

Sonification of Emotions II: Live music in a pediatric hospital

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ABSTRACT

In this paper, we argue that music can be used to sonify emotions. Further, we propose that the ‘sonification of emotion’ conceptualization can explain some aspects of the practice of playing music in hospitals. Music can be constantly adjusted to reflect (but more accurately, we argue, sonify) various aspects of the emotional situations unfolding in a hospital, namely the interaction between the child/patient, their caregivers and the hospital staff. The case study of a musical interaction between a musician and a child/patient is presented and led to the development of a Cycle of Sonification model, where the musician collects complex environmental cues and then portrays them through the music to adjust the emotional ‘temperature’. That is, the emotion of the environment is reflected (sonified) by the music, but additionally the music is also calibrated so as to allow the regulation of the emotional mood (including distraction) in the otherwise stressful environment. As well as adjusting the mood, the music provides a ‘reading’ or measure of emotion through the auditory, non-speech mode, consistent with some pertinent definitions of sonification

1. INTRODUCTION

Sonification has evolved its definition into one that allows for complex and subtle representations of data through an auditory, but in general non-speech, channel [1, 2]. This provides sounds with more value than just reproducing a single data stream, such as the amount of radiation emanating from a source (as sonified by the Geiger counter). It allows auditory stimuli, such as music, to be considered a form of sonification. Vickers and Hogg [1] for example, speculate that music could be a signification of the performer’s emotion. Schubert et al [3] have attempted to take this idea further by arguing that listeners can identify the emotion coded into music, because music sonifies those emotions. They argue that this is conceptually different from the ability of music to portray and evoke emotion by proposing that the listener is a kind of emotional meter of the emotion coded into the music. They demonstrated that when emotions are presented as a kind of dial—i.e. related emotion labels represented in a circular fashion similar to Hevner’s adjective wheel [4] and Russell’s circumplex model of affect [5]—listeners agreed on the profile of emotions expressed. This agreement was argued to reflect a complex sonification that was coded into the music [6], but more subtle than previous research tended to suggest. Instead of a single putative emotion (as determined typically by the researcher or statistical analysis of

pilot data), the sonification of emotion model proposed that the listener is a meter of combinations of usually related emotions.

In the present research, we take this concept one step further. Here we discuss the role that a musician can have in constantly monitoring - quite likely at an intuitive level - the various complex and subtle emotional situations that occur in a hospital setting. If our ‘sonification of emotion’ hypothesis is supported, the musician will have an advantage over recorded music, which as Vicker and Hogg pointed out, is likely to be sonifications of the composers’ emotions [1]. The musician, on the other hand, can monitor the various, multidimensional inputs of the environment and translate the emotions and moods of those situations (including his own perception), in a way that may impact positively on the hospital environment [7, 8].

2. THE HOSPITAL CONTEXT

A live music program has been ongoing for eight years in a pediatric hospital in Italy and provides the main source of data for this study. Nine musicians are scheduled to play across the hospital for a total of 45 hours a week. Their general brief is to distract the children and their caregivers from the stress and anxiety connected to hospitalization. The music program does not have any direct therapeutic aims. Seven out of the nine musicians involved in the program have a formal music curriculum, two of them are self taught.

Although they play a variety of instruments (guitar, viola, violin, flute, oboe, and saxophone) musicians are always encouraged to sing, either accompanied by their main instrument, or by little percussion instruments. The organizers of the program maintain that the use of the voice is a powerful means to interact with young children, in line with the literature on musical communication between mothers and babies [9, 10]. The selected musical repertoire consists of age-appropriate songs that are familiar to the children and their caregivers.

The musical interaction often begins with the involvement of the caregivers that through their example facilitate the participation of the child in the music session [11]. The role of the caregiver is likely to determine the subsequent involvement of the child in the musical activity. As the literature reports, the attitude of the caregiver towards the child’s illness and related hospitalization is an important predictor of the child’s adaptation to illness and treatments [12, 13]. Melnyk [14] reports that the emotional state of the parents and the quality of parental support are among the variables that most influence children’s adaptation to hospitalization. Other research indicates a significant correlation between children’s

coping styles and the mother's ability to parent effectively during hospitalization [15]. Moreover, it has been suggested that anxious mothers tend to have highly distressed children during and after hospitalization [14]. Anxiety is seen to inhibit parenting styles and mothers are 'less likely to fulfill their protective, nurturing, and decision-making roles' [14: 6]. Therefore, if the reaction of the caregiver to the live music in hospital is a negative one, the musician will be less likely to establish a successful musical interaction with the child, as the caregiver will tend to inhibit the child's involvement in the music session. In other circumstances, though, the positive reaction of the child to the music might also be likely to influence the attitude of the caregiver towards the live music session.

