarly investigations have found that human-AI co-creativity interfaces can contribute to better support a wide range of creative pursuits involving generative AI applications [26]. Through evaluation studies with real users, researchers have explored the way people manage expectations in the act of creating songs through AI and found that AI-generated music can function as a catalyst by harnessing the innate artistic creativity of music producers in tasks like songwriting [27]. At the same time, generative AI has also the ability to enrich experiences by stimulating other sensory modalities (e.g., visual arts) when the music exhibits characteristics of being composed by a human in terms of its naturalness and melodiousness. This is congruent with other work suggesting that people tend to exhibit a greater level of appreciation for AI-generated songs when they perceive the generative AI tools as authentic “musicians” possessing a high level of anthropomorphism and subsequently human-like attributes and characteristics [28]. In the literature we can find examples of human-AI music creation systems such as Cococo [19], ReStyle-MusicVAE [29], and MoMusic [30]. Noting the creative benefits of human-AI music partnerships, Tchameube and colleagues [31] proposed an interactive system for harnessing music composition experiences, denoting positive results in terms of enjoyment levels while reducing the creative block and refining one’s artistic vision in the process of generating new ideas. However, some challenges were reported at the interface design level, particularly related to steering issues when addressing experts’ projections and ways of use.

Alongside recent advances in human-AI music co-creation, there are many examples of problems caused by the inscrutability nature of AI-infused systems in terms of how they act and generate their outputs [32]. Here, sociotechnical imaginaries [33] play an important role as

articulation instruments in imagining intersectional futures about generative AI and its impacts as encapsulated in unifying and socially constructed visions that humans foresee as being possible to realize. With this pointer to how people construct their imaginaries about AI technology and its intricacies, metaphors hold the potential to manage expectations through their ability to capture the sociotechnical and sociomaterial characteristics of human-AI interaction. This is stressed by Khadpe and co-authors [14] who claim that conceptual metaphors have an influential effect on the users' pre-existing expectations, adoption intentions, and ex-post system usage perceptions. The use of metaphors as orchestration tools with generative capacity can be particularly useful in this design space to change the way as music creators perceive the role of AI in their daily needs and explorations based upon the specific prior knowledge and experience they hold, and subsequently help in dealing with what is novel [34]. By turning this knowledge actionable, metaphors can contribute to create new ways of seeing while overcoming the uncertainties that remain about the intrinsically linked futures of human interaction with AI based on familiar, previously known representations of real-world phenomena.

Using metaphors as a lens to explore human-AI relationships in music making practices, developers can alleviate the complexity faced by artists and creative enthusiasts when utilizing generative AI to (re)produce musical artworks by embracing the situated (and sometimes messy) practice of AI-supported music composition. As Caramiaux and Alaoui [35] have pointed out, seeing AI as a sociotechnical artifact which is itself a cultural construction shaped by implicit and explicit attitudes presents a distinctive set of challenges to conventional interaction design approaches and holds the potential to contribute to the expansion of the framework within which we comprehend, discuss, and conceptualize the music that is produced by (and through) generative AI. This encompasses the externalities created as novel norms and tools are incorporated into the creativity process, as well as the changes that impact the methods used in music creation and the various expressive moods through which music is generated using intelligent music interfaces.

3. Research Method

With regard to the issues discussed above, the research work presented here is grounded on the role of metaphorical design in shaping user experiences and expectations towards interactive AI systems capable of supporting the production of musical creative content. Through a rapid review following the Garritty et al.'s [36] guidelines, a methodological approach recently used in the field of HCI "to generate a quick yet systematic descriptive and narrative summary of a focused area of study" [37], this paper contributes a characterization of metaphors and design principles in the context of human-AI co-creative practices. This section provides a summary of the steps followed, and the insights obtained contribute to characterizing the dynamics and changing roles between humans and AI with an emphasis on a metaphorical understanding of their relationship and how music enthusiasts can better perceive and engage with AI in such sociotechnical configurations.

