

# AI-Aided Co-Creation for Wellbeing

Haizi Yu<sup>1</sup>, James A. Evans<sup>1</sup>, Donna Gallo<sup>2</sup>, Adam J. Kruse<sup>2</sup>, William M. Patterson<sup>2</sup>, and Lav R. Varshney<sup>2</sup>

<sup>1</sup> University of Chicago, IL 60637, USA {haiziyu, jevans}@uchicago.edu

<sup>2</sup> University of Illinois at Urbana-Champaign, IL 61801, USA {dogallo, akruse, wmpatter, varshney}@illinois.edu

## Abstract

Human health is a state of complete physical, mental, and social wellbeing; not merely absence of disease or infirmity. Longstanding research in the psychology of wellbeing lists *mastery*, *relatedness*, and *autonomy* as the three innate psychological needs that must be fulfilled. Group creativity, when carefully designed and coordinated, is a unique activity that fulfills all three simultaneously, boosting not only global wellbeing but also cultural and economic wealth of diverse communities. However, group creativity is difficult and can thwart competence if not done properly: individual creative contributions are fundamentally complex and co-dependent; their combination requires more intelligence than simple summation or independent voting. We propose a vision to advance AI-aided social co-creation platforms that boost interactive and effective human-human and human-AI collaborations in creating music, which can then expand to other creative and productive domains. Current videoconferencing, distance learning, and social networking helped maintain connection in these pandemic years, but are insufficient for people to collaboratively create. We leverage a new human-interpretable learning paradigm---*information lattice learning*---together with equity-centered design principles, to build AI-aided platforms that integrate disparate groups of people, their ideas, and expertise into high-quality creative outputs while preserving autonomy of individual human contributors and supporting anti-racist teaching efforts.

## Introduction

In the preamble to its constitution, the World Health Organization states that health is a state of complete physical, mental, and social wellbeing and not merely the absence of disease or infirmity. Many believe that even with COVID-19 abating in many communities, our lives are going to be more physically constrained and more virtual than before (Rannastu-Avalos and Siiman 2020). Surgeon General Vivek Murthy and others have warned that social distance will cause a crisis of loneliness and a social recession with permanent damage to communal bonds that are essential to health and wellbeing (Murthy and Chan 2020; Murthy 2020). This position paper argues that it is possible to improve human wellbeing and

therefore health via a platform for co-creative music composition with anyone in the world, powered and coordinated by artificial intelligence (AI). Moreover, it can support critically creative musical collaborations that build cross-cultural competence and foster social change in communities by developing *knowledge of self* among educators, students, and community members (an element of Hip Hop that is key to transformative practice, goals of racial justice, and development of critical consciousness).

In particular, we argue such a co-creativity platform can be built on emerging foundational AI theory on interpretable learning paradigms (e.g., information lattice learning) (Yu and Varshney 2017), human-AI interaction design, music intelligence, sociology of creative teams (Yin, Wang, Evans, and Wang 2019; Wu, Wang, and Evans 2019), computational (co-)creativity for mental wellbeing (Cheatley, Moncur, and Pease 2019; Cheatley, Ackerman, Pease, and Moncur 2020), street inquiry methods for social impact in research, Hip Hop entrepreneurship and the commercialization of AI creativity technology, as well as relevant lived experience. We further argue such a platform built on interdisciplinary foundations will enable economic and societal impact; answer significant research questions at the intersection of artificial intelligence, the arts, and the social sciences; and grow the cultural and economic wealth of diverse social groups, e.g., Black communities in the United States.

Designing AI-aided social co-creation platforms can boost interactive and effective human-human and human-AI collaborations in creating art and science. However, in addition to the underlying AI technology, the user interface and user experience (UI/UX) must also be high-quality to ensure human creators and AI can initiate and maintain effective interaction. Moreover, large-scale adoption of a consumer-facing technology requires it to have broad appeal.

We argue the following pipeline of key activities for human-AI interaction-focused research and development will yield a music co-creation platform.

1. Develop further theory on collective human and artificial intelligence.
2. Design practical UI/UX to support deep human-human and human-AI creative interaction, leading to equity-centered music composition.

