

INVESTIGATING USER COLLABORATION IN MUSIC BASED GAMES

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ABSTRACT

This study uses a combined method for the analysis of social interplay/interaction among users (or players) in a multimodal interaction and musical performance situation. The combined method consists of a) realtime interface data analysis for the description and interpretation of player actions detected by the system and b) video analysis used to describe and interpret the interaction situation and the context in which the social interplay takes place. This combined method is used in an iterative process, where the design of interactive games with musical-sonic feedback is improved according to newly discovered understandings and interpretations of joint user action. For example: How do two people play together if they play music with a pen tablet interface? Can a sound based computer game encourage two players to co-perform and co-create music? This study investigated two players' joint performance in relation to their mutual play speed, synchronization and mirroring of play styles when 'drawing with sound'.

IN SEARCH OF 'INTERPERSONAL DRAMA'

Rock Band® and Guitar Hero® are two examples of music based games where users act like players in an ensemble situation. These games are designed to entertain people by creating a social situation where players can bond through their joint performance in a rock band setting. Players collaborate

as a team to compete with other teams (or themselves) about "best performance". Rock Band and Guitar Hero have paved the way for a new form of entertainment, where the experience of each player's performance is key: These games potentially offer users the possibility to express themselves together with others. The good thing about these games is that each player

is offered a limited set of expressions, so that it becomes relatively easy to learn how to 'play music'. Also, the gameplay is recognizable: The Rock Band® screen interface shares the typical 'car lane' layout that is seen in multiple computer games. Players navigate along a small selection of paths at a set speed, and they are to collect points in the shape of 'tones' or 'beats' coinciding with a precomposed piece of music. Each player in the band has his/her own separate path to navigate. You could say that their joint play is theatrical: Players mimic the image of a band. However, it is not dramatic in the sense that the players actually create the musical content. Players don't co-create, or improvise together. They do not have mutual influence each other's content, play styles and phrasing.

VISION

In the type of music-based games that encourage open-ended play and improvisation, we find it important that sound feedback is not too dominating or controlling. In many music-based games a sequenced rhythm often eliminates possibilities for phrasing, speed change (*accelerando* / *ritardando*) and expression variability in general. Players end up trying to 'fit in' with an in-

flexible musical parameter. In the development of “intelligent” gameplay, we wish to categorize and quantify aspects of individual and joint action, so that a computer can be programmed to recognize some of them. In order to put the computer in the loop of interaction, it is essential to build a music-based game upon the most important social interaction and musical improvisation parameters that can be measured by a computer. When allowing negotiation of musical performance through co-action, it is important that a computer can respond to the players’ idea of what is happening. By using quantitative and qualitative methods, we can investigate what players do, if they are to share expression on a ‘white canvas’. The improvisation experience should be the ‘goal’ of the game and players should have access to a wider palette of possible participation frameworks than the typical ‘winner-looser’ framework. (Goodwin, 1990). When two players enter a participation framework while playing music based games they engage in a specific way of joint expression. For example, when a player plays a melody, the other player may accompany with rhythmic strokes: a solo-accompaniment framework. Within each momentary participation framework, players impose additional rules as of how to play together. Participation frameworks can change as players continuously negotiate what to do in relation to each other while they play.

In this study we have investigated how players engaged in joint play with simple draw styles when using a pen tablet interface (see figure 1).

With draw styles, we mean that players could either draw dots and lines, circles or scratch movements resulting in different forms of musical expression. Players could engage in partici-



Figure 1: Wacom Intuos4 pen tablet interface*.

pation frameworks with combinations and variations of these draw styles. Examples of variations of a draw style would be to change the speed of one of the draw style. Other changes could be change of scratch angle and the size of the lines, scratch movements and circles. The two main hypotheses about the game design for a pen interface sounded as follows:

- 1) If there was only additional sound feedback, when players used the same draw style combinations (for example if both players drew circles), then players would only use the draw style combinations that resulted in additional sound feedback, once they had discovered how to bring that forward.
- 2) Two players would also start to mirror each other’s speed and timing in the draw movements, if they got additional sound feedback on that.