For the purposes of this review, the updated preferred reporting items for systematic reviews and meta-analysis (PRISMA) [38] were followed in order to identify and synthesize the research conducted on human-AI interaction from both explicit and implicit perspectives. A full survey of metaphors for human-AI interaction is outside of the scope of this paper. Unlike most

previous work, the original Madsen's [11] guide to metaphorical design was used as a generic frame for the systematic analysis of the literature. This includes a look at how the metaphors suggest different roles and relationships over time in the human-AI interaction space grounded in previous ways of thinking about human-computer interactions. Initially, the publications returned from the pilot searches were filtered and then the following search query was used to find relevant records in the Dimensions² database:

((“human-AI” OR “AI-human” OR “human-algorithm” OR “algorithm-human” OR “human-machine” OR “machine-human”) AND (“metaphor*”) AND (“design”) AND (“user experience*” OR “expectation*” OR “interact*”))*

The selection of the Dimensions database to perform the search was mainly due to its exhaustive coverage in comparison to Web of Science and Scopus [39]. In a similar way, the same search string was also applied on ACM Digital Library (ACM-DL) since this database has been widely used in prior UX studies in the field of HCI (e.g., [40]). Only English-written documents published in peer-reviewed journal articles and conference proceedings between 2018 and 2022 were considered. This time frame was chosen due to the recent nature of the field of human-AI interaction [41]. From the resulting list, 2,077 papers were reviewed in total. During the study selection process, we proceeded to the exclusion of extended abstracts, keynote talks, posters, demonstrations, panels, columns, tutorials, commentaries, workshop summaries, erratums, editorials, books and book chapters, etc. In line with previous studies (e.g., [42-44]), this literature review is restricted to well-known conferences and journals that represent established sources and prominent venues in the field of HCI. Therefore, the main search was complemented with a forward and backward snowballing approach [45] followed by hand-made additional searches comprising the year 2023 to manually inspect related references and more recent studies that were not captured by the pilot and main searches which had a more generic scope. The period chosen for the study was also considered in other systematic literature reviews on generative audio models (e.g., [46]). After filtering publications by narrowing the focus to human-AI co-creation settings, 11 records were identified as primary studies.

4. Metaphorical Landscape in Human-AI Music Co-Creation: A First Look and Roadmap to Future Examinations

Designers of AI-powered music generative systems face a novel and increasingly complex set of conceptual, ethical, methodological, and sociotechnical challenges when designing for culturally sensitive experiences. Therefore, adopting a culturally-responsive design approach [47] is of utmost importance since the cultural identity of each user has a significant impact on the formation of their views, adoption behavior, and capacity to assimilate various facets of their interaction with an AI system. In other words, it is important to adapt interaction and other user interface (UI) elements such as colors, icons, or even taxonomies to the contextual background and cultural aspects of target users who are the subjects of practice and therefore socially and culturally situated. Kapania and co-authors [48] go even further by claiming that “AI is not understood in a standardized manner across cultures, contexts, internet exposures

² <https://www.dimensions.ai/>

and age groups”. Thus, the cultural background, preferences, meanings, and requirements that distinguish each user must be embedded during the model pre- and post-training stages when developing AI-driven solutions in the realm of music co-creation [49]. For instance, Louie et al. [2] found that music composers occasionally link music to particular cultural references, drawing inspiration from reminders of songs heard in the past or even reminiscing memories from childhood which is a common phenomenon in subgenres like underground hip-hop music. If designed properly, culturally sensitive generative AI tools offer unprecedented opportunities to engage underrepresented communities in meaningful and creative experiences around AI-generated music [50] and therefore contribute towards more inclusive practices.

Despite the recognized value of designing for culture-specific aspects, the rapid review presented here shows a gap in evidence around the design of culturally sensitive generative AI when considering human-AI music co-creation. This is illustrated in Table 1, which indicates that cultural aspects were discussed in only three of the studies comprising the total sample of this study.

Table 1
Overview of the papers that discuss the metaphorical design space in human-AI music co-creation

Reference	Conf./Journal	User Study	Metaphor(s)*	Cultural Aspects
McCormack et al. [52]	CHI	Yes	CID, CP, CI	No
Louie et al. [2]	IUI	Yes	T	Yes
Tchemeube et al. [31]	IJCAI	Yes	CcT	No
Hong et al. [28]	Comput. Hum. Behav.	No	MG, M, cAg, MC, MComp	No
Suh et al. [18]	CHI	Yes	G, SG, C, PT, CT, Ac, S, M, PSN, CPS, FfP, F, HA, SL	No
Truesdell et al. [50]	ICCC	Yes	Comp, PT, Ag	Yes
Frid et al. [56]	CHI	Yes	D	No
Micchi et al. [57]	Trans. Int. Soc. Music. Inf. Retr.	No	Su, AT, CST, Coll	No
Smith and Freeman [54]	AIIDE	Yes	CoMuAg, CoAg, CC, CoMu, CoP, AA, I	No
Newman et al. [49]	ISMIR	No	C, MAT	Yes
Louie et al. [19]	CHI	Yes	P, C, H, A, CMP	No