Knobloch and Zilmann's mood management hypothesis [5] can in part explain the ability of the musician to turn the hospital environment into a positive space that facilitates healing. A sad mood might slowly evolve into a happy mood by starting with sad music (to match the listener's mood), and then gradually, adjusting musical qualities, to make step by step adjustments that are synchronized with the emotional state of the listener. However, this does not explain the group music making activities, where the musician must constantly assess the different interactions taking place between the children/patients, the caregivers and the hospital staff. The sonification principle helps to explain *how* the musician is altering mood ('measuring' and sonifying this measurement), rather than *what* the musician is doing (e.g. mood matching, mood manipulation, distraction). This study illustrates how the sonification of emotion is applied to live music activities in hospital settings, to better understand the principles through which musicians operate.

3. SELECTION OF MUSIC

The selection of songs, when first approaching the child and their family, is an important predictor of a successful musical intervention [11]. The selection of music in a hospital setting is likely to be affected by the psycho-acoustic features of the music combined with the level of pain experienced by the children, their ethnicity and socio-musical background, and the mood of the caregiver at that particular moment in time, among other possible variables. In one sense, music in a hospital setting 'allows a person to access experience of emotions that are somehow already on the agenda for that person' [16:35] and this might explain why the same song does not always produce the same emotional responses. Music appears to be an excellent way of communicating different emotions and this process, as suggested in the introduction, can be explained as the sonification by music of the complex, multiple input signals.

The choice of music in a hospital setting depends on different variables. Musical behaviour has been defined by Welch [17:3] as the interface between three generative elements 'namely (i) the overall nature and individual developmental history of our human anatomy/physiology, (ii) socio-cultural context, and (iii) music (however defined).' This implies that characteristics like personality traits, language, culture, educational influences, are all relevant in musical

choice. It also means that music is likely to become more effective if these characteristics are addressed somewhat consciously in the musical choice. Further, the manipulation of the musical features allows an additional level of emotional expression that can penetrate the constraints of the invariant aspects of a given piece of music [23]. That is, one might not be able to change the melody of the selected piece, but tempo, articulation and other features can be changed, without affecting the cognitive integrity and identity of the familiar piece.

Davis and Thaut [18:184] found that the criteria for the selection of music to reduce anxiety or increase relaxation seemed to include some factors such as 'preference, familiarity, cultural context, past experiences, and perception of elements of the music such as structure, tempo and dynamics'. Therefore, they supported (ibid) the importance of 'considering [a] client's unique musical preferences and background' when selecting the music. Similarly Standley [19] maintained that is not the selection of music *per se* that is important to elicit a reaction in the patient, but rather the personal associations that the patient has developed with such selection. Furthermore, she found that live music administered by a music therapist had a greater effect than recorded music [20, 21].

From what has emerged so far, the musical identity of both children/patient and musician seems to be central to the process of communication. The musician needs to speak the musical and emotional language of the child and, at the same time, he needs to perform an adequate and appealing selection of songs. These are additional variables that feed into the complex web of data that the musician, if successful, is able to sonify.

4. METHODS

The study reported in this paper is part of a qualitative research project that investigated the nature of a long term live music program in a pediatric hospital, in Italy. Analytical case studies, based on multiple methods of data collection (participant observations, interviews, audio and video recordings) were employed to investigate each group of participants involved in the live music sessions in the pediatric hospital (musicians, children/patients, caregivers, and hospital staff). The case study design was selected for its capacity to focus on 'the subtlety and complexity of the case in its own right' [22:123].

