Mobile Group Music Improvisation

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Abstract

Collaborative improvisation, composition, and performance of music constitute a basic and distinctive form of human interaction. Across cultures, the production and enjoyment of music is typically an open, collaborative, activity more analogous to informal conversation or story telling than to a formal lecture. We know very little about how to design for such situations even though we have seen a blossoming in the range of mobile interactive devices. In this paper we present a design for a remote group music improvisation environment and a evaluation framework based on psychoanalytic theories of attunement between mother and baby in early development. The applicability of such evaluation to joint creative play in adults is demonstrated through observation of the use and development of the remote group music improvisation environment using mobile tablets

Key words: play, collaboration, music, design, evaluation, psychoanalysis, user interface

Introduction

We take group music improvisation as a vehicle in which to explore group creativity as it constitutes a basic and distinctive form of human activity. This contrasts current approaches to understanding collaborative work which have focussed on task, role, and knowledge oriented issues. In turn these have typically lead to the development of systems concentrating on the logistics of collaboration – how to share data, how to negotiate roles, and how to make knowledge available in different contexts. We need to move beyond this to consider the glue that makes collaboration engaging, enjoyable, and rewarding for the participants. We argue that the *mutual engagement* of participants is fundamental to the efficient and satisfactory completion of group activities and moreover becomes increasingly important for more creative and innovative the activities where participants understand, appreciate, and in some cases anticipate each other's actions and requirements.

It is proposed that from notions of individual's engagement with interactive experiences (Douglas and Hargadon, 2000) mutual engagement can be characterised as a point at which participants feel engaged with the production in hand (*i.e.* able to change and appreciate changes in the form) and engaged with other participants (*i.e.* able to understand their role in the collaboration, the possible next steps of others, and others' perceptions of their possible next steps). This can be viewed a state in which participants experience flow (Csikszentmihalyi, 1991) as a group (Sawyer, 2003) – highly focussed activity pushing at the boundaries of a shared understandings of experience and expectation. It is argued that whilst collaboration can be undertaken without high levels of mutual engagement, it is vital to enjoyable and high quality collaborative activities.

Mutual engagement itself is a state of being within a social construction, and as such we cannot directly observe or induce mutual engagement in people. Instead we can look for indications that mutual engagement has occurred in traces of interaction, and we can try to develop tools which are designed to remove barriers to mutual engagement. For example, we might try to reduce the need to become

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immersed in the logistics of collaboration by explicitly supporting cues to mutual knowledge (*cf.* Healey and Bryan-Kinns, 2000).

As we are considering collaboration in some way supported by tools, the features of a collaborative situation which relate to mutual engagement are twofold – the tools themselves (production mechanisms, co-ordination mechanisms), and social constructs – these are briefly outlined in the following sections.

Production mechanisms

The aim of creativity is to produce something novel, so we need to design interfaces which support and enhance play rather than hindering it. We have developed a set of design criteria for idea exploration and formulation (Bryan-Kinns *et al.*, 2004) based on Tabor's notion of a 'space for half formed thoughts' (2002) which consists designing for a spatial metaphor, multimodality, emergent patterns of interaction, and variable focus allowing shifting of attention.

Co-ordination mechanisms

Of course, we are interacting with others in collaborative situations so we need to reduce the emphasis on the logistics of interaction – knowing who is doing what, when, and where. To this end we developed a set of design criteria (Bryan-Kinns *et al.*, 2003a; 2003b) for efficient collaboration from features of human interaction: Localization within the artifact being produced, mutual awareness of actions, mutual modifiability, and shared and consistent representation.

Social constructs

What we believe about activities, others, and ourselves is socially constructed (Burr, 1995) and frames our action. Moreover, each interaction contributes a change to the social constructs which will in turn change the way we view the world. Within social constructs there may be many factors influencing mutual engagement in a collaboration *e.g.* personal characteristics, experience, social setting, cultural conventions; the focus of our research is on the effect of technology on mutual engagement, and how that effect could be assessed. In this paper we focus on identifying indicators of mutual engagement - such assessments could be used to compare systems, or to generate guidelines for system development.

