Decay in Collaborative Music Making

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ABSTRACT

This paper reports on ongoing studies of the design and use of support for remote group music making. In this paper we outline the initial findings of a recent study focusing on the function of *decay* of contributions in collaborative music making. Findings indicate that persistent contributions lend themselves to individual musical composition and learning novel interfaces, whilst contributions that quickly decay engender a more focused musical interaction in experienced participants.

Keywords

Music improvisation, creativity, group interaction, design.

1. INTRODUCTION

Music making is inherently a social activity, yet a vast majority of our musical instruments are designed to be used by individuals. Such instruments rely on physical proximity to foster group music making i.e. being in the same space as others. Whilst we have embraced new forms of group verbal communication such as text messaging on mobile phones, for many of us informal and pervasive group music making has lost its place as an everyday form of social interaction [6]. Reviews of support for music collaboration [1] indicate that remote group music making is a field ripe for exploration yet there is little work investigating support for remote group making, let alone exploring what it might mean to engage in such activities.

We believe that we can start to design richer and more satisfying musical experiences by understanding what encourages and supports *mutual engagement* between people as they interact with each other. We characterize mutual engagement as points at which participants start to play with, and explore their interaction with others over and above the mediating devices involved. At these points participants start to rely on their shared beliefs and understandings of what is going on, what might happen, and who might do what in the interaction. Such points are crucial in group music making which relies heavily on both shared expectation and experimentation. Indeed, group music making is a pertinent example of a basic form of group creativity which has many

parallels to normal verbal conversation including being multimodal and co-present.

The rest of the paper is organized as follows: First the design of a novel group music making tool is outlined, then a study of the effect of persistence of contribution has on mutual engagement is detailed followed by discussion of the emergent patterns of use. Finally the paper is concluded with some discussion about implications for the design of group music making tools.
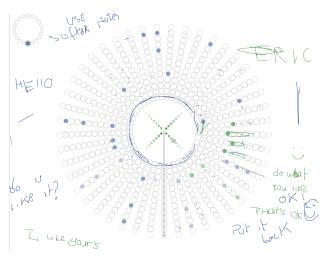
2. DESIGN

Daisyphone is an on going design project [2, 3] whose aim is to support remote group music making. By remote *music making* we refer to the form of musical interaction which is somewhere between improvisation and composition; participants can jam together and yet the resultant music is persistent and editable. In previous work we identified four design features which we believe contribute to the support of mutually engaging collaborations and which we employed in the design of Daisyphone: **Localization** within the artifact being co-produced; **Mutual awareness** of actions; **Shared and consistent** representations; **Mutual modifiability** of contributions.

The Daisyphone user interface is illustrated in figure 1. Notes are lower in pitch towards the edge of the circle. As the grey arm rotates clockwise, the notes underneath are played, so each of the spokes represents notes played at the same time. Hues of notes indicate who contributed them (this provides *mutual awareness* of actions), and intensity of color represents the volume of the note. Different shapes represent different instruments including piano (circle), and percussion (diamond). Volume and instrument are modally controlled from the four central spokes.

In Daisyphone's current form up to 10 remote participants can create and edit a short shared loop of music semi-synchronously – typically updates take under one second to be shared. This provides support for a form of remote group music making whilst requiring little network bandwidth. As with other remote group making tools such as WebDrum [4], Daisyphone works by clients sharing indications of musical contributions *via* a central server through the internet so providing a *shared and consistent* representation of musical loops being constructed. There is no ownership in Daisyphone – people can edit each others' notes and play the same instruments supporting *mutual modifiability*. As well as sharing musical contributions, Daisyphone also shares graphical annotations on and around the music composition space; drawing occurs whenever the mouse button is pressed which results in a 'messy' form of interaction. This annotation

is intended to support both *localization* within the composition, and social and discursive exchanges