Each musician received a copy of the research project with the attached code of ethics from the BERA (British Educational Research Association). Other participants and stakeholders completed a consent form where they agreed to participate in the study and to allow publication of anonymised data. The case study account reported here is based on the observations and interviews of one musician that has been playing in hospital for eight years, at the time of the research. He was scheduled to play in hospital three times a week, one hour each time.

Interviews took place before and after the musical intervention. A semi-structured interview schedule allowed the first author to have a flexible tool to explore the musician's planning of the musical intervention, to discuss its outcomes on

the bases of the observations, and to help ascertain in what way the musician might be sonifying the emotions through the music.

5. RESULTS (I) CASE STUDY EXAMPLES

There were several variables in the daily schedule of the musician. He did not know which child he would have met on the day, nor their age or their physical conditions (e.g. presence of pain, level of stress, etc.). His schedule only indicated the type of ward he would perform in. Once in the hospital, the musician was consulting with a nurse in the designated ward. The nurse usually provided the musician with a summary of the physical and psychological conditions of the children. This knowledge provides one of the many inputs that the musician is likely to process before and during the musical performance. The challenge for the musician, at this point, was to select the 'right' music from a range of songs that he had in his repertoire. In general, the musician would start the intervention by playing a gentle tune in the corridor, walking up and down until he felt that there was a particular interest from a child or a caregiver. At that point he would enter the room and perform for that specific child and whoever was with him. The identification of such a child might be one way of indicating an early success of the sonification process. The music captured the attention of the child. While not excluding the possibility of an interest by the child in the music/musician, it is conceivable, and perhaps essential, that the musician has 'correctly sonified' the current environment and *therefore* attracted the interest of the child.

The case study example reported below illustrates the typical stages of the musical interaction between the musician, the child, and their caregivers. The photographs have been converted into line drawing for privacy reasons. The musician is playing in a room within the neurosurgery ward. We present the data through a series of sequential drawings that capture key moments of this particular intervention. The live music intervention, takes the form of a narrative guided by the following five figures.

Figure 1: The musician enters the room playing a soft tune from a popular Italian pop song ('L'isola che non c'è'). The song is a gentle ballad. The boy is awake, although he is facing the wall. He has just had an operation on his back and does not seem to be willing to interact with the musician. His mother sits at the end of the bed and looks at him. The musician keeps singing the song, directed to the child.

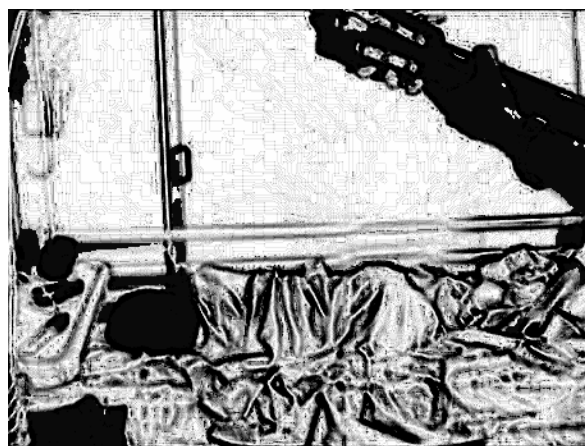


Figure 1

Figure 2: The musician offers the mother a chapchas (Bolivian percussion instrument made of sheep hooves). After having tried the instrument, she shows it to her son. He just looks at it, and also briefly turns towards the mother and musician. Then he turns back to the wall. The musician keeps singing more verses from the same song.



Figure 2

Figure 3: The nurse enters the room to dress the boy's wound. The musician keeps playing the song in a noisy background.

The room is now rather crowded as - apart from the mother, the boy, the nurse and the musician - there is also another child in the room with his mother and a hospital volunteer. The mother of the boy is looking at the wound. She appears distressed. The musician steps back and turns towards the other child that is in the room and starts interacting musically with him through a Walt Disney song ("Hey Ho").