In general, we had the following research questions:

- What if a music-based computer game can provide users with a musical setting, where different kinds of player collaboration is supported and challenged through available types of participation frameworks?
- Can a computer play an active and positive role in the player-player relation?
- Does it make a difference that there is additional sound feedback as a result of joint improvisation, or is it enough to ‘just’ provide users with some electronic music instruments?
- How do players establish a mutual understanding of the available means of expression?
- How do players react, if a music-based game only gives sound feedback on selected forms of joint action?

HOW DO PEOPLE PLAY TOGETHER?

In this paper, one music-based game is presented that reacted to specific combinations of draw styles, synchronized timing and speed. The goal of this study was to find out if players would mirror each other’s movements and stay in sync, when the sound feedback ‘rewarded’ this kind of behavior. In nine game sessions, teams of two individuals played together. The teams were either male or female teams consisting of university students. Based on the findings from both the video and pen data analysis, it has been possible to pinpoint some important aspects of joint

interaction and come up with some design directions for further development of music based games that support co-performance and co-creation. In a short summary, the characteristics of joint expression were as follows:

- 1) First players needed to ‘find each other’ and establish a participation framework. They needed to realize what each other did, so that they could relate to each other: they established musical and social ‘grounding’. This happened through many other ways than mirroring and staying in sync with each other.
- 2) Then, players started to expand a participation framework by exploring variations of joint play. Players did not continue to stay in sync or mirror each other, once they received sound feedback on that.
- 3) If both players succeeded in following each other, they would guide each other into new participation frameworks.

THE ROLE OF THE COMPUTER

How can a music based computer game support joint player action? We propose that a game design can contain three types of sound feedback that support joint interaction and encourage co-performance:

- 1) Players need individual *reactive* sound feedback for orientation purposes. They also need some reactive feedback of their joint expression, so that they can orient themselves towards each other. In this paper, we investigated how players understood reactive feedback.
- 2) The computer can *adapt* to two players’ found participation framework by rewarding them with additional layers of sound that expand the characteristics of this relationship and also provide extended joint expression possibilities. The sound feedback could adapt to two players’ variations of a participation framework.
- 3) If a participation framework becomes monotonous or trivial, the *adaptive* sound layer may become *pro-active* in that it can push into new participation frameworks or inspire players to make variations of play style within a found participation framework. For example, if players make fast repetitive moves, a *pro-active* sound feedback may contrast this by being slow.

ELECTRONIC MUSIC INSTRUMENTS

There have been several examples of prototypes of new multimodal interfaces that have mapped user gestures to sonic and musical content. Blaine, Fels and Weinberg have discussed mapping of joint user action in networked interfaces (Blaine and Fels 2003, Weinberg 2005). Although the interfaces described are very imaginative in their physical/hardware design and gesture-to-sound mappings, none of these interfaces have been studied in order to evaluate the quality of joint user interaction further than ‘proof-of-concept’. In this paper, we present studies of ‘how people play together’ with a simple music based game application designed for the commercially available pen tablet interface. With the pen tablet players express themselves through fine motoric movements in a well-known setting that resembles drawing activity with pen on paper.

LITERATURE AND THEORY

The music-based game designs that we continue to study are developed through an iterative design process, where some music improvisation principles presented in the field of music theory are considered for the design of multiple music-based games. In “Improvisation. Methods and Techniques for Music Therapy Clinicians”, Wigram presents several techniques that can be used to support, guide and expand a client’s musical expression. All these techniques involve creative uses of rhythm and tempo, phrasing and harmonic structures (Wigram 2004). Furthermore, Bruscia describes various types of client-therapist relationships such as in what he calls “improvisation assessment profiles” (Bruscia 1987). Of course there is a big difference between the dyad: therapist-client and the dyad player-player, whose relationship is triangulated by a computer that can only provide a limited set of expression possibilities for improvisation. While the goal of a music therapist’s musical engagement with another person is treatment, the goal of a music-based game is entertainment through focussed social engagement among players.

