Emotional Response as a Measure of Liveness in New Musical Instrument Performance

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Abstract
In this paper we propose that the measurement of an audiences emotional response to the performance of a new musical instrument correlates with an expert judgment of liveness. An initial experiment has shown a strong positive correlation between the two, indicating that audiences who have a positive emotional response to a performance also consider the performance as being more 'live'. Observations are then made on what elements of the performances in our study contributed to or detracted from perceived liveness.

Author Keywords
Performance, Emotion, Musical Instrument Design.

ACM Classification Keywords
H.5.2 User Interfaces

Introduction
The liveness of a performance is a topic of discussion commonly raised in critical response to performances of new musical instruments, particularly to laptop-based performances where the activity of the performer is almost entirely hidden and an audience cannot easily establish the connection between a player's action and the resulting sounds. One of the aims in the design of new musical instruments is to create a system that will

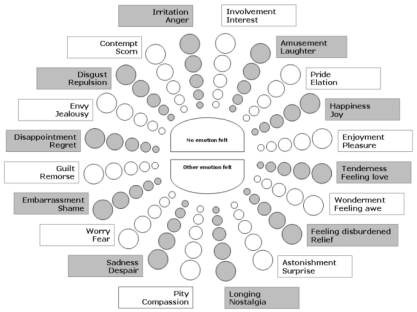

Figure 1. The Geneva Emotions Wheel [4]. The range of emotions runs from positive on the right, to negative on the left.

Figure 2. A conventional instrument played alongside an unconventional new instrument may provide an 'overspill of liveness'.

allow the performer to connect with the audience, and liveness is one of the main ways in which this connection can be achieved. As such, the knowledge of how to design an instrument that encourages greater liveness would be a useful design tool.

As a first step towards achieving this goal we propose that being able to measure, or at least approximate, the level of liveness of a performance will aid in the evaluation and critique of new musical instruments. In particular we are interested in methods of measuring liveness that do not depend on an expert opinion.

Existing frameworks for classifying musical interfaces provide one method of mapping out a scale of liveness, an example being the Skill-Rule-Model taxonomy [3] (fig.3). This taxonomy has a scale of `interruption tolerance' that we believe closely maps to a perceived scale of liveness. An example is that a radio DJ (having more interuption tolerance) is likely to be seen as less 'live' than an instrumental performance (having less interuption tolerance).

The discussion of instrumental liveness can also be discussed in terms of causation [2]; an audience member that recognises causation between the performers action and resulting sound may attribute a higher level of liveness to the performance. Research on the recognition of causation between people [5] may provide a fundamental starting point for further work on the recognition of liveness in musical performances. Another avenue of exploration to consider is how liveness relates to expression, in particular looking at intentionality and how the addition of more controls does not necessarily lead to greater expressive possibility [1].

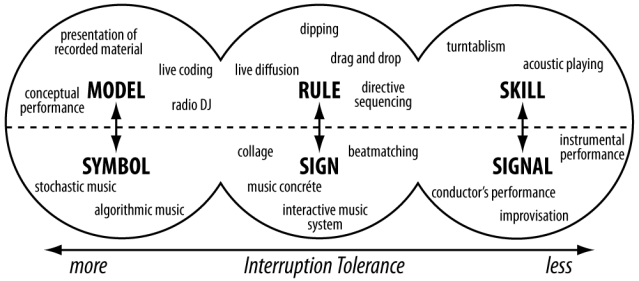

Figure 3. Skill-Rule-Model Taxonomy of Digital Musical Instruments (redrawn from [3]). The scale of interruption tolerance is analogous to level of performance liveness, where less interruption tolerance equates to high liveness.

Process

Our study took place as part of a second year computer science undergraduate module in HCI. Fourteen groups of 5 or 6 students were set the task of designing and constructing a new digital musical instrument. The resulting instruments were marked during an end of term performance, where each group performed in turn in front of the rest of the class. In order to gain feedback from the audience as to their enjoyment of each performance, each group in the audience was given a Geneva emotions wheel to complete for each performance (fig.1). The emotions wheel lets the participant record both the type of emotion they are feeling along with a basic indication of emotional strength.

For the purposes of marking the projects, a subjective score of enjoyment of each performance was made at the time of the concert by each author. The authors later examined videos of each performance and between them determined an overall score of liveness for each performance.