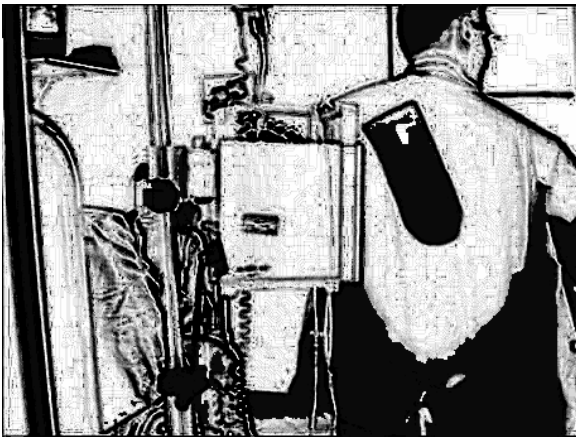
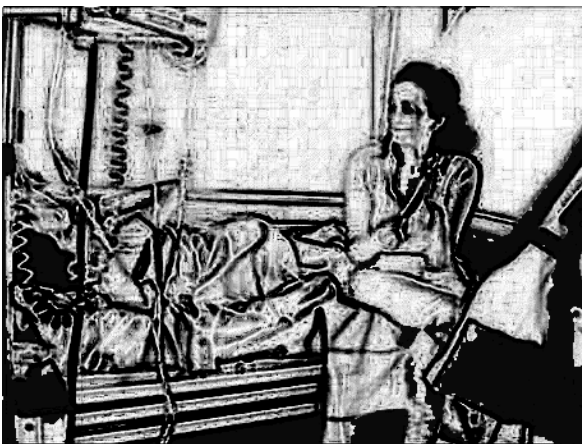


Figure 3

Figure 4: the musician distributes little percussion instruments to all the adults in the room. The boy eventually takes the percussion instrument (chapchas) that he had offered him at the beginning of the session and has now joined the music session, together with his mother. The boy is now looking at the musician while playing, despite the position in which he is constrained.



Figure

Figure 5: The musician is playing a series of 'happy' songs from both Boy Scout tradition and familiar-traditional children's

songs. The boy is now facing the musician and is holding a chapchas, joining in the music.

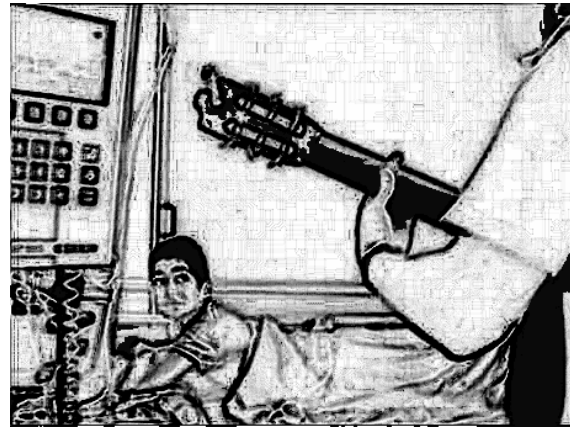


Figure 4

The sequence in the case example reported above illustrates how the selection of songs, and its temporal sequence, can determine the progression of a musical intervention in a hospital setting, where children and caregivers experience a diversity of affects like pain, stress and anxiety. In this environment music can be a positive distraction for all the participants involved [11]. The instinctive selection of songs made by the musician at the beginning of the session appears to be an important predictor for how the session will unfold. The start of the intervention could be seen as a gathering of information by the musician, where the mood of the situation required further calibration in the music. When the child turns away from the music, the musician reassesses the situation and communicates the revisions through the music. One of the adjustments the musician makes is to involve the mother, perhaps to help with sonifying the measure of the emotional situation. By Figure 3 the situation becomes even more complex, and an alternative course is taken by the musician who engages with the other child in the room. The change in the music is a clearer example of how these changes may be sonified. It is possible, too, that music might not be able to sonify such a complex situation, therefore the musician chooses to focus on a more manageable aspect by using quasi-musical strategies (such as handing out percussion instruments), while still monitoring, or looking for opportunities, with the 'target' child. The positive facial expression of the mother in Figure 4 suggests some kind of improvement, or is an encouragement for the child who can now see the mother drawn into the process. We argue that the final scene of this progression (Figure 5) can be explained, at least in part, as the ability of the musician to sonify the complex emotional situations and then to gradually, carefully and skillfully modify the environment into a space that has alternatives to pain and stress.