3. Implement real AI-aided platforms and explore their potential for economic/societal impact.
4. Work with diverse user groups (e.g., K-12 classrooms, Black communities) to inform tech features and human-AI interaction via user-centered design, and to support critically creative musical collaborations that build cross-cultural competence and foster social change in communities by developing knowledge of self.

Besides developing AI agents as team members working with people, it is also important to design AI “admins” coordinating teamwork and capturing value from individual contributors. We leverage *equity-centered* methodology as our design principle for such AIs: it is the practice of purposefully involving diverse communities (including minority social groups) throughout a design process so as to allow all voices to be directly heard and to directly affect how the solution will address the inequity at hand. It is a form of user-centered design (Vredenburg, Mao, Smith, and Carey 2002; Garrett 2010; Endsley 2016), an iterative design process in which designers and system-builders focus on users and their needs in each phase of the design and build process.

## The co-creative future between humans and AIs

*Creativity is powerful.* Regarded as one of our most sophisticated cognitive skills, this ability drives human progress by allowing us to perform nonroutine tasks, take advantage of novel opportunities, and invent new solutions to problems facing the world. Creativity is the hallmark of art and science, as well as engineering and technology that benefits wide swaths of society. More broadly, it is the basis for innovation and continuous reinvention—enhancing creativity can accelerate and improve product and service development across all industries.

*Co-Creativity is critical.* Although popular culture tends to lionize the lone genius, group creativity often trumps individual creativity. It is not surprising that creative work is largely carried out by teams rather than heroic solo inventors. Teamwork, however, comes with its own dynamics. Effective collaboration requires not only cooperation, i.e., having aligned goals, but also coordination mechanisms to enable effective alignment and adjustment to teammates’ actions. Both are enhanced in social creativity if teammates have an effective theory of mind, or the ability to accurately attribute mental states such as beliefs, desires, and emotions to oneself and to others. Proper social workflows and organizational architectures also help. Group music composition is an important example because music is engaging and central to human self-expression and culture; Google’s Bach

doodle for music harmonization, only briefly online, catalyzed 350 person-years of creative human engagement.

*AI-aided co-creativity is the future.* The COVID-19 pandemic restricted co-creativity, with technical, scientific, engineering, musical, and other creative teams largely shifted to remote work. Videoconferencing, social networking, digital curation, and education tools have all seen significant increases in usage as teams interact virtually. Unfortunately, these tools seem to be ineffective at fully recreating the wide range of social heuristics and institutions that support creativity in shared physical space. These shortcomings have a deleterious effect on both productivity and work satisfaction. AI-aided systems can bridge this disconnect and help effectively rebuild what has been lost during the pandemic. Although started as a solution, AI-aided co-creation may in turn trigger a new revolution that fundamentally changes how intelligences, natural and artificial, interact in the long run.

## Enhancing wellbeing

In psychology, self-determination theory states that people across cultures manifest three innate psychological needs: *mastery*, *relatedness*, and *autonomy* (Ryan and Deci 2000; Varshney 2012; Church et al. 2013). Satisfying these needs is said to lead to psychological health and wellbeing, which in turn leads to greater creativity, effective problem solving, motivation, performance, and persistence. While existing remote tools often satisfy one or two of these needs, group creativity activities satisfy all three at once, yielding the highest levels of health and wellbeing. For these benefits to accrue, however, AI-based creativity systems must be able to combine disparate contributions while retaining the distinct creative contributions from each person in order to maintain a sense of autonomy and broad personal identification with the co-created work. In ensemble composition, melodic contributions by people should not be overwhelmed by the harmonization of AI so they cannot be identified and appreciated. Unfortunately, cognitive support tools have a tendency to change content for creative activities and reduce the feeling of human agency, which people indicate is important to feeling ownership of creative artifacts.

## AI as a team member: human-interpretable models

How to disaggregate/aggregate disparate contributions in complex tasks such as composing music has been an open question in human-computer interaction (Frich, Vermeulen, Remy, Biskjaer, and Dalsgaard 2019) and collective intelligence (Kittur, Lee, and Kraut 2009). Yet we argue emerging work on human-interpretable and human-like AI (rather than black-box models like neural networks) is up to the challenge, leveraging information lattice learning (ILL) technology first designed for human-interpretable knowledge discovery via information- and group-theoretic

foundations. The technology recovers music theory in the same human-interpretable form as textbooks, as well as discovering powerful new music concepts of interest to music theorists. The basic idea is an iterative discovery algorithm that operates on a generalization of Claude Shannon's information lattice, which itself encodes a hierarchy of abstractions and grows algorithmically from universal priors (e.g., symmetries) consistent with human innate cognitions.