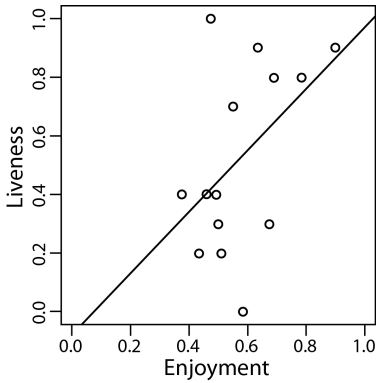

Figure 4. A positive correlation was found between expert scores of Liveness and Enjoyment (across the ratings of 14 new instruments)

Figure 5. The 'body drumkit' allows for quick establishment of cause and effect, despite lack of a visible instrument (sensors were hidden on feet, knees and chest).

Analysis

The data from the emotion wheels was represented numerically and analyzed using GNU R. Each emotion variable was checked for correlation with the overall measure of liveness using Pearson's correlation coefficient. For each of the emotion variables tested, we found that positive emotions showed a positive correlation with liveness, while negative emotions showed a negative correlation with liveness.

In addition to testing the audience's emotional response against our score of liveness, we also compared our score of enjoyment (made at the time of the performance) against our later score of liveness (determined from the concert video). In this comparison we find a positive correlation with liveness, (fig.4) [$r(12) = 0.58$, $p < 0.05$]. These results would seem to show a link between the perceived liveness of a performance, the emotional response of the audience to the performance, and overall enjoyment of a performance.

Observations from the Performances

In addition to finding that performances with a higher liveness tended to produce a positive emotional response in the audience, we have made a number of general observations based upon the student performances:

Miming Effect. In some of the groups, performers added extra gestures that were not sensed by the instrument. This led to confusion as to what the performer was controlling. This did not tend to be a problem when the extra gestures were clearly performance based. This problem may be accentuated by the use of accompanying music or backing tracks.

Visibility. Small hidden gestures are hard for the audience to read. This can make it difficult for the audience to determine if the performer is actually creating the sound or whether the sound is simply happening automatically. A projection showing the software or workspace helped to prevent this problem (fig.6), along with the use of exaggerated gestures.

Multi-player. Multiple players all playing the same instrument, or playing copies of the same instrument, led to confusion as to which performer was producing each sound. However, this was something that could be overcome by a performance where time is taken, either before or during, to clearly introduce each instrument.

Conventions & Instrumental Contrast. An instrument that follows, or at least hints towards standard musical instrument conventions can be 'read' more easily by the audience. This allows them to easily determine a relationship between the performer's actions and the sound created and thus increases the perceived liveness of the performance (fig.5). A similar effect can be achieved by performing using a traditional instrument alongside a new instrument. For example, a new instrument that is played alongside a singer or guitarist appears to gain some 'overspill liveness' from the clearly live performance happening alongside (fig.2). Conversely, a new instrument played alongside a video or other non-live backing (such as a backing video or even a metronome) can also gain liveness, this time through the struggle to keep in time with the prerecorded material.

Interaction Fidelity. The granularity of the interaction can help determine how the audience understands the causality between performer and generated sound. A gesture or action that is translated immediately into a

Figure 6. Projection used to show a close up of smaller-scale interaction. Exaggerated gestures also helped to convey small movements to the audience.

sound can be more easily read than one that takes a minute before a change in the sound takes place. This notion of interaction fidelity links to the interruption tolerance of the Skill-Rule-Model taxonomy (fig.3).

Sampling. Live sampling of sound can be used as a quick method for the performer to establish the liveness of the performance. Unfortunately, once sampled, the manipulation of the recorded sound tended to be manipulated in a relatively static, or non-live manner.

Audience Participation. Involving the audience in the performance, such as though means such as live sound sampling, quickly allows the audience to establish a base level of liveness. This also worked if audience members were invited to try out the instrument before or after a performance, allowing them to judge themselves how difficult the instrument is to play.

Performer Engagement. Performers who appeared to be fully engaged with their instrument, making constant adjustments and changes also appeared to increase the liveness of the performance. This is in part determined by the interaction fidelity and partly by the performers skill and stage presence.

Future Work and Conclusion

This initial study has shown a link between the positive emotional response of an audience and the liveness of a performance. Additionally a link was also found between a less live performance and a negative emotional response from the audience. This indicates that it may be possible to measure liveness indirectly though the measurement of an audience's emotional response. This technique does not aim to quantify a performance's liveness as a single number, but rather to show that the liveness of a performance directly effects the positive emotional enjoyment of a performance, therefore making liveness an important consideration in the design of new musical instruments. We hope this initial study will be a springboard from which to further discuss the intricacies of purposefully designing new musical instruments that encourage greater 'liveness' in performance.

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