

An interactive technology for health: New possibilities for the field of music and health and for music therapy?

A case study of two children with disabilities playing
with 'ORFI'

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Digital music technology represents new challenges as well as new possibilities for the discipline and practice of music therapy. When such technology also incorporates interactivity, even further steps are taken in our efforts to improve health and wellbeing through musical means. This article explores how interaction with a new type of interactive musical tangibles can contribute to health and life quality for certain children with disabilities and developmental disorders. Its point of departure is the multidisciplinary research project RHYME, which explores a new treatment paradigm based on collaborative and interactive net-based musical 'smart things' with multimedia capabilities, positioned within a broader perspective upon the definition of health. The article is an extended in that we discuss theory, method, and results deriving from the first first test situations in RHYME. Following a short introduction of the RHYME project, part 1, which is theoretical, we will define our position with regards to various concepts of 'music' as well as 'health and wellbeing'. We also briefly relate the RHYME technology to traditional as well as digital instruments within music therapy practices. In part 2, we introduce our methods of sampling and evaluation in this study, including our applications of action research and video analysis. Our process of data collection is reviewed in part 3, which includes two video analyses. In the first analysis, we focus on the relationship and interaction between the child and the co-creative tangibles, and in the second analysis on the interactions among the child, the co-creative tangibles (CCTs) and the close others who assist the children in their exploration of the CCTs. We also introduce the tool called Assessment of the Quality of Relationship (AQR), which we applied in the first analysis. In part 4, we consider the potential health benefits for children who interact with the CCTs. We also look at the ways in which music therapy might benefit from the use of this kind of music-interactive digital health technology.

After presenting the background for RHYME, we will discuss aspects of data deriving from the experiments involving the CCTs called ORFI (see later). We will discuss the results deriving from our video analysis of two of the participating children, 'Frode' and 'Ulla'. Our research question is threefold: *How do the children relate to and interact with the co-creative tangibles; in what ways can their interaction become potentially health promoting; and how could music therapy profit from such interactive music therapy?*

Part 1

The RHYME project:¹

RHYME is a five-year interdisciplinary research project (2010–2015) financed by the Research Council of Norway through the VERDIKT program. Its aim is to develop Internet-based, tangible interactions and multimedia resources that have a potential for promoting health and life quality. The project specifically addresses the lack of health-promoting interactive and musical information and communications technology (ICT) for families with children with severe disabilities. RHYME explores a new treatment paradigm based on collaborative, tangible, interactive Internet-based musical 'smart things' with multimedia capabilities. Within the project, these interactive and musical tangibles are called 'co-creative tangibles' (CCTs). The goal of RHYME is twofold: (1) to reduce isolation and passivity, and (2) to promote health and well-being. The RHYME research team represents a collaboration among the fields of interaction design, tangible interaction, industrial design, universal design and music and health that involves the Department of Design at the Oslo School of Architecture and Design, the Department of Informatics at the University of Oslo and the Centre for Music and Health at the Norwegian Academy of Music. The project encompasses four empirical studies and three successive and iterative generations of CCTs. The media is developed in collaboration with the Haug School and Resource Centre, the children and the families. Its user-oriented research incorporates the users' influence on the development of the prototypes in the project. The users include from six to ten families who have volunteered to participate, and the children with disabilities in these families range from seven to fifteen years old. The children vary considerably in terms of behavioural style, from very quiet and anxious to cheerful and rather active, but all of them become engaged in enjoyable activities when these activities are well facilitated for them. The most extreme outcomes of the variation in behavioural style relate to disability conditions, and mostly those within the autistic spectrum, which applies to four of the children. These conditions include poor (or absent) verbal language and rigidity of movement. Also, the children's mental ages range from six months to seven years, and their physical handicaps range from being wheelchair dependent to being very mobile. The Norwegian Social Science Data Services approved the RHYME project in February 2011, provided it would gather, secure and store data according to the standards of ethics in Norwegian law.