MEASUREMENTS OF USER EXPRESSION

In order for the computer to be able to respond to levels of social and musical

engagement, the computer needs to measure only limited aspects of complex player action: individual as well as joint actions. These limited measurements can be mapped real-time to a musical output that players interpret as ‘inspiring’. By ‘inspiring’ we mean that the sound feedback becomes an open-ended game element that guides players in their joint improvisation, focuses their joint attention and supports players in their attunement to one another. In the field of systematic musicology and computer music there has been several examples of how a computer can measure music related gestures through means of sensor technology, electronic music interfaces, video cameras and data processing (Godøy et al. 2010, Godøy et al. 2009, Jensenius et al. 2008 and Leman 2008). However, this kind of research often relies on technology that can be invasive and data processing may be too slow in a game play setting. Realtime gesture analysis, performed on signals from an accelerometer and a gyroscope, has been developed for the purpose of music pedagogy. Here a simple physical interface performs fast interpretation of user gestures (Bevilacqua et al. 2007). In order to simplify gesture recognition in the game design, we chose to measure very simple gestures that users can make with a pen tablet interface (see section 3.2). Users needed to get realtime sound feedback on their actions in order to orient themselves, give rapid response to each other’s actions and maintain flow of action. When working with reactive feedback, we wanted the soundfeedback to be present no later than up to 200 milliseconds after a specific gesture type had been detected. However, in later development, when designing sound feedback that adapt to joint player action, more complex and time based gestural relationships can be measured and mapped to sound feedback that evolves over time.

PLAYERS’ MUTUAL UNDERSTANDING OF SOUND FEEDBACK

In order to answer the research questions posed in section 1.1, we decided to look at player action through ethnographic video analysis. In further analysis, we could use conversation analysis to see how two players engaged in joint

play. With the sound feedback seen as an ‘encouragement’ of joint improvisation, how did players establish a ‘participation space’ and what did players regard as a relevant next action? Why did players pause? (Goodwin 2000). Did pauses indicate congruence or accommodation? (Crown and Feldstein 1985). How were pauses valued in a musical setting? (Tannen 1985). Did players hesitate, because they had difficulties, or did they think about where to find the next focus? (Chafe 1985). Did players direct each other through ‘shifts in physical alignment’? (Goodwin 2007). What was the sequential organization of the players’ sonic utterances like? (Goodwin 1990). Was there any ‘interactional synchrony’? (Kendon 1990a; 1990b).

DATA AND METHODS

In this section we describe the design of a music-based game that was used in this study. This particular game introduced some premises for joint play: Mirroring of movement and synchronization. Similarly, the experiment procedure influenced how players negotiated joint play. In the analysis of joint expression these interaction premises are discussed and evaluated.

EXPERIMENT SETUP AND PROCEDURE

In nine games sessions with two players in each game session we documented how two players played together. The teams consisted of either two females (4 teams total) or two males (5 teams total). The documentation happened in two ways: A video camera filmed the team of two players, and pen interaction data was logged into the computer that also ran the game (see figure 2).

A note about the setup: On each side of the table, next to each player, there was a speaker that played the individual sound feedback of each player.



Figure 2: Experiment setup: A camera filmed two players from the side. A microphone was placed on the table to record what the two players said. Speakers next to each player played sounds as a result of individual and joint actions.

The additional sounds that appeared as a result of selected joint action were centred between the two speakers or panned between them. In the beginning, the two pen tablets were positioned so that the players would face the camera while they played the game. However, when the two players sat down, they adjusted the pen tablets, so that they faced each other and not the camera. The video of the test setup can be found on the following link: <http://www.vimeo.com/16822793>, password: AMSH5research.

At the beginning of each game session, the two players were briefly introduced to the game. The experimenter asked the two players to ‘find additional sounds’ when playing together. Players were told that they could draw dots and lines, make scratch movements and circles. First, each player got to try out his/her individual pen tablet instrument. Then followed a joint play session, where the players could explore the game as long as they wanted. In other words, players had to agree on how to end their joint play session. After the joint play session, the two players participated in a semi-structured interview about their game experience.