6. RESULTS (II) INTERVIEWS

Interviews were conducted with the musician before and after the music session in the hospital. The aim was to understand the level of planning involved in a regular performance routine, and whether there was an awareness of the underlying emotional data.

Four main themes emerged from the interviews with the musician in relation to the organization and the development of the musical intervention:

1. Issue related to the musical repertoire;
2. The role of the caregivers in facilitating the musical involvement of the child;
3. The role of the caregivers in obstructing the musical involvement of the child; and
4. The role of the child in facilitating the involvement of the caregivers in the music session.

6.1. Issue related to the musical repertoire

The musician worked on the musical intention that he wanted to communicate through the song at that moment in time. Therefore, it was not strictly the breadth of repertoire that seemed to be important, but rather a range of musical modalities and improvisation techniques in so far as they allowed the musician to respond to the need of constantly building his repertoire [11]. We see this as evidence of the musician sonifying the emotional aspects of the environment at a somewhat conscious level.

6.2. The role of the caregivers in facilitating the musical involvement of the child

An advantage of the sonification model we propose is that multivariate inputs can be measured and reported by the music. An example of this feature is the influence of the music on the caregivers. The attitude of caregivers towards the musical intervention was considered to be crucial by the musician to predict the reaction of the child to the music, as children were perceived to be emotionally dependent by their caregivers and to respond to their anxiety. The musician:

‘According to my experience, the success to involve the child depends on the involvement of the parents. Children generally respond to the anxiety of their parents.’

‘If parents are willing to be involved in the interaction, then all is fine.’

‘When the child was crying I decided to keep playing because the mother was singing and the child calmed down after having noticed that.’

6.3. The role of the caregivers in obstructing the musical involvement of the child

The musician made use of special songs (and related lyrics) when he wanted to elicit specific emotions. In three different situations, the musician was observed to use the same song to facilitate the release of tension through crying. This happened exclusively with parents, especially mothers. In this case, the song was an Elton John song written for a Disney cartoon: ‘Il cerchio della vita’ (‘The circle of life’). Those songs were characterized by emotionally charged lyrics rather than other musical features. Although the musician here is consciously trying to adjust or manipulate emotions, as per the mood management theory discussed above, it is also likely that he was channeling the current mood in the room through the music to provide an emotional metric and thus to use the music as a tool in a mood-management cycle.

6.4. The role of the child in facilitating the involvement of the caregivers in the music session

When parents were particularly distressed, their protective attitude was reported to prevent the musicians from getting close to their child. When the musician managed to break the ‘wall’ that the parent had put up, musicians noticed that the music was having a calming effect on both the parent and the child, and consequently it impacted on their interaction:

‘After the intervention, if the child is calm, they see you as an occasion in which they can take few minutes off. But when the child is in pain, they put up a wall and then I cannot do much. I just keep playing in the corridor as music can go through all these kind of walls.’

‘Music is a tool that facilitates the relationship between children and their parents.’

It seems that low arousal states of the child/caregiver provide an easier entry point, or a greater opportunity, for the musician to access their emotional space. However, playing music that express high-arousal, negative emotions (e.g. stress, anxiety) could be counterproductive. In this situation the sonification is not used as a mood management device in the high distress state, but only in the calm, low arousal state. These observations and analyses led us to propose a development and extension of our assertion that an important component of the task of the musician is to sonify the emotion of the environment he is in. We present this model in the conclusion.

7. CONCLUSIONS

In this paper we have argued that the musician is sonifying a complex collection of situational and emotional data presented by caregivers, patients, medical practitioners and the musicians themselves. One criticism against our proposed conceptualization of music as sonification is that it is nothing more than the kind of mood matching and adjusting proposed by Knobloch and Zilmann [5]. In their mood management theory,

they propose that '[b]ased on the hedonistic premise that individuals seek to experience the highest degree of pleasure attainable under given circumstances, this theory posits that persons are motivated to make entertainment choices that will help them to diminish or terminate negative moods and to extend and enhance good moods' [p. 352]. However, this application of music is dependent on understanding the mood of the individual whose mood is to be regulated. In the hospital setting under investigation the situation is more complex and, we argue, more subtle. The brief of the musician is not to regulate mood, but to distract children and their caregivers from the anxiety, stress and sometimes, boredom, experienced in the hospital. Certainly, mood regulation is one component of the aims of the musician. However, the novel aspect of our study is that we have identified a new aspect of such aims that is to sonify the emotions that the environmental inputs are presenting. Since this is one of the components of the aims of the musician, we propose a way of combining some of the tasks into a model that we call the Cycle of Sonification, shown in Figure 6.