1 The section inside the frame below is similar in all of the RHYME articles in this anthology, Music, Health, Technology and Design by Stensæth (Ed.).

The present article focuses on the first prototype with the help of collaboration partners including children with disabilities, their ‘close others’² (most often someone they know well from school) and the CCTs. In the empirical study of ORFI, the first generation of tangibles (see more later), there were five specific areas that the research group identified for further exploration and development:

- To accommodate more, easier and more varied interactive and shared musicking possibilities.
- To provide responses using sound and light that are *close to the place of interaction*.
- To experience *more sensory and cross-media interactive possibilities*.
- To work further with *voice input* as a base for the musicking experience.
- To develop CCTs that might one day be possible to have *at home*.

Based on what was learned from the early rounds of actions with ORFI, the WAVE concept was developed by the creators and designers in the RHYME research group.³

Music therapy instruments – from ‘unplugged’ to MIDI

The use of digital music technology represents a continuation of previous technologies used to create or reproduce music. Musical instruments, in general, are technologies and we know how for instance music therapists rely upon a whole range of musical instruments in the interests of promoting development and improvement in their clients.⁴ Their options span the traditional piano and drums of the Creative Music Therapy developed by Nordoff and Robbins to the spectrum of Orff instruments in combination with ethnic instruments and sound sources, band instruments and the high quality, aesthetically crafted anthroposophical instrumentarium. More recently, we have witnessed the development of a new generation of electronic instruments that rely upon MIDI technology as well as the digital and interactive sound media that are exemplified through the present RHYME project.⁵

2 In sum, the term close others refer to people who are all open and sensitive to the needs and the expressions of the children with disabilities. For more see Eide (2014) or elsewhere in this volume.

3 See Stensæth (2014a) or elsewhere in this volume.

4 See Ruud (2014) or elsewhere in this volume for a discussion of instruments as artefacts.

5 In the context of electronic musical instruments and digital music technology, we must always include recording equipment and the technology of music production. Though it is beyond the scope of the present discussion, it remains very much the case that music therapists today use portable music technology for recording, editing and producing music in tandem with their clients.

Much electronic music equipment also uses MIDI-generated sounds combined with a special technology for example, Soundbeam. Or the electronic music equipment could work in combination with software that produce sounds through switches, like Midicreator, or with drum machines that use either switches or drum pads. This equipment can also be attached to an acoustic instrument. Magee and Burland (2008), as well as Magee (2013), give an overview of such technology as it is used in music therapy.

The Soundbeam system, for instance, seems to be the most commonly applied music technology in music therapy. Its website reads as follows: 'Soundbeam is a distance-to-MIDI device which converts physical movements into sound by using information from interruptions of ultrasonic pulses emitted from a sensor' (see www.soundbeam.co.uk).

Midicreator is also popular:

A device which converts the various signals from electronic sensors into MIDI. Assorted sensors are available which sense pressure, distance, proximity and direction. These are plugged into the front of the unit, which can be programmed to send out MIDI messages corresponding to notes or chords (Magee, 2008, p. 125).

Other known technologies include switches and sensors attached to computers and custom-designed software. In general, digital music technology is developing very quickly in tandem with research on the interaction between sound and movement.⁶

The ideology behind the construction of ORFI derives from the research group's interest in facilitating musical cooperation and communication on equal terms between different users in different situations. ORFI resonates with music therapy in general in this way, because therapy also puts great emphasis on relating to the individual according to his or her particular needs, interests and skills, and to create mutually meaningful experiences through musical interaction. Cappelen and Andersson sum up the ideology behind ORFI in this way:

The persons consuming the sound are not passive listeners anymore, but active users, able to dynamically *shift between roles*, by choosing position in space, relations and roles to other people and the music. The user can take part in changing the sound experience in real time, based on the rules the composer has created as a potentiality in the software.

⁶ See Refsum Jensenius (2009) and Johansen (2007).