Mutual Engagement Indicators

There may be many indicators and measures of mutual engagement which would be applicable in different situations. For example, we might rate the quality of the end product, or judge the creative 'prowess' of the activity as it unfolded, or ask participants to rate their enjoyment and engagement with others in the process. These ratings would tend to be both subjective and highly domain dependent, making them difficult to usefully apply across domains. Instead it is argued that by examining the communicative interaction involved in collaboration we can identify key features of the collaboration which might indicate levels of mutual engagement between participants.

The approach detailed in this paper is inspired by psychoanalytic descriptions of attunement (Stern, 1985) between mother and baby in early childhood (see Wright, 2000 for a introduction to Stern's work in the area and its relation to creativity in adult life). Such a view describes the interaction between mother and baby where in a normal situation, the mother responds not only to their infants' major emotions, but also in a moment-by-moment way to smaller changes – 'she reads her baby by every possible non-verbal means and intuitively senses the changing patterns of its feeling state'. Moreover, 'in the normal situation, the mother does not merely register the infant's state in an ongoing way: she engages in responsive displays of her own, which, in one modality or another, reflect the patterns and rhythms of the baby's' (Wright, 2000). We draw inspiration from the approach and focus on three levels of attunement:

1) **Acknowledgement** – participants show that they are aware of the contribution of another

2) **Mirroring** – participants mirror, or reflect, others' contributions thus demonstrating that they themselves are able to produce it

3) **Transformation** – participants transform others' contributions, indicating a high level of mutual engagement

This framework has strong parallels to the alignment of words and gestures in everyday conversation which indicates a level of interaction and engagement with each other where joint meaning and understanding is being created (Tabensky, 2001). However, by focussing on attunement of action, we do not limit ourselves to verbal or gestural interaction.

Remote Group Music Improvisation

As mentioned previously, we take group music improvisation as a paradigm example of group creativity and play. Titon (1996) provides ethnomusicological discussion of music and improvisation from rain forest cultures such as the BaAka people to classical Indian music where performances are a balance between precomposed and improvised music. State of the art music technology for individual and group music production focuses on two issues: novel tools for improvisation, and support for composing and editing music. New forms of instruments aimed at individual improvisation are exemplified by systems such as the Electric Circus (Coady, 2002) which is played by jumping on a floor mounted 'keyboard'. New means of individual composition are exemplified by the mixed reality techniques employed by the 'augmented composer' (Berry *et al.*, 2002) where computer recognisable cards are arranged on a table to create musical phrases. From a group music perspective composition is supported by commercial systems such as Rocket networks (*cf.* Hall, 2002) where support for group composition is limited to file sharing across networks, not the process of collaboration *per se*, and research into the effects of representations on temporal location in music during group composition (Nabavian, 2002).

Work on group improvisation technologies is less advanced. Research such as FMOL (Jorda, 2001), Webdrum (Burk, 2000), and Metatone (Leach, 2001) have begun to explore the group improvisation in geographically remote locations. This typically involves developing a shared visualisation of the music being produced and some communication support, but they are based on a very limited analysis of the character of mutual engagement in musical collaboration. Without this perspective we are left to design devices by intuition – hoping that we will create new forms of interaction that somehow are more musically and socially engaging.

Design of a novel group music environment

Daisyphone is an on going design project (Bryan-Kinns *et al.* 2003; 2004) whose aim is to support remote group music improvisation. In its 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 improvisation whilst requiring little network bandwidth which is important when designing for mobile devices which may have limited processor power and network bandwidth – approaches such as BT Music On-Line (BT, 2004) which rely on high speed networks, processors, and video, would not be appropriate for such *ad-hoc*, low cost, and informal collaboration. As with other remote group improvisation tools such as WebDrum (Burk, 2000), 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.

We have used our design criteria for production and co-ordination mechanisms outlined earlier to inform the design of Daisyphone. There is no ownership in Daisyphone – people can edit each others' notes and play the same instruments which we hope will start to breakdown conventional playing patterns such a audience *vs.* performer. As well as sharing musical contributions, Daisyphone also shares graphical annotations on and around the music composition space. This annotation is intended to support both localization within the composition, and social and discursive exchanges. Moreover, it provides a 'messy' space in which to create and play which we hope engenders exploration and fun interaction (*cf.* Fass *et al.*, 2002). Finally, in order to be usable in a variety of form factors and devices, the design is scalable and does not rely on conventional user interface widgets such as menus or pointers, and instead relies on true direct manipulation of the representation.