GAME DESIGN

We have chosen to design a game that consisted of measured x and y pen positions translated into simple draw styles: dots/lines, scratch movements and circles (see figure 3-5). It did not matter where on the tablet these draw styles were drawn. In addition some features connected to the draw styles were detected: Size and speed, line and scratch degree (360) and circle drawing direction (cw/ccw). It was relatively simple for a computer to detect the draw movements in realtime (within a

sample rate of 20 to 200 milliseconds). In addition to pen x and y positions, we measured pen tilt data.

We limited the sound feedback to regard only parts of the possible interactions that players could perform with the above mentioned draw styles: First, the players got individual feedback on their chosen draw styles. A limited amount of tones were activated along the lines and curvature of a circle. Single tones occurred when players made dots and at the peak points of a scratch movement. Tones changed depending on the size, degree and direction of the movement. The amplitude and tone length changed according to the x and y tilt of the pen. The two players had each their own ‘instrument sound’. One instrument sound (string instrument) was based around high frequencies (HF), and the other instrument (also a string instrument) around low frequencies (LF). The tones were fixed along a Balinese Pelog scale, so that any combination of tones would sound relatively nice. The bigger the drawing area, the more pitch distance there was between the activated tones. Also, different tone combinations would be activated, depending on line or scratch directions.

When two players chose to use the same draw styles (dots/lines, scratch, circles in pairs) and if two players agreed on drawing the same draw styles at the same speed, they activated an additional sound layer: Piano chords were played back at the mutual pace of the two players. If the players kept drawing at the same speed, the rhythm structure of the piano chords changed, however it stayed within the same speed. This design was made in order to present some material that

two players could interact with without being dependant on doing something together. They could express themselves perfectly fine through the means of their individual expression possibilities. However, they were ‘rewarded’ by piano chords, if they mirrored each other’s play style and played at the same speed. If the offset times between scratch peak points and circle top points were low, the two players would activate high pitch chime tones.

ANALYSIS OF JOINT EXPRESSION

Although the players gave some interesting ideas for further development of music based games in the interviews, we will focus on the video and data analysis of joint play in each game session. In order to get a rough idea of how players expressed themselves, we present some overall statistics about the player action that the game design allowed:

- 1) Most popular draw movement combinations,
- 2) Player activity (pens on and off the tablets)

Through the video analysis we found a large variety of participation frameworks among players. This is also seen in the data in that players chose play style combinations that did not result in any additional sound feedback (see figure 6). In order to look at how the game design worked with the players’ joint play, we have divided the video documentation up into five rough groups with the headlines: 1) player explorations, 2) negotiation in joint play, 3) successful joint play, 4) interruptions and difficulties, 5) differences between male and female teams. In addition to providing overall statistics, the logged interaction data also provided a detailed report of how the

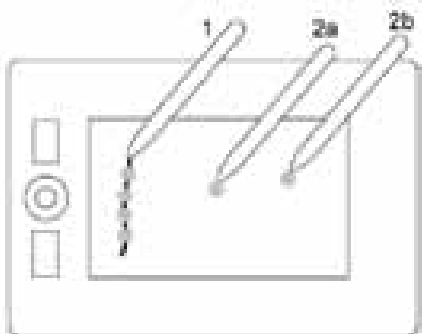


Figure 3: Dots and lines. The grey dots are tones activated along a line (pen 1), or tones activated when the pen touches the tablet (2a and 2b).

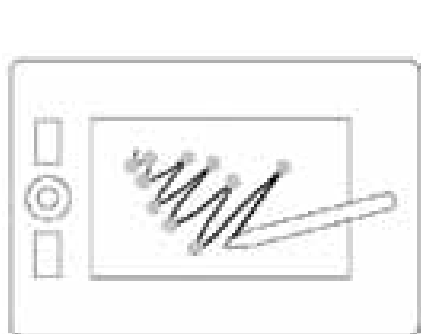


Figure 4: Scratch movement. Grey dots are tones activated at the points of direction change. Here the scratch direction is 45°.