This differs in a significant way from the jazz improvisator or the professional musician. The fact that the composer writes *programming code* is an essential difference. Instead of writing one linear work, he creates infinite numbers of *potential music* that reveal themselves as answers to user interactions in many situations. This might be like an *instrument* responding to a musical gesture, or a competent and *intelligent actor* answering musically in an improvisation session. But everything has to be formulated in advance as rules in the software. The challenge is to create music, through user interaction, that *motivates* to further *co-creation* of the music and moving image narrative. Everything has to be formulated in advance, based on genre and music knowledge and competence in social behaviour (Cappelen Andersson, 2008, p. 84, italics in the original).

The fact that the ORFI music is programmed as an *interactive* composition – that is, as ‘potential music’ which might best facilitate (musical) interaction – will merit further discussion later. Andersson and Cappelen note that they structure ORFI’s software and musical compositions using three layers: sound nodes, compositional rules and narrative structure. The sound nodes are the least-defined musical units – single tones, chords or rhythmic patterns. These nodes can be combined in sequences or in parallel events using the compositional rules (algorithms). The user then perceives these combinations as narrative structures according to his or her experience with existing musical genres. By pressing or flexing the arms of the ORFI pillows, the user can even manipulate the compositional rules that arrange the sound nodes. The results of this intervention create a new musical narrative as well as an altered visual display. The narrative structure may also imply future results and thereby create expectations, not all of which will be satisfied, occasioning further intervention in turn. This is also how ORFI fundamentally differs from traditional and even MIDI-based instruments, which are exclusively responsive rather than co-creative as such.

Part 2

Methods connected to the collection of the empirical material

Given its reliance upon subjective interpretation as well as the in-depth study of selected user interactions with the co-creative tangibles, this study places itself solidly within a qualitative paradigm, and indeed, as a research project, RHYME has been governed by the model known as ‘action research’. Its main tools for analysing its data are two types of video analysis: micro and macro. In what follows, we will discuss some of the methodological challenges that are associated with action research (briefly) and video analysis (more extensively).

Action research

In terms of the present project, action research is understood to encompass both work undertaken to solve an immediate problem and a more reflective process of progressive problem solving. The research group, again, represents three distinct interdisciplinary fields; as such, it is not a ‘community of practice’, and a big part of its reflective action research is the development of common ground. Defining core concepts such as ‘health’ and ‘co-creation’, for example, is crucial.⁷

The RHYME project also incorporates responses from users, as mentioned above, so that researchers must record all of their impressions from the live interactive settings (observed through a two-way mirror or on the video recording of the interaction), analyse the video recordings in terms of user contributions, and compose and consider questionnaires in order to incorporate the reflections of close others or the child’s family members.

The use of video and analysis of video recordings

The word ‘video’ comes from the Latin *vide*, ‘to see’, and the process of analysis, of course, involves taking something apart in order to see it more clearly or systematically, or simply in a different way (Stensæth, 2008). The RHYME project benefits from the use of video analysis thanks to its rich access to the details of intersubjective interaction, both verbal and non-verbal. Introducing video recordings into this

⁷ The concept of health is defined by Ruud and Stensæth in their articles in this anthology. Stensæth (2013) has elaborated upon the salient concept of ‘co-creation’.

research makes it possible to observe details in the expression of emotion and in actions, including, for example, subtle facial expression or small finger movements.

This type of close video analysis is also about *meaning* – what we see, that is, demands interpretation according to the implications of *denotation* (what is recorded needs description and recognition) as well as *connotation* (the ideas and values communicated through the recording, including the manner in which it was done) (Stensæth, 2008).

