For Novices Playing Music Together, Adding Structural Constraints Leads to Better Music and May Improve User Experience

Luke Samuel Dahl
CCRMA
Stanford University
lukedahl@ccrma.stanford.edu

Sébastien Charles Robaszkiewicz
Computer Science Department
Stanford University
robi@cs.stanford.edu

ABSTRACT

We investigate the effects of adding structure to musical interactions for novices. A simple instrument allows control of three musical parameters: pitch, timbre, and note density. Two users can play at once, and their actions are visible on a public display. We asked pairs of users to perform duets under two interaction conditions: *unstructured*, where users are free to play what they like, and *structured*, where users are directed to different areas of the musical parameter space by time-varying constraints indicated on the display. A control group played two duets without structure, while an experimental group played one duet with structure and a second without. By crowd-sourcing the ranking of recorded duets we find that structure leads to musically better results. A post experiment survey showed that the experimental group had a better experience during the second unstructured duet than during the structured.

Author Keywords

Music; interaction; constraints; collaboration.

ACM Classification Keywords

H.5.2. Information Interfaces and Presentation: User Interfaces.

INTRODUCTION

Making music with others is an enjoyable experience for those with musical skills. With computer-based interactions, designers can create simple instruments which can be easily learned by anyone [1]. However, for non-musically trained users a simple instrument may not be enough. Being unfamiliar with possible musical goals or how to achieve them, they may not know what to *do* with an instrument.

In jazz improvisation, musicians' actions are constrained by multiple layers of structure, including the style and form of the piece, and the conventions of jazz practice. The addition of explicit structure such as rules or games to group theater improv can reduce the risk of poor outcomes, thus improving the quality for general audiences [3]. Constraints are utilized by artists to drive creativity [**?**], and can be used in collaborative systems to foster group awareness and cooperation [2].

We hypothesize that for musical novices, adding structure may provide a focus and context that helps players feel less inhibited and more expressive. It may also result in better music. We created a simple instrument, and conducted a study in
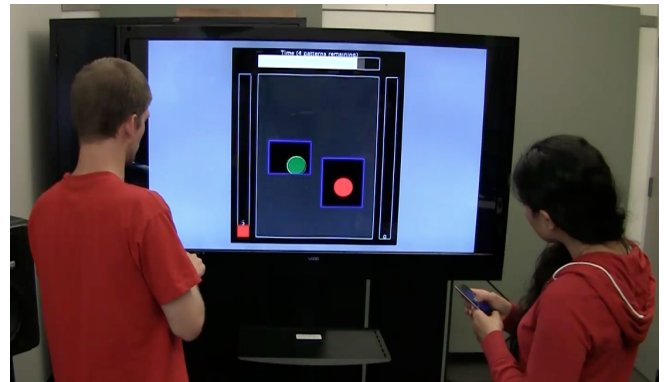
Figure 1. Novices playing a structured duet.

which pairs of users play duets under two interaction conditions. In the *unstructured* condition users may play whatever they like. In the *structured* interaction users must play within time-varying constraints which direct them to different areas of the musical parameter space.

INSTRUMENT AND INTERACTIONS

We created a simple instrument that is intended to be quickly learned and easy to play on a mobile device. Touching the screen plays a note, and touching and dragging plays a stream of notes. A note consists of a short synthetic tone with a sharp attack followed by a quick decay.

The instrument allows users to control three basic musical parameters: *pitch* is controlled by the vertical location of the touch, *timbre* is controlled by horizontal location, and *note density* is a function of how frequently notes are played.

Making Music Together

Two users can play together, each with their own instrument controlled from separate mobile devices. Each instrument has a slightly different tone. There is a shared public display where the players' actions are visible as colored circles in a single large rectangle that mirrors the touch area on the controller (see Figure 1).

Playing a Duet

Users can play a duet together along with a background accompaniment of chords and a drum pattern. A duet consists of eight "patterns" of four measures each, and lasts a minute and twenty seconds. A bar at the top of the display shows time progressing through each pattern and the number of patterns
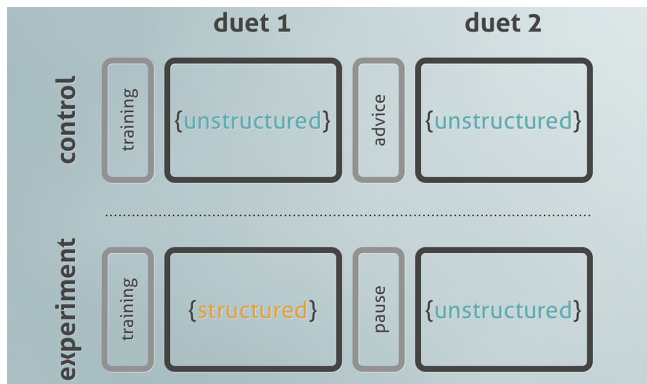
Figure 2. The experiment.

left in the song. The notes of the instruments are constrained to a scale which sounds good with the accompanying chords, and the timing of notes is constrained to fall on 16th-note intervals of the rhythm. As a result the instruments will always sounds musically consistent with the accompaniment.