Previous studies [2, 3] have identified several design issues with Daisyphone and its support for group creativity. In this paper we explore the nature of persistence in contributions. In pervious versions of Daisyphone all contributions were persistent. It quickly became clear through studies that participants did not clear up after themselves and the musical space quickly became saturated with notes which created a cacophonous noise. The ability to move to new, clean, sessions was one of the first design developments and resulted in the circular session selector illustrated in the top left of figure 1. However, further studies showed that this still was not sufficient to promote flowing and engaging musical interaction – participants simply got bogged down in a sea of contributed notes. In order to investigate the effect of persistence of musical contribution, a new version of Daisyphone in which notes disappear was developed (referred to as the **decay** version). Only the notes are transient, therefore the graphical annotation created when the notes are contributed remain providing some visual cues to the contributions (a form of history of contribution). The rate of decay of the notes is critical to the design – too quick and coherent sharing of music will not occur given the semi-synchronous nature of the infrastructure; too slow and the musical space will continue to became overcrowded. For the studies here, decay is created by halving the volume of notes every time the arm passes over them. This typically gives 3 plays of a loud note before it disappears which appears from initial studies to be sufficient for co-ordination.

Figure 1: Daisyphone interface

3. STUDY
The aims of this study are twofold: 1) To investigate the effect decay of contributions has on remote group creativity in music; 2) To further explore the nature of remote group music making in general.

3.1 Format
Ten post graduate students studying Advanced Methods in Computer Science at the authors' institution were set a piece of coursework in which they were asked to:

- Use both the persistent and decay versions of Daisyphone to remotely create music together over three weeks.
- Perform their piece of music for the rest of the group.
- Analyze and report on the interaction that took place in Daisyphone in both versions.

The students grouped themselves into 3 groups. They had a wide range of musical ability from novice to proficient musicians playing in bands. None had ever used a tool like Daisyphone before.

Participants were asked to report on whether, and how, they experienced flow as a group [7]. We also asked the participants to identify points of *attunement* between each other on a three point scale: **Acknowledgement** –they were aware of the contributions of another; **Mirroring** – they mirrored, or reflected, others' contributions; **Transformation** – they transformed others' contributions (indicating a high level of mutual engagement). These reports and ensuing discussions are used in the rest of this paper to help make sense of the observed behavior. Flow was categorized in terms of: Chance of completing the activity; Ability to concentrate on what they're doing as a group due to clear goals and adequate feedback; Deep, effortless involvement with a reduction in concern for external factors; Sense of control over actions; Transformation of time.

Additionally, logs of all actions in Daisyphone were stored for later re-play and analysis.

4. PATTERNS OF USE
This section outlines the patterns of use and behavior that took place in the study with the persistent and decay versions of Daisyphone. Initial analysis of logs are presented here – detailed analysis is currently being undertaken. An average of 8 sessions with the persistent version and 3 sessions with the decay version were recorded for each group. Each session lasted on average 16 minutes for the persistent version and 12 minutes for the decay version.

Participants reported being fairly relaxed about deleting other participants notes and making modifications to their contributions. This is in contrast to previous studies and ongoing public use where reluctance to edit others' contributions is evident. We suggest that this is due to the nature of the exercise set ('you must create a piece of music together for performance later') and the social situation (they all knew each other quite well and had possibly worked together before).

4.1 Patterns of Use with Persistent Version
As with ongoing analysis of the use of Daisyphone, in both versions the participants tended to spend the first parts of their sessions exploring Daisyphone on their own. Typically in the shared environment this meant working in a particular quadrant of the loop of music. Once participants were able to understand Daisyphone's interface they then moved on to working in other areas to develop longer tunes or contribute to other participants' work.

Interestingly, an informal role assignment developed when using the persistent version with participants tending to stick to one instrument. Moreover, a 'leader' tended to emerge during the sessions. This person typically constructed the main melody which was then supplemented by others in the group. Daisyphone has no explicit mechanisms or guidance