Of core importance regarding human-AI interaction, the adopted AI approach is both self-exploratory and self-explanatory, so its rule induction and training function can be naturally used for co-creativity. By understanding the basic abstractions underlying contributions from one's creative partners, one can work better together. Indeed, theory of mind is considered essential for effective human group creativity and even human-AI creativity (Mehta, Somaya, and Varshney 2020). Moreover, methods for taking incoherent sets of rules and making them coherent by violating a minimal set (rather than violating all rules a little bit) (Yu, Li, and Varshney 2017) play an important role in resolving conflicts that typically exist in all sorts of teamwork. Thus, an aggregation function can emerge by exploring, selecting, and re-assembling rules underlying disparate contributions, making them coherent, and then generating novel musical pieces from the new rule set.

The base AI technology is core to develop a music co-creation platform where people and their AI partners can play several roles in a creative ecosystem. Key AI functions include decomposition of music into melody, harmony, rhythm, style, and similar components as well as intelligent synthesis that recombines these into harmonious compositions.

### **AI as an administrator: equity-centered design**

Drawing on results from user-centered and equity-centered design methods (supplemented by street inquiry methods) can inform new social theories of human-AI interaction. We develop practical insights for developing UI/UX and networked platforms applicable for diverse communities to capture their values in various creative processes (e.g., young, Black aspiring musicians, producers, and DJs around the world). Notably, interaction design involves:

- Assessing individual strengths (and weaknesses);
- Identifying what might help people with the way they currently do things;
- Exploring what might provide quality user experiences;
- Listening to what people want and getting them involved in design; and
- Using user-centered techniques as part of the design process.

Outcomes of this methodology include flows that describe individual differences and importances in user experience, which in turn inform the technological features needed to support anything anyone wants to do in the system. An example feature that could emerge from a flow would be content-based musical fragment search. As we develop new social theories for the interaction of human and "alien" intelligences and discover the flows of how users actually want to participate in human-AI co-creativity, we expect new technological ideas to emerge to suggest novel AI research questions.

### **Assessing wellbeing**

Testing the hypothesis that AI-based music co-creation has significant stickiness, that it enhances mastery, relatedness, and autonomy, and that it indeed leads to increased subjective well-being, is important for any implemented social co-creation platforms. Ethnographic, qualitative and digital information elicitation with users are necessary methodologies. Assessment of specific dimensions of self-determination theory like human autonomy using batteries such as the Index of Autonomous Functioning (Varshney 2020) is another example of effective evaluation.

### **Broader societal impacts**

Following our focus on improving global wellbeing via musical co-creativity for everyone, we believe the proposed approach can satisfy aims including: (a) centering Black cultural wealth that connects historical and contemporary musical practices; (b) supporting critically creative musical collaborations that build cross-cultural competence; and (c) fostering social change in communities by developing knowledge of self among educators, students, entrepreneurs/technologists, and community members. In this way, we may address power and structural issues noted in so-called third wave AI ethics. We enable this via the participation of our local partners. One of them is a mobile Hip-Hop classroom and sound studio, a means to collect oral histories, a cross-generational catalyst for music sharing and production, and a method to link communities across the state through music, dance, visual arts, and history. Members of its street team play a crucial role in ensuring participatory, community-driven, culturally authentic experiences. Notably they can identify artists in the community with cultural cachet, and once identified, will onboard them via mindset and skill set development training.

Notably, Hip-Hop is a natural setting for information-lattice based decomposition and recomposition. It evolved as an extension of the Black narrative of using music and manipulations of various technologies to speak truth to power, but also pivots beyond current realities with creativity as a form of spiritual survival and flourishing (Petchauer 2012).

Working with AI technology enables honoring and exponentially expanding Black cultural wealth, providing a platform for communicating issues critical to Black communities, and bolstering anti-racist efforts within and beyond our local community, all in an engaging manner that enhances visceral interest in computing technologies.

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