Figure 5: Circle movement. Grey dots are tones activated along the curved line of the circle. Here the draw direction is clock-wise.

particular game design interpreted player actions: draw style combinations (dots/lines, scratch and circles), pen position and tilt, size and angle of movements and patterns in mutual timing and rhythm. The data sample rate was every 20 milliseconds. In comparison, the video ran at 24 frames per second.

EVALUATION OF DATA

Video data provided material for qualitative analysis of individual and joint player action in music-based games: It showed how players perceived and interpreted the sound feedback that happened as a result of individual and joint action. The logged data provided a quantitative analysis of specific aspects of individual and joint action. When logged data was seen in relation to the video, it was possible to get an idea of which aspects of the individual and joint action that the game design captured, and which it could be designed towards capturing. The logged data could also be used to display details of interaction that it was impossible to see on the video and the other way around.

RESULTS: 'A JOURNEY OF MUTUAL

Pen activity	All game sessions
Both pens off tablet	23%
One pen active	30%
Both pens active	47%

Table 1: Pen activity during all nine game sessions.

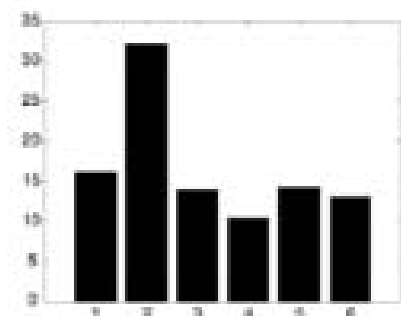


Figure 6: Most popular draw style combinations of all nine teams. Y-axis = percentage of all total game session times. X-axis = draw style combinations: 1= players played circles at the same time. 2 = dots and lines at the same time. 3 = scratch movements at the same time. 4 = one scratched, the other played circles. 5 = one drew dots/lines, the other scratched. 6 = one played dots/lines and the other played circles.

EXPRESSION'

Results showed that two players found many other participation frameworks than the game design suggested. When recalling that the players were asked to find 'additional sounds' together, we saw variations of draw styles that the game design did not account for. In fact, even when the two players realised that they had found 'additional sounds' they were not encouraged to 'stay in touch' with these additional sounds. Instead they revisited them briefly as a starting point for new exploration. In the sections below, there are examples of how the sound feedback on individual action was used as a means of expression, while the sound feedback on joint expression fell into the background or in some cases interrupted joint play. The sections also evaluate video and data results according to each other: Since future designs are to rely on a continuous stream of interaction data, it is important to select the most characteristic interaction data for future action to sound mappings. The selection will be supported by the video analysis.

EXPLORATIONS IN JOINT PLAY

When two players managed to establish a participation framework, they immediately started to explore variations of this framework. Typically one player stayed with one way of playing, while the other player made variations (see video: 00:00-00:35, titled: "variations of scratch movements"). The logged data showed that even though the players only got sound feedback when both made the same draw movements, they also explored other draw movement combinations (see figure 6). Note that dots were not registered in a separate category, but as small lines. The most popular draw style combination was the line-line combination. The results may indicate that dots should be separated from lines in order to get a more even distribution of draw style combinations.

When looking at the player activity (pens on or off the tablet), there was a tendency towards both players being active at the same time (see table 1).

In further analysis, variations of draw styles could be described by looking at the video from the play sessions that deviated from the mean. Some examples are seen in figure 7, how the most

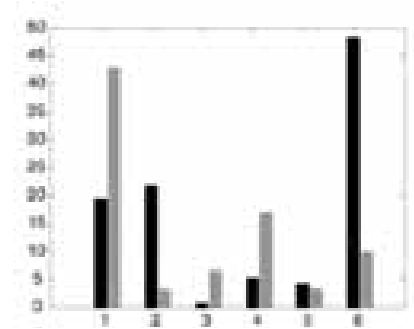


Figure 7: Deviations of most popular draw style combinations. Session 2 = black, session 7 = grey. Y-axis = percentage of total game session time. X-axis = draw style combinations: 1= players played circles at the same time. 2 = dots and lines at the same time. 3 = scratch movements at the same time. 4 = one scratched, the other played circles. 5 = one drew dots/lines, the other scratched. 6 = one played dots/lines and the other played circles.

