Understanding and Mining Patterns of Audience Engagement and Creative Collaboration in Large-scale Crowdsourced Music Performances

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Overview: We have developed a performance system called *Crowd in C*, which allows audiences to create melodies on their smartphone and collaborate with each other. The system generates short melodies for each user and allows the user to *edit* the pitch and timbre of the notes with a simple graphical user interface that is intuitive to use and keeps the musical choices aesthetically pleasing and in line with the design choices of a composer who synchronizes users' musical choices. However, a crucial part of *Crowd in C* is the interaction that can occur between users. Users may also *browse* each other's melodies and *"heart"* them (similar to a "like" action on social media such as Facebook). Finally, each user can collaboratively form music by *mingling* their melody with that of another user, overlaying the other user's melody on top of their own.

Our goal is to facilitate greater musical engagement and sustain it for the duration of a musical performance. We show that the social actions permitted by *Crowd in C* are instrumental to facilitating musical engagement, which we see as the number of audience actions—particularly social actions such as "hearts" and "mingles" increases over time. A second research question is to understand which factors—musical or social—drive audience engagement. Clustering the users based on their patterns of behavior, we find different groups of users. Whether by initial results based on visual inspection or more sophisticated hierarchical clustering, we often find some group of users that is more *musically* active (these users have high numbers of "edit" actions as they refine their own melody; they may or may not browse other users' melodies, and generally send fewer "hearts" or "mingles") and another group that is more *socially* active (sending several "hearts" and "mingles"). From curated examples, we can see distinctive musical or even visual patterns in melodies that receive many "hearts" or "mingles", which suggests that users are in fact sensitive to the artistic dimension of each other's work and are using *Crowd in C* to engage in creative as well as social expressions. We do find that users who "heart" a melody often go back and edit their own melodies, indicating that users do in fact receive inspiration from each other to create more music.

Publications: The system is freely available at https://crowdinc.github.io/. Analysis of the data from crowdsourced performances with *Crowd in C* was presented in the 2019 ACM Conference on Creativity and Cognition, and a paper was published in the proceedings [1]. An additional paper describing the *Crowd in C* system in more detail was also presented at the same conference [2]. The work was invited as a talk the Information, Expression, and Immersion Symposium.

Student Involvement: University of Michigan undergraduate student Aaron Willette was involved in developing the *Crowd in C* system and writing the paper. Additional data analysis was performed by graduate student Mark Heimann and undergraduate student Grae Abbott.

Music Performances: This work has been presented as a music performance as follows:
- Virginia Tech Faculty DISIS Concert 2018
- ACM Creativity and Cognition 2019, San Diego, CA
- The Information, Expression, and Immersion Symposium, Blacksburg Virginia
- Welcome Reception for New Graduate Students, University of São Paulo, Brazil (Performed by Antonio Deusany de Carvalho Junior)

Press Release: The work was introduced in a local CBS news show (link).

[1] Lee, Sang Won, et al. "The Effect of Social Interaction on Facilitating Audience Participation in a Live Music Performance." *Proceedings of the 2019 Conference on Creativity and Cognition*. ACM, 2019.

[2] Lee, Sang Won, and Aaron Willette. *Crowd in C*. In Proceedings of the 2019 on Creativity and Cognition. ACM, 2019.