The validity of the resulting interpretations is enhanced by the research team's collective background and practical experience within the larger field of study, whatever the individual discipline in question (Creswell, 1998). As music therapists, including one person with significant experience with children in special schools, the present authors qualify as *insiders* in the field – scholars with privileged access to interpretations (Kvernbekk, 2005). Still, this does not mean that our interpretations are 'truer' than others. It is rather the case that, because we are trained to look for links, and because we have the terminology necessary to describe those links in these contexts, we are able to interpret and describe the different layers of meaning in the videos more quickly and precisely than most (Creswell, 1998). By linking the different categories of health – like mastery, vitality, meaning – to activity, emotions and co-created actions, we hope that our analysis will demonstrate that children's access to and use of CCTs can improve wellbeing via interactive intersubjectivity.

In the present analysis, the work of videography means 'to observe graphically' – that is, to observe and analyse the video material in either (1) a systematic way or (2) an exploratory way. The aim is the same: to capture and understand the various layers of meaning in the given video recording. In the present study of ORFI, we will present a systematic analysis, meaning that we have decided what to look for in advance (in this case, moments of co-creativity and the promotion of health).

In order to avoid bogging down in excessive detail, we have decided not to characterise the present approach in relation to other established orientations. Instead, we will characterise it pragmatically, by discussing the various challenges and outright hurdles that come into play with a reliance upon video recording for data.

Challenges connected to video recording

Among the problems arising from the use of video recording in research, also discussed in Stensæth's (2008) thesis, are (1) a video camera can disturb the setting/interaction, (2) a video observation might produce 'stronger' data than a firsthand

observation (seeing becomes believing), and (3) the video recording can conceal data.

In relation to the RHYME project, we indeed saw that two of the children were slightly disturbed by the cameras, but this did not prove to be a factor in the video clips as such, and we will not dwell upon it here.⁸ Regarding the possibility of distorted or ‘strong’ data, we remained vigilant throughout about this challenge to our study’s practical validity, always asking ourselves: Are our interpretations representative? Does the way a child with disabilities acts on camera during the RHYME actions necessarily anticipate his or her behaviour elsewhere (and especially at home)? In addition, because we are admittedly privileging initiative and positive interaction among the children with disabilities, their close others, and the co-creative tangibles, body movements can receive exaggerated and even ‘undeserved’ positive attention. Lastly, because we are only able to process limited recorded material (each child, as of this writing, has been recorded four times for thirty minutes each) we must remember that, even in the RHYME action context, the children could have been acting very differently in situations outside of our video work.

Nevertheless, we know of no better tool for observation than video recordings. In the interests of studying individuals who use few words, we must be able to see and interpret their body language, and particularly individual actions and gestures, and to do so we must have the fullest possible access to the relevant events and processes. The idea that the body is the centre of ‘everything’, as phenomenologist Maurice Merleau-Ponty (1945/1994) first declared, is in fact a governing principle for the RHYME project. Merleau-Ponty likewise saw that certain areas of artistic practice, such as dancing or playing an instrument, are better understood via the body than the intellect (or language), and this holds true for our CCTs as well. Without our body-related data, our project results would have been weaker and even more distorted. We decided that the limitations of video data and analysis, then, were a hurdle rather than an outright obstacle to our success.

Levels of appearances connected to the video recording

Given the centrality of video data to our enterprise, then, we must elaborate upon the three levels of appearances involved in this material, following upon the work of Stensæth (2008) and Fink-Jensen (2003). They are as follows:

⁸ For further discussion of this particular circumstance, see Stensæth (2008).

- 1) The phenomenological level – that is, the live situation.
- 2) The *quasi*-phenomenological level – in this case, the phenomenon in a video recording is perceived indirectly, so that the researcher experiences it as if he/she were actually there.
- 3) The objective level – this derives from the researcher’s memory, via a diary or a log, and there is no direct perception of the phenomenon as such (Fink-Jensen, 2003, p. 263).