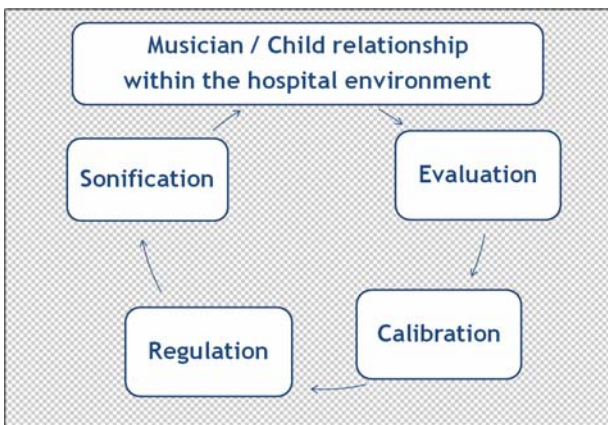


Figure 5. Cycle of Sonification: This cycle is continuous during the music session. The musician evaluates the environment data coming from the hospital ward and from the musical interaction with the child/patient; he then calibrates the music performance in real time in such a way as to adjust and regulate the mood of the child. Each regulation cycle leads to a new assessment of the environment for possible additional calibration of the music.

According to our model, the musician is taking a range of complex indicators from various parties and he is sonifying this through the music (Figure 6). It could be an attempt to regulate the mood of an individual patient, but it may also take into consideration the state of the caregiver, the duty nurse, and the current situation (e.g. commencing, or ending of a medical procedure or treatment). The musician has the tools of sonification and mood management at his disposal. The interview data suggest that there may be a sonification-calibration and regulation cycle, where the musician has collected and sonified the environmental mood through the music, but adjusted it slightly in an attempt to shift the mood to

a more desirable state. This task becomes more subtle when the music is favored by low arousal states. It may be that music will not be as effective when the environmental mood is high in arousal. Sonification is still possible, but mood management becomes more difficult.

The input data, to date, cannot be reduced to a series of numbers that represent emotions which are then pieced together by the musical structure. Instead, the expressive devices available to the performer [23], and their ability to make subtle and sudden adjustments in their sonification is in part intuitive, allowing the emotions (e.g. stress, fear, anxiety, boredom, excitement) portrayed in hospitals to be presented in a culturally digestible way.

A criticism of the approach presented in this paper might be that we do not provide explicit ways of quantifying emotion and that we do not explain the mapping of these emotions into auditory parameters. This problem is discussed in detail in [3]. In §5.1 it states:

'It is currently too complex to both quantify the emotion and find the mapping onto the multiple music parameters that sonify these emotions, and we are therefore forced to take an approach that is more complex for sonifying...'

In particular, the reader is directed to Figure 3 [3], where the authors argue that such an approach lies toward the 'complex for sonification' end of the spectrum of conceptualizations of emotion sonification.

The sonification model presented here, explains an important aspect of how a musician in hospital can 'measure' the emotional situation in the various environments. It is not the only means the musician has to communicate through music, but according to the evidence from our case study and interviews, is a part of a set of tools available to the musician performing in the hospital. The conceptualization of music as sonification of emotion, along with its inherent flexibilities may be applied in other arenas in future research, particularly where improvisation and interaction are called for.