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 (each participant is allocated a unique hue), and intensity of colour represents the volume of the note. Volume and instrument are modally controlled from the four central spokes.

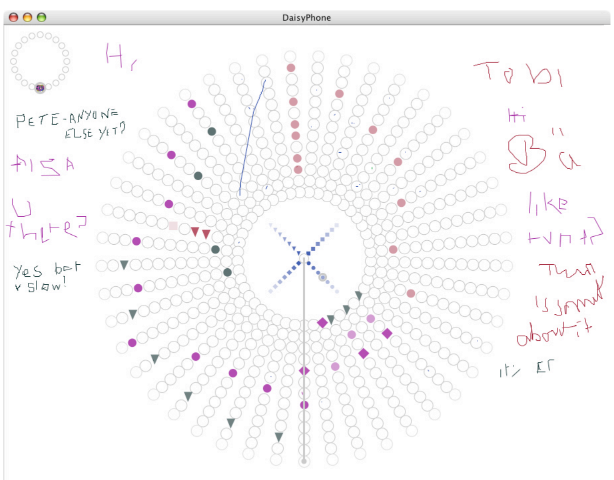

Figure 1: Daisyphone interface

Previous studies (Bryan-Kinns *et al.*, 2003; 2004) have identified several design issues with Daisyphone and its support for group creativity. In this paper we present analysis of logs of the use of Daisyphone to illustrate our analytic framework for identifying points of mutual engagement in collaborations.

Study background

Logs of the use of Daisyphone were gathered from a study involving 10 school pupils interacting with Daisyphone in a semi-remote situation using wirelessly connected mobile graphical tablets. The participants were given a brief introduction to how the Daisyphone worked covering: how to set notes, how to unset notes, how to select different instruments, and the shared nature of the representation. They were then asked to work with remote co-participant(s) to try to create a recognisable tune *e.g.* a TV theme tune, or a tune they liked.

Participants had up to 15 minutes to complete the task. During the session participants could ask for a new Daisyphone session giving them a blank canvas to work with. This was negotiated between the participants of the group. They could return to previous work if they wished; none of the groups revisited old work.

The aim of the physical setup was to provide semi-remote collaboration where non-Daisyphone interaction between remote participants could easily be identified and recorded. Two desks were set 10m apart to reduce audio contact between the tables as illustrated in figure 2. Visual contact could be achieved by turning away from the table, and vocal communication achieved through shouting. Each desk had on it: a tablet running Daisyphone, an instruction sheet, and a pair of speakers connected to the tablet.

Figure 2: Study setup

From logs of the interaction contributions were categorised in two primary ways: inferred contribution to graphical form, and inferred motivation for contribution which are decomposed below and discussed in the following sections.

Graphical form was categorised in four ways as illustrated in figure 3: filling of the space (F), drawing straight lines (L), drawing curved lines (C), and individual dots (D) not forming part of a discernable and contiguous geometric shape.

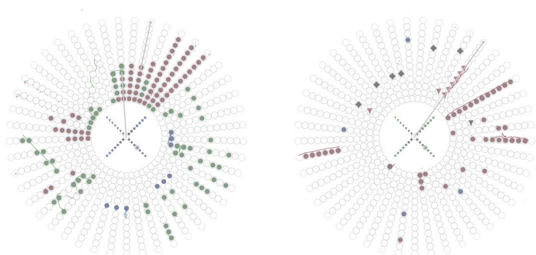

Figure 3a: Filling **b: Straight lines**

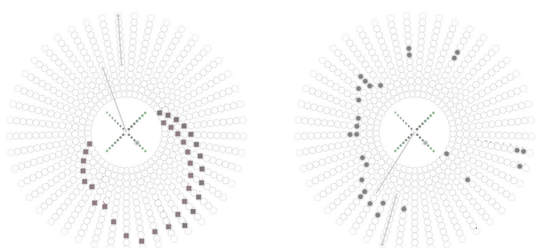

Figure 3c: Curves **d: Individual dots**

Inferred motivation was categorised in six ways: apparently random (R), experimental (E), and intentional contributions which are necessarily related to other contributions in some way as they make a sequence or graphically align. Intentional contributions may either be fitting to their own contributions (S), or others' contributions. Fitting to others' contributions indicates a form of attunement – transformation (T), mirroring (M), or acknowledgement (A) of others' contributions as outlined below:

Acknowledgement – participants made contributions which took into account other people's already present contributions by not writing over them, or by creating chords using part of someone else's contribution. This shows that they were aware of others, and in the case of chord creation, had high levels of musical ability. Figure 4 illustrates a situation in which the two participants implicitly acknowledge each other's existence by working in their own part of the Daisyphone space – playing in their own space and not encroaching on the other.