for how to divide the collaborative effort, so we believe that we are starting to see here some emerging behavior which could give us insight into how to develop more engaging collaborations in the future. We suggest that role assignment emerges naturally and does not need to be explicitly built in to the interface *i.e.* in this case there was no need for ownership control of instruments as participants negotiated it themselves.
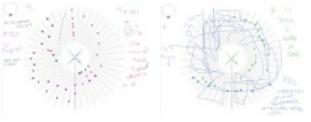
In pervious studies we noted that participants tend to write their name on Daisyphone. Given the ongoing nature of Daisyphone public trials, and the informal nature of other trials, we suggested that this name writing was a form of stating ownership - saying 'This is mine'. From post study discussion it became clear that participants were using their names as presence and authorship indicators – saying 'This is me'. Furthermore, as the study progressed, participants started to use shorter and shorter tags – starting from more explicit versions such as 'Hi, its me, Nick', to abbreviated versions such as 'Nick'. Daisyphone was designed to provide mutual awareness of actions through shared and consistent representations of: the current state of the shared loop, different hues for each participant, and a flicker on the session selector when activity occurs in that session. We suggest that the emergent and conventionalized behavior of writing one's name on entry to a session indicates that the messy nature of the interface additionally supports the informal evolution of expressions of identity. To this end we do not believe that the introduction of explicit identity into the interface is necessary or worthwhile. Interface features such as pictures, textual names, *etc*. add an unnecessary layer of interaction (setup, login, and so on) which we seek to avoid in the development of informal, *ad-hoc*, serendipitous musical interfaces.

4.2 Patterns of Use with the Decay Version

The use of Daisyphone with decaying contributions was not as engaging we had as anticipated. Participants complained that they could not keep up with the required contributions and that sessions tended to become unstructured and uncoordinated. Experience with Daisyphone as a musical instrument was a key factor in engagement with the decay version – the more experience participants had, the easier they found the decay version to handle.

When looking back over the logs of the interactions it is clear that in the version with decay participants tended to make musical 'gestures' rather than placing individual notes as they had on the persistent version. This is illustrated by the amount of annotation in figure 3 which reflects the creation of music through gesture rather than placing of notes as in figure 2. These gestures tended to be quickly drawn lines which could easily be replicated to keep the tune going. Perhaps providing an even more fluid form of interaction where gestures are interpreted around the Daisyphone would provide easier ways to create musical motifs in real time. It was also clear that the decay version required more focus on the music, and much less discussion of pieces, with participants having to keep musical motifs in their head in order to keep a tune going. In some ways this makes the decay version more akin to conventional group musical improvisation where typically the music and gestures provide for communication between participants as opposed to speech (or text in Daisyphone).

Anecdotally, there were more reports of experimentation with compositions with the decay version as the space did not require cleaning up. However, the persistence of annotation which provides some history of contributions did not prove as useful as anticipated as the proliferation of contributions meant that there were a lot of indications of old notes as illustrated by the mess of graphical lines in figure 3. Perhaps the sequence of contributions also needs to be indicated in some way.

Figure 2: Persistence   **Figure 3: Decay**

Also, interestingly there was anecdotally more convergence of tunes between participants with the decay version *i.e.* they started to *attune* to each other and make similar tunes within a group more quickly than they did with the persistent version. This indicates that decay may encourage quicker convergence of musical patterns after a period of experimentation. However, participants felt that they experienced flow as a group far less when the notes decayed as they felt anxious about making enough contributions, and felt that they had lost some control of the situation. So, it seems that whilst they mirrored each other more quickly, they did not transform each others' contributions as they disappeared too quickly.

In terms of organization, participants found that with the decay of notes the division of labor was more egalitarian. That is, there was no longer the typical emergent leader of the piece, instead participants contributed what they could, with the tendency to converge quickly on a musical theme (if one could quickly be established).

Unexpectedly, participants tended to make non-overlapping contributions as with the persistent version. We had expected that when notes decay participants would start to make more contributions at the same time (as with conventional music playing). This may be a feature of the way music is made with Daisyphone rather than an indication of mutual engagement.