Pen activity	Session 5	Session 9
Both pens off tablet	28%	9%
One pen active	35%	27%
Both pens active	37%	64%

Table 2: Pen activity in game session 5 and 9.

popular draw style combinations from game sessions 2 and 7 deviate.

In game session 2 and 7, there was a relatively even distribution of draw style combinations. The data showed that one player team was much more active on the tablet than the other player team (see table 2). This indicates that player exploration happened in two different ways. This is also seen in the video (see "00:35-01:12, titled: "two different ways of exploring").

JOINT PLAY NEGOTIATIONS

When players negotiated joint play, they would sometimes negotiate verbally or use mutual gaze. Often one of the players would look at the other player's pen and tablet in order to relate to his/her playstyle or copy it (see video 1:12-1:30, titled: "turn taking... attunement"). In other cases, one player would direct the other player into a participation framework by using head movements and by tilting his/her body backwards and forwards, side to side. In other cases both players would gaze frequently at each other and smile (see video 1:31-1:53, titled: "opposite movements" and 1:53-2:13, titled: "melody negotiations"). In the video section

(The two players: LF = Low frequency instrument/right HF = High frequency instrument/left)	
01	LF: lægger ... du lægger også din ned som en pen? <i>lay ... you also lay your's down as a pen?</i>
02	HF: ((looks at LF with lifted eyebrows and smiles))
03	LF and HF: ((Both players tilt the pen for a while.
04	HF looks at LF's pen movements, and LF leans to the left and purses her lips as if she expects a changed sonic outcome. Leans back, lifts the pen and looks briefly at HF and then down))
05	LF: Nå ... ja? <i>ok(?) ... yes?</i>

Example 1: "opposite movements" (1:31-1:53).

titled "opposite movements" one of the players used the pen metaphor in order to suggest a play style based on an observation that she made (or a desired participation framework?) (see example 1).

The reason why players used gaze and postures rather than gestures could be that communication happened so fast that gestures were too time consuming or required too much effort to decode. Perhaps mutually agreed upon gesture conventions, not unlike those musicians use, are necessary if players are to use gestures in a play situation.

SOME JOINT PLAY CHARACTERISTICS

The characteristics of successful joint play were that two players managed to guide each other through variations of a participation framework and furthermore transfer each other into other participation frameworks. Players continuously had to agree on paths to take in their 'journey of mutual expression.' A journey consisted of variations of play style combinations, pen positions, pen tilt, size of movement, speed and timing. In further analysis we could quantify how many times two players explored these expression

(The two players: LF = Low frequency instrument/right HF = High frequency instrument/left)	
01	HF: hvad nu hvis man laver en cirkel inde på midten? <i>What if you make a circle in the middle?</i>
02	HF and LF: ((Both players draw circles and look at each others pen movements. They get the additional sound feedback))
03	LF / HF: Hmmm / Ja ja. <i>Hmmm / Yes yes.</i> ((Both players look at each other, smile and nod. While HF continues is playstyle, LF starts to tilt the pen))

Example 2: "... then he tilts the pen" (2:50-3:06).

possibilities and position them into a hierarchy. When looking at the following video clips (2:13-2:33, titled: melody and tempo change and 2:33-2:50, titled: joint "pen tilt" and 2:50-3:06, titled: "... then he tilts the pen" and 3:06-3:49, titled: "different kinds of scraching") it seems like there is a hierarchy in that players needed to first agree on play style combination before they started to engage in an exploration of e.g. pen position, pen tilt and play speed. In "... then he tilts the pen", players agreed verbally on a participation framework, where after one of the players made a variation of this framework (see example 2).

Even though the game design favored simultaneous play and synchronization, the individual sound feedback for each player encouraged players to switch between turn taking and solo and accompaniment. Players easily switched between participation frameworks once they had defined them (see 3:49-4:11, titled: "solo - accompaniment to simultaneous play" and 4:11-4:35, titled: "from turn taking to solo-accompaniment").