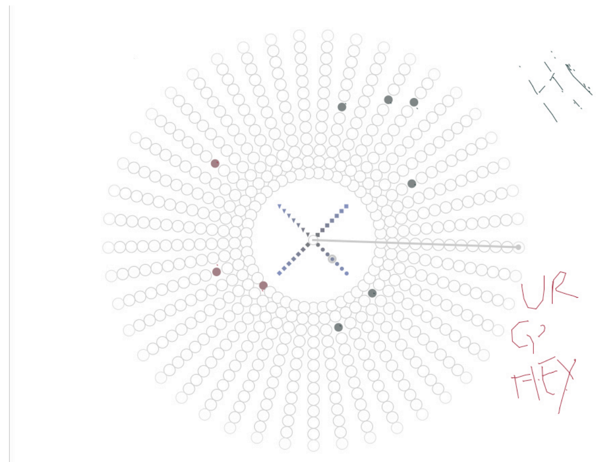

Figure 4: Acknowledgement

Mirroring –participants may start to mirror patterns or tunes created by others. For example, two users (Lindon and Curtis) in the same space initially started making different geometric shapes with Lindon sticking to lines and Curtis sticking to curves as illustrated in figure 5a. Later on in their third of session Lindon then started to move on to making curves – mirroring Curtis' work (illustrated in figure 5b). In the study mirroring typically focussed on the geometric patterns (lines and curves) rather than on mirroring musical melodies which indicates a level of mutual engagement, but a low level of engagement with the music itself – they are playing with each other through visual interaction, not musical interaction as we had hoped.

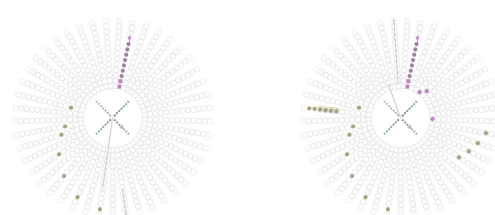

Figure 5a: Pre-Mirroring **b: Mirroring**

Transformation – there were very few instances (discussed later) of participants taking other people's contributions, playing with them, and creating their own versions of them. This is a indication of higher levels of mutual engagement than mirroring as it indicates a willingness not only to mimic others, but also to play with other people's ideas. For example, Lindon and Curtis went on to a situation illustrated in figure 6 in which Lindon was making quite complex variations of curves – a play on the original work by Curtis through transformation.

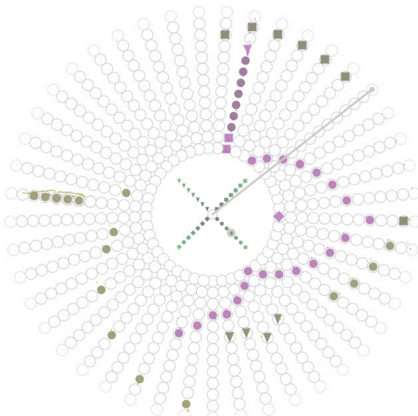

Figure 6: Transformation

Time and transition

To indicate what an activity looked like, and what we believe the intentions behind it were we paired the graphical and motivational codes. For example, drawing a straight line experimentally would be coded as LE.

We are interested in the points at which intentional activities showed some level of attunement with others as we argue that this is an indicator of mutual engagement. In these situations we suggest that participants are tying to construct musical pieces (rather than exploring individual sounds) and so try to link notes together to make a tune. This is distinguished from experimentation as it involves some editing of the notes – un-setting as well as setting.