Finally, from analyzing the logs it is clear that participants contributed notes more frequently with the decay version (*e.g.* one group made approximately twice as many contributions per minute with decay *versus* persistence). This is clearly because of the amount of contributions that are needed to keep a tune going when the notes disappear. Figures 4 and 5 illustrate overviews of Daisyphone generated by the log tool. In these diagrams time is represented horizontally from left to right, and points in the timeline indicate a contribution of some sort with each column representing one second of interaction. Thus the amount of activity is indicated by how tall the columns are. As with Daisyphone itself, colors represent users – in figure 4 there are two users represented by green and blue, whereas in figure 5 the users are represented by purple and pink. Note that there are multiple saturations of the same color as saturation represents the volume of the contribution. Yellow points indicate the removal of notes in Daisyphone. In figure 5 we see the timeline for the example session shown in figure 3 lasting 13 minutes where contributions decay over time. There are several peaks throughout the interaction, and the total number of contributions 4230. In contrast, figure 4 illustrates the

interaction in the persistent version over 11 minutes with fewer peaks (in this case these peaks are actually points at which writing takes place in the interaction whereas in the decay version they are musical contributions) and approximately half the number of contributions.
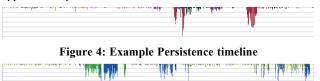

Figure 4: Example Persistence timeline

Figure 5: Example Decay timeline

5. Discussion

The key implication with respect to the decay of contributions is that contributions should only start disappearing once people have learnt how to usefully make them. We had expected the converse to be true – that when contributions decay it would be easier to learn the effects of the interaction through experimentation. So, we suggest that in order for creative musical experiences to become more engaging people's contributions should become more transient as they become more experienced, whilst support for the logistics of collaboration remain constant *e.g.* mutual awareness of actions should not change. We can usefully relate this to Csikszentmihalyi's analysis of flow and its relation to skills and challenges [5] as illustrated in figure 6. From this point of view, in order to experience flow one should have an appropriate match between the skills that people have and the challenges they are encountering – high levels of skill with low challenge leads to boredom, whereas high challenge with low skill leads to anxiety. As people become more skillful in relation to the activity they need to encounter greater challenges to remain in a flow experience.
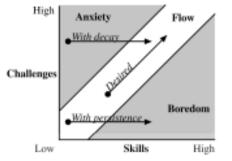

Figure 6: Flow, skills, and challenges, adapted from [5]

In the case of Daisyphone we believe that with persistence people became bored of the interaction as the challenge was no longer sufficient for their skills, whereas with decay participants were initially anxious, but some did increase their skills enough to experience flow as illustrated in figure 6. We suggest that as people become more skilled with the interface the rate of decay should gradually increase so that the challenge is sufficient for a flow experience, as illustrated by the desired interaction in figure 6. This could either be done automatically as time passed, or under user control as they felt boredom approaching. Doing so would provide people with an experience of music in which their initial low skills are supported by persistence of contribution, so not being too anxiety provoking, whilst boredom is abated by increasing the

challenge (decay). Moreover, we suggest that by keeping the collaboration support constant the participants will become more engaged with each other as well as the product at hand. We would expect to see more convergence of music, and hopefully more reliance on others' contributions in the joint production. Furthermore, we believe that the decay of contributions by skilled users could be usefully employed to engender mutual engagement in other group creative tools such as brainstorming, problem solving, and so on.

6. Conclusion

This paper presents observations on the use of a novel group music making tool in two versions: one where musical contributions persist, and one where they decay. We suggest that allowing variable amounts of decay in an interface will allow the challenge of an interface to change to reflect the skills of participants and so hopefully more flow experiences will occur. Moreover, it will support increased engagement between people as indicated by more convergence and borrowing of other people's ideas. These are useful features for group music interfaces as well as other creative applications.

Additionally, we feel that the 'messy' nature of Daisyphone provides a useful interaction metaphor which informally supports many aspects of the logistics of collaboration including identity, awareness, history, localization, and the development of communicative conventions. We argue that the introduction of explicit support for these features of group interaction is unnecessary and instead suggest that more messy support will encourage people to intuitively develop their own conventions.

The key issue we are going to pursue next is how to flexibly manipulate the decay of contributions both graphically and musically without disturbing the participant, whilst still keeping the challenge, engagement, and flow to the forefront of their experience.

7. ACKNOWLEDGMENTS

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