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9. REFERENCES

- [1] P. Vickers and B. Hogg, "Sonification abstraite/sonification concrete: An 'aesthetic perspective space' for classifying auditory displays in the ars musica domain," in *Proceedings of the 12th*

- International Conference on Auditory Display*
London, UK, 2006, pp. 210-216.
- [2] T. Hermann, "Taxonomy and definitions for sonification and auditory display," in *Proceedings of the 14th International Conference on Auditory Display*, Paris, 2008.
- [3] E. Schubert, S. Ferguson, N. Farrar, and G. E. McPherson, "Sonification of Emotion I: Film Music," in *17th International Conference on Auditory Display (ICAD)*, Budapest, Hungary, this volume.
- [4] K. Hevner, "The affective value of pitch and tempo in music," *American Journal of Psychology* 49 1937, 621-630 Univ of Illinois Press, US, 1937.
- [5] S. Knobloch and D. Zillmann, "Mood management via the digital jukebox," *Journal of Communication*, vol. 52, pp. 351-366, Jun 2002.
- [6] P. N. Juslin, "Cue utilization in communication of emotion in music performance: Relating performance to perception," *Journal of Experimental Psychology: Human Perception & Performance*, vol. 26, pp. 1797-1813, Dec 2000.
- [7] T. K. Naylor, S. Kingsnorth, A. Lamont, P. McKeever, and C. Macarthur, "The effectiveness of music in pediatric healthcare: A systematic review of randomized controlled trials," *Evidence-Based Complementary and Alternative Medicine*, vol. Sep 30 [Epub ahead of print], 2010.
- [8] M. Mrázová and P. Celec, "A Systematic Review of Randomized Controlled Trials Using Music Therapy for Children," *Journal of Alternative & Complementary Medicine*, vol. 16, pp. 1089-1095, 2010.
- [9] T. Nakata and S. E. Trehub, "Infant's responsiveness to maternal speech and singing," *Infant Behavior and Development*, vol. 27, pp. 455-464, 2004.
- [10] H. Papousek, "Musicality in infancy research: Biological and cultural origins of early musicality," in *Musical Beginnings*, I. Deliège and J. Sloboda, Eds. Oxford: Oxford University Press, 1996, pp. 37-55.
- [11] C. Preti and G. F. Welch, "Music in a hospital: The impact of a live music program on pediatric patients and their caregivers," *Music and Medicine*, [Epub ahead of print], 2011.
- [12] D. Turk and R. D. Kerns, "Health, Illness, and Families. A Life-Span Perspective," New York: John Wiley & Sons, 1985.
- [13] P. Darbyshire, *Living with a Sick Child in Hospital. The Experiences of Parents and Nurses*. London: Chapman & Hall, 1994.
- [14] B. M. Melnyk, "Intervention studies involving parents of hospitalized young children: An analysis of the past and future recommendations," *Journal of Pediatric Nursing*, vol. 15, pp. 4-13, 2000.
- [15] P. Jacobson, S. Manne, K. Gorfinkle, O. Schorr, B. Rapkin, and W. Redd, "Analysis of child and parent behaviour during painful medical procedures," *Health Psychology*, vol. 9, pp. 559-576, 1990.
- [16] J. A. Sloboda, "Empirical studies of emotional response to music," in *Cognitive Bases of Musical Communication*, M. R. Jones and S. Holleran, Eds. Washington, DC: American Psychological Association, 1992, pp. 33-46.
- [17] G. F. Welch, "The ontogenesis of musical behaviour: A sociological perspective," *Research Studies in Music Education*, vol. 14, pp. 1-13, 2000.
- [18] W. B. Davis and M. H. Thaut, "The influence of preferred relaxing music in measures of state anxiety, relaxation and physiological responses," *Journal of Music Therapy*, vol. XXVI, pp. 168-187, 1989.
- [19] J. M. Standley, "Clinical applications of music and chemotherapy: The effects on nausea and emesis," *Music Therapy Perspectives*, vol. 10, pp. 27-35, 1992.
- [20] J. M. Standley, "Music research in medical/dental treatment: Meta-analysis and clinical applications," *Journal of Music Therapy*, vol. 23, pp. 56-122, 1986.
- [21] J. M. Standley, "Music as a therapeutic intervention in medical/dental treatment: Research and clinical implications," in *The Art and Science of Music Therapy: A Handbook*, T. Wigram, B. Saperston, and R. West, Eds. London: Harwood Academic Publishers, 1995, pp. 3-22.
- [22] L. Cohen and L. Manion, *Research Methods in Education*. London: Routledge, 1995.
- [23] A. Gabrielsson and P. N. Juslin, "Emotional expression in music performance: Between the performer's intention and the listener's experience," *Psychology of Music*, vol. 24, pp. 68-91, 1996.