Being able to identify instances of attunement is a useful activity in itself for spotting points at which mutual engagement may occur. However, it does not help us to compare designs or to understand the overall nature of the collaboration. To this end we also analyse the amount of time indicators of mutual engagement occur for, and the transitions between different indicators. We found that that most time was spent in DE (Dot Experimenting – 926s) which may have been due to the novelty of the user interface meaning that many people were engaged in learning to play music on it – essentially playing with the *interface* rather than playing with *each other through* the interface as we had hoped. We then found that the most frequent transition (9 times) from DE was to chat (writing on the graphic area), and less frequently (8 times) a transition to LE (299s) as the participants learnt how to create lines, not just dots. The most striking aspect of the analysis was the lack of transformations or mirroring. These were never reached from any other state more than once, and the total time spent was relatively small: LM 9s, CM 17s, LT 26s, CT 30s, DT 35s.

Discussion

So, what does our analysis tell us about the design and use of Daisyphone and group creativity systems in general? First it indicates that the level of expertise was low with participants tending to move between experimenting and chatting. This was to be expected given the novel nature of the interface, a potential development could be to try to develop a more intuitive, or easier to play interface, for example, by only allowing providing notes from certain musical scale so that they were always in tune with each other. Second, it illustrates the typical development of skill from experimenting with dots (DE) to experimenting with lines (LE) and on to experimenting with curves (CE). This probably reflects development of musical understanding through the use of graphical patterns. A useful development might be to exploit people's familiarity with graphical shapes in order to develop musical skills *e.g.* by using free form music to create gesture rather than a circular interface. Third, it illustrates a learning path from experimenting with lines (LE) to making lines with reference to one's own compositions (LS) and on to skilled composition with respect to one's own contributions (DS). We could better exploit this path by providing more coherent building blocks such as rhythmic patterns which could be joined together to make longer pieces and experimented with. Indeed, the feedback we received from the pupils was that only 50% felt that they could develop good tunes with Daisyphone, so there is clearly still some development to be done on the production mechanism, though it should be noted that it was a very unusual interface for the pupils and they only had a short time to interact with it. Finally, it illustrates that acknowledgement was the highest level of attunement reached which had more than one transition to any other state – this is not what we had expected when we designed the system and is discussed in more detail below.

Considering the two design criteria of production and co-ordination, it seems to us that whilst Daisyphone's production mechanisms are somewhat effective, the co-ordination mechanisms appear to not be providing enough support for engagement between participants. Figure 7 illustrates this situation – we see indicators of mutual engagement (attunement in this case) as a function of the production and co-ordination mechanisms as illustrated by the bands of italic text. As production and co-ordination mechanisms improve from concentrating on logistics of the interaction to focussing more on engaging interaction we posit that there will be more indicators of higher levels of attunement indicating more mutual engagement is happening. From our observations we believe that there is typically a combinatorial effect of production and co-ordination mechanisms, hence the curved shapes of the attunement indicators. For example, tools with very engaging production mechanisms but poor co-ordination mechanisms may be better for mutual engagement (*e.g.* reaching the acknowledge band) than a tool with both mediocre production and co-ordination mechanisms.

Our current design of Daisyphone is illustrated by the 'Current' dot within the Acknowledge band of attunement – we need to improve both the production and co-ordination mechanisms to get to our 'Aim' in the Transform band of attunement. In its current state, we believe that development of Daisyphone's co-ordination mechanisms would make the greatest difference. For instance, making other people's contributions glow more prominently, or providing more feedback about who is in the space at the same time, what they are doing, and their focus of attention.

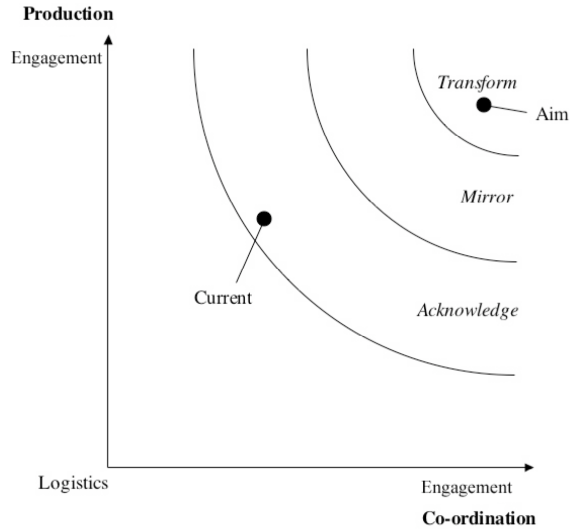

Figure 7: Indicators of Attunement in Relation to Production and Co-ordination Mechanisms