The first-order perspective (level 1), which could be called a pre-scientific level, is where the subject and the phenomenon meet. At level 2, the researcher has already created an object. At level 3, the objective level, the researcher does not experience the phenomenon directly at all. Sometimes these levels interact and alternate. Levels 2 and 3, for example, have something in common, in that parts of the situation can only be perceived indirectly. Yet it is more important to note the differences among the levels, because the quasi-phenomenological level tends to resemble the phenomenological level if the observer experiences the video recording as if he or she were really there in the live setting. As our interpretations move away from the phenomenological level, we will observe a certain degree of reduction in them, which in turn begs the following question: How much do we let the video recording *interfere* with ‘reality’? Stensæth observes (2008, p. 67):

Because a video recording is always a *re-construction* of a situation, two essential considerations must be made. First, we need to remember that a video recording is not the authentic situation but an image and a representation. A video recording cannot therefore reproduce an objective reality ... Second, we must remember that re-presenting through a video recording involves other qualifications than being present. Basically, this means that observing a video recording allows other modes of consciousness and other levels of reflection to come into play. Since the video recording allows rewinding and stopping, the observer will have more time to include more reflection.

Ultimately, she says, the video recording can only ever amount to a product of the researcher’s interpretation in the context of the project in question:

It is not a neutral representation; rather it represents a perspective of the person(s) in charge of the filming and the interpretations. This is just part of the reflexive nature of social research: as long as human beings are involved, they will influence the social setting in which they take part, either passively or actively. In the end, the overall challenge for every researcher is to convey and discern the various influences connected to the choice of data collection *and* to integrate it all in a sensible way into his/her particular research project (Loc. it).

Part 3

The data

In the following, we will present an analysis of videos taken from the testing of the first generation of co-creative tangibles, the ORFI.

Introducing ORFI⁹

The ORFI test period took place at the special Haug School and Resource Center in March 2011. ORFI is a prototype designed by Birgitta Cappelen, Anders-Petter Andersson and Fredrik Olofsson as part of their art project MusicalFieldsForever (see musicalfieldsforever.com) before the RHYME project began, so it was brought into the project as a basis for discussion of future co-creative tangible development.¹⁰

The technology and the musical ideology behind ORFI are reflected in the use of about twenty tetrahedron (pyramid-shaped) pillows that collectively represent a hybrid of a piece of furniture, an instrument and a toy (see picture 1). The pillows were handmade with black fabric in three different sizes that range from thirty to ninety centimeters in width.¹¹ Most of the black pillows have orange, origami-shaped (see photo) 'wings' with a 'light pin' along the edge. When the user bends the pillow (see picture 1), sensors inside generate light, sound and an image upon a screen or an adjacent wall. Through pressing upon a particular pillow, the user can then choose among eight different musical genres that will in turn govern ORFI's

⁹ Read more about the design of ORFI in Cappelen & Andersson (2014).

¹⁰ 'ORFI' is not an acronym, though it appears to be; it derives from the combination of 'Or' (short for origami) and 'fi' (short for 'field'). It also refers to Orpheus, the father of music in Greek mythology (see www.rhyme.no).

¹¹ See Andersson & Cappelen (2014, 2008) for more details.



Picture 1: *Bending 'arm' of ORFI 'pillow'*¹³

sound output.¹² When the user bends the various wings, he or she is choosing to make music and also change the light and the image(s) on the screen or wall. The co-creative tangible is both mobile and multimodal, and it could be said to behave in an 'intelligent' fashion that is quite different from a traditional musical instrument or a regular CD player. Because the co-creative tangible is programmed to remember and 'learn', that is, it can react musically but also idiosyncratically, either imitating or even improvising something new to suit the situation at hand.

12 These genres are labeled Arvo, Funk, Glitch, Mini, Jazz, Tati, Techno and Voxx. For more information, see www.rhyme.no.

13 All photographs courtesy Birgitta Cappelen.

The ORFI analysis

Collecting the data

Frode and Ulla are two of the five children who participated in the exploration of ORFI. Each child arrived at the music room with an adult from class whom the child knew well and trusted. Each child stayed for half an hour over the course of four consecutive Fridays. The ORFI room had been adapted for the test; its piano, chairs and musical instruments had all been removed, and the floor had been covered with a large, square, single-colored woolen carpet, placed in front of a large blank screen for the images. This screen covered an entire wall, and the different-sized ORFI CCTs were scattered atop and around the carpet.