Structured Interactions

We create a structured interaction by directing users into different areas of the musical parameter space. Users are instructed to play within blue squares that appear on the display, and notes played outside of them becomes distorted. The boundaries of the squares change for each 4-bar pattern. This serves to constrain the dimensions of pitch and timbre.

To constrain note density, we limit the number of notes that a player can play during each pattern. Colored bars on either side of the screen indicate the number of notes left to each player for the current pattern. A video of the instrument and interactions can be seen at **http://vimeo.com/46977021**.

Implementation

The instruments are controlled with a custom layout for the TouchOSC iOS app, which sends Open Sound Control messages to a computer running ChucK for the sound synthesis and sequencing and Processing for the display.

STUDYING THE EFFECTS OF STRUCTURE

The Experiment

In order to understand how adding structure affects musical interactions for novices we conducted the following experiment. Pairs of users were assigned to either a control or experimental group. In both groups the instrument was demonstrated, and users were allowed to learn the instrument by playing freely together. They were then asked to play two duets together with a brief pause in between.

The experimental group played the first duet in the *structured* condition while the second duet was *unstructured*. The control group played both the first and second duets in the *unstructured* condition, and between duets they were given verbal advice for structuring musical interactions (Figure 2). All 16 participants were university graduate students.

Results

Does adding structure lead to better music?

Musical quality is a subjective judgement, and thus difficult to assess. However by soliciting judgements from a large number of people we hope to average out personal preferences and converge on a measure of quality. We created a website that asked visitors to compare recordings of two duets and indicate which was better, from which we gathered 474 evaluations from 114 unique IP addresses. Using the Elo rating system we calculated quality scores for all of the first duets in one pool, and all of the second duets in a separate pool .

In the first pool, one duet's score was two standard deviations below the mean. After removing this performance we find that the average score of music performed by the experimental group is significantly greater than the score of the music performed by the control group ($t(6) = 3.55$, $p = 0.006$). In other words, people preferred music played with structure to music played without structure. We did not find any trend in the scores of the pool of second duets.

Does adding structure lead to a better user experience?

A post-experiment survey was used to measure the participants' experience for both duets. The experimental group enjoyed the second (unstructured) duet more than the first (structured) duet, ($t(14) = 2.89$, $p = 0.006$), they took their partner into account more in the second duet ($t(14) = 2.09$, $p = 0.028$), and thought that the music was better in the second duet ($t(14) = 3.47$, $p = 0.002$).

Furthermore, we calculated the increase of these metrics from duet 1 to duet 2 and compared the groups. We found that the experimental group had greater increases in enjoyment ($t(14) = 1.85$, $p = 0.043$) and perceived musical quality ($t(14) = 2.17, p = 0.024$) than did the control group.

DISCUSSION AND CONCLUSION

We designed a simple musical instrument that users can play together under unstructured or structured interactions. Our study was meant to show the effects of adding structure. Our crowd-sourced musical quality evaluation shows that structured interactions lead to better music. It is also clear from our survey that going from a structured to an unstructured interaction leads to an improvement in perceived user experience. However, it is not clear whether this is because the structured interaction was less enjoyable *in itself*, or whether having the previous experience of structure *led* to a better experience during the subsequent unstructured interaction. Our initial results suggest that a larger study is warranted.

REFERENCES

1. Blaine, T., and Fels, S. Collaborative Musical Experiences for Novices. *Journal of New Music Research 32*, 4 (2003), 411–428.

2. Hornecker, E. A Design Theme for Tangible Interaction: Embodied Facilitation. In *Proceedings of the ninth conference on European Conference on Computer Supported Cooperative Work*, ECSCW'05, Springer-Verlag New York, Inc. (New York, NY, USA, 2005), 23–43.

3. Sawyer, R. K. *Group Creativity: Music, Theater, Collaboration*. Lawrence Erlbaum Associates, 2003.

4. Stokes, P. D. *Creativity from Constraints: the Psychology of Breakthrough*. Springer Publishing Company, 2005.