Summary

We are still a long way from understanding what makes that creative 'spark' happen in group creative situations. In this paper we have proposed a framework for analysing the interactions within a group in order to identify points of mutual engagement. We used this to analyse group play with a novel group music instrument and to form proposals for redesign in order to hopefully make the experience more mutually engaging. We believe that such frameworks can provide insights into the design and evaluation of a wide range of playful interfaces as they are based on fundamental notions of interaction rather than modal specific analyses.

Acknowledgements

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References

Berry, R., & Tadenuma M. (2002). "Augmented Reality for Music." *Proceedings of the 2002 International Computer Music Conference*, 110-113.

Bryan-Kinns, N., Healey, P., Thirlwell, M., & Leach, J. (2003a). "Designing for Group Creativity." *Supplementary Proceedings of HCI International 2003*.

Bryan-Kinns, N., Healey, P., & Thirlwell, M., (2003b). "Gudar – A Novel Group Music Instrument." *Supplementary Proceedings of INTERACT 2003*.

Bryan-Kinns, N., Healey, P., & Thirlwell, M., (2003c). "Graphical Representation for Musical Improvisation." *Proceedings of 2nd International Workshop on Interactive Graphical Communication 2003*.

Bryan-Kinns, N., & Healey, P. G. T. (2004). "Daisyphone: The Design and Impact of a Novel Environment for Remote Group Music Improvisation." *Proceedings of DIS 2004, Boston, USA*.

BT. (2004). *BT Music On-Line*. http://music.york.ac.uk/musiconline/ (last visited 19 May 2004)

Burk, P. (2000). "Jammin' on the Web - a new Client/Server Architecture for Multi-User Musical Performance." *Presented at ICMC 2000*.

Burr, V. (1995). *An Introduction to Social Constructivism*. Routledge.

Coady, N. (2002). *Interaction design for real-time music creation environments – The Electric Circus*. MA thesis, University of Westminster.

Csikszentmihalyi, M. (1991). *Flow: The Psychology of Optimal Experience*. Harper Collins.

Douglas, Y., & Hargadon, A. (2000). "The Pleasure Principle: Immersion, Engagement, Flow." *Proceedings of Hypertext 2000, San Antonio, USA*, pp. 153-160.

Fass, A., Forlizzi, J., and Pausch, R. (2002). "MessyDesk and MessyBoard: Two Designs Inspired by the Goal of Improving Human Memory." *Proceedings of DIS 2002, London, UK*, 303-311.

Hall, G. (2002). "Bands Without Borders." *Electronic Musician Magazine*, October 2002, 72-86.

Healey, P., & Bryan-Kinns, N. (2000). "Analysing Asynchronous Collaboration." *Proceedings of HCI 2000: People and Computers XIV – Usability or Else!*, 239-254. Springer-Verlag, London.

Jordà, S. (2001). "Improvising with Computers: A Personal Survey (1989-2001)." *Proceedings of 2001 International Computer Music Conference. La Habana*.

Leach, J. (2001). *MetaTone: Shared Environment for musical collaboration*. MSc IT Thesis, Queen Mary, University of London.

Nabavian, S. (2002). *Supporting the Emergence of Composition from Improvisation*. AMSc Thesis, Department of Computer Science, Queen Mary, University of London.

Sawyer, R. K. (2003). *Group Creativity: Music, Theater, Collaboration*. Lawrence Erlbaum Ass.

Stern, D. N. (1985). *The Interpersonal World of the Infant: A View from Psychoanalysis and Developmental Psychology*. Karnac Books, London.

Tabor, P. (2002). "A Space for Half-Formed Thoughts." *Speech given at Doors of Perception 7 Conference, Amsterdam, 2002*.

Tabensky, A. (2001). "Gesture and Speech Rephrasings in Conversation." *Gesture*. 1:2, 213-235.

Titon, J. T. (1996). *World of music*. Schirmer Books, NY.

Wright, K. (2000). "To Make Experience Sing." In Caldwell, L. (ed.) *Art, Creativity, Living,* Chapter 5, pp. 75-96.