INTERRUPTIONS AND DIFFICULTIES

In the game sessions it was clear that the game design in many cases caused interruptions and difficulties in terms of play fluency. By play fluency we mean that one or both players actively improvised with the available sounds, because they were inspired to do so. In some cases the additional sound layer was in the way of continued play when it indicated mirrored movement and synchrony in timing and speed. In other cases, players did not take note of the additional sound layer (see 4:35-4:59, titled: "they do their own thing ... ") Often players reacted to the additional sounds with mutual gazes, utterances, pauses and laughter. These same reactions also happened as a result of successful joint play, so in further analysis similar types of player reactions to additional sound layers need to be valued in different ways.

GENDER DIFFERENCES?

It was difficult to do a rough estimation of differences between men and women. We would need to look more into details in the logged data in terms of pauses and pause lengths in individual and joint play. Also, we would need to study gaze directions in the video more

carefully. In general, the video showed a tendency that female teams engaged more in mutual gaze than male teams. This seemed to have resulted in reduced play fluency. In further analysis of the logged data, female and male teams could be compared according to pen activity, and how many times there were individual or mutual pauses above a certain length. Currently, it has been difficult to separate play fluency into individual and joint play fluency. A hypothesis about gender differences could be that the 'play fluency learning curve' is higher for women than men, because of the mutual gaze issue. However, mutual gaze may be an advantage when female players have become more skilled in switching between and varying jointly explored participation frameworks.

DISCUSSION

This study investigated how two players reacted to additional sound feedback as a result of limited aspects of their joint play: mirroring of play style and synchronized speed and timing. With this experiment it was clear that it was enough to provide two players with electronic music instruments in order to encourage joint improvisation. With the means of individual expression possibilities the two players managed to improvise together. The hypotheses presented in section 1.1 were that two players would 'stay in touch' with additional sounds by only performing those actions that resulted in additional sound feedback. The two players did manage to find the additional sounds, but as soon as they were found, the players engaged in other participation frameworks that did not result in any additional sound. Perhaps the premise of the game "find additional sounds" demanded players to move on? In general, players were very inventive in that they continuously explored variations of participation frameworks. In this regard, the sound feedback became trivial to them, and it sometimes interrupted them in their further explorations of joint play. It held them back from making a 'journey of mutual expression.' In order for the game design to give sound feedback on a wide variety of participation frameworks, we suggest that the total amount of expression possibili-

ties should be narrowed down. In this way it is possible to have a music-based game account for the majority of all possible joint expression possibilities. We suggest that a game design should support levels of joint play, so that players can be confirmed and challenged in all their play negotiations. For example, if we look at the play style characteristics described in section 5.3, we see that there was a hierarchy in how players explored joint play. Levels of sound feedback could support levels of exploration. In the case of the pen tablet interface, musical and social grounding took place through pen position and play style combinations. Reactive sound feedback would be relevant for all possible pen positions and play style combinations. When players rather quickly started to vary a found participation framework, they needed sound feedback that would adapt to fluctuations in pen tilt, draw area, draw positions and draw directions. Yet another sound layer could be dedicated to adapt to tempo changes, timing variations and individual and joint pauses. The video documentation was divided into five categories in order to characterize different kinds of play flow that happened as a result of individual and joint sound feedback. Further video analysis could look at the following: When do players laugh, talk or pause? How do players signal to each other what to do in terms of gestures, postures, headmovements and gaze? Further data analysis could look at details in individual and joint action in order to find interaction patterns. With the experiences from this study, we can argue that only when the sound feedback of joint expression is something that players can use as a means of expression, the players will find it meaning-

ful. Sound feedback as a mere indicator of joint action can in worst-case scenario interrupt joint player action or influence player actions so that the joint play quality is reduced. More detailed studies of play fluency should be accomplished in order to find out when exactly players find the individual and joint sound feedback meaningful.

ACKNOWLEDGEMENTS

Thanks to students at Aalborg University for participating in the game sessions and for the critique and comments each of the participants gave regarding the game design. Also, special thanks to students from the music therapy department at Aalborg University for providing critique during the design of the experiment.

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