* Metaphor descriptive codes used to represent AI as a creative partner (CP), collaborative improvising drummer (CID), peer (P), collaborator (C), helper (H), composer (CMP), drawer (D), glue (G), social glue (SG), partner (PT), composition tool (CT), mitigator (M), composer (CPS), facilitator (F), helpful assistant (HA), social lubricant (SL), co-creative companion (Comp), creative agent (cAg), anchor (Ac), assistant (A), co-creative agent (Ag), creative improviser (CI), seed (S), collaborative agent (CoAg), co-creator (CC), autonomous agent (AA), collaborative musician (CoMu), collaborative partner (CoP), collaborative musical agent (CoMuAg), tool (T), instrument (I), suggestion (Su), music creator (MC), musician (M), force for progress (FfP), co-creative tool (CcT), creativity support tool (CST), music composer (MComp), automation (AT), music co-creative colleague (Coll), generator (MG), psychological safety net (PSN), and music analysis tool (MAT)

Regarding the metaphorical design space of human-AI music co-creation, a total of 43 metaphors were captured from the literature. This vast capturing of ways of seeing AI systems go in line with the fragmented nature of the field of HCI in terms of conceptual representations of technologies and use cases [51]. In terms of roles played by humans and AI in these sociotechnical configurations, we found that some systems are conceived as co-creative “partners” or even “improvisers” instead of passive tools or instruments in the context of AI-mediated improvisation in live musical performances [52], while other authors found that users can adopt different AI “collaborator personas” depending on the use situations [19]. When seen as a “social glue” [18], AI technology can contribute to mitigating interpersonal stalling and conflict, thereby altering users’ collaborative and creative roles while enabling them to build fluidly on each other’s ideas. As we may see from the extensive list of metaphors captured in

the primary studies included in this rapid review, the degree of anthropomorphic attributions can vary from technical (non-anthropomorphic) to technical (non-anthropomorphic, rudimentary human-like) and anthropomorphic (rudimentary technical) language, as pointed out by Waytz et al. [53]. For instance, Smith and Freeman [54] discussed different stages in the use of a collaborative musical agent that could also be seen as a human-like collaborative musician with impact on the user's perceived autonomy. Although we believe that the sample chosen only shows a snippet of all metaphors that may be of practical use in the design of human-AI music creation systems and applications, our preliminary findings can contribute to raise awareness around the need of designing for culturally sensitive generative AI [55] with the ultimate goal of matching users' expectations and avoid adoption barriers such as algorithm aversion and harms in the algorithm's afterlife as a consequence of problematic AI behaviors.

5. Concluding Remarks

The available plethora of AI-powered products in both commercial and non-commercial settings has brought several options that musicians and music enthusiasts in general can utilize in their everyday co-creative practices. Such music composition pursuits can go beyond professional music studios and live concerts to incorporate everyday life contexts involving individual and family-level activities occurring inside and outside home environments when sharing music, teaching music composition, or producing a song for a video presentation. This is in line with the paradigmatic shift observed in the field of HCI towards an understanding of the everyday life-world and its sociocultural nuances when people use a fully-digital interface for playback controls or any kind of hardware music-making device. Embracing this involves a deep understanding of whether and how generative AI shapes (and is shaped by) creative endeavors towards a better alignment between users' expectations and how they really interact with generative AI systems taking into consideration a diverse set of musical styles, cultural characteristics, and individual (or even collaborative) preferences. Consequently, addressing this new set of challenges and opportunities can lead to a set of actionable insights and guidelines that might be transferable to other creative scenarios and cultural production domains involving a broad array of stakeholders such as designers, developers, and researchers with interest in different genres of culture and media production through generative AI. Our future work will further expand on these situated practices by studying how artists and other music enthusiasts are using AI in their artworks with a focus on an in-depth ethnographic fieldwork investigating music production communities to inform how metaphors are both culturally and socially constructed in their AI-assisted creations.

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