We chose to give only a few instructions. The adults with the children were told to 'go ahead as they liked' in terms of both the CCTs themselves and the interaction that they might inspire. We did identify one pillow as the special 'genre pillow' – that is, the one whose manipulation changed the style of music produced by the ORFI.

The entire session was then recorded on three video cameras. Two of the cameras were fixed to the wall, one filming the ORFI and the other filming the screen in the background. A member of the research team, sitting unobtrusively in the background and some distance away from the carpet, used a handheld camera as well.¹⁴ Multiple cameras allowed us to obtain the most comprehensive amount of data.

AQR: how children develop a relationship with musical instruments

A developmental psychologist specialising in early mother-child interaction (especially involving children with disabilities) Claudine Calvet, and a music therapist specialising in working with children with autism or other developmental disturbances, Karin Schumacher, first developed the scale Assessment of the Quality of Relationship (AQR). They in turn relied heavily upon the theories of Daniel Stern, which we will summarise in what follows.

The experience of what Daniel Stern calls the subjective self, which is related in turn to the onset of intersubjectivity, becomes part of the development of the child between the seventh and ninth months of life. At this point, the child becomes aware of the fact that other people have feelings, motives and intentions that the child

¹⁴ This person did not know any of the children or adults who entered the room. The idea of having him in the room was to allow the participants to address him if they had any questions regarding the furniture. While he was there, we considered it expedient to have him capture minor movements and facial expressions, at his discretion.

cannot influence directly. Stern calls this complication the 'self with the other', noting that with it commences the development of the child's ability to interpret and evaluate, rightly or wrongly, what is going on in his or her environs (see Stern 2000).

According to Karin Schumacher and Claudine Calvet (Schumacher & Clavet, 2007), the AQR is meant to function as a tool to assist in the evaluation of the *quality of a relation*. The scale (see below) describes the relationship between the child's self (body and voice), objects (such as musical instruments or, in this case, the RHYME) and the music therapist. There was no music therapist present in the room during the test. However, the child did relate to the CCTs through the accompanying adult, whose role was to be with the child and support the child's exploration.

AQR describes the development of the user's relationship to the object using a series of 'modi', as follows:¹⁵

- Modus 0: Lack of contact/contact refusal/pause
- Modus 1: Contact reaction
- Modus 2: Functional sensory contact
- Modus 3: Contact with oneself/sense of a subjective self
- Modus 4: Contact with others/intersubjectivity
- Modus 5: Relationship to others/interactivity
- Modus 6: Joint experience/interactivity
- Modus 7: Verbal-musical space

In brief, then, this scale extends from modus 0, where the child do not show any conscious awareness of the object, to modus 7, where the child, through contact with the object, undergoes emotional changes and/or creates a new meaning (or 'imaginary', in the authors' words) which leads to verbalisation (either description or reflection). As none of the children in our video analysis have any verbal language, modus 7 is unlikely. To both Frode and Ulla, that is, non-verbal forms of expression such as bodily communication, movement, vocal expressions, facial expressions and simple finger signs (mostly sign-to-speech based) are much more relevant. Modus 6 is a possibility, because it describes a form of play that allows the child to experience and in turn demonstrate a particular feeling or affect.

With the help of AQR, then, we will be able to distinguish among the various conditions, interactions, and emotions that appear on the video recordings. This scale represents a point of departure for looking at the ways in which ORFI

¹⁵ For an extended explanation, see Schumacher & Calvet (2007).

can lead to various forms of vitalisation and interaction, all in the interests of the possible health benefits associated therein.

The selection of video clips and children

From a total of thirty hours of video footage in this first action (reflecting all of the coverage from all three camera angles), we have found that an analysis of only one minute from the interactions of Frode and Ulla, respectively, gives us a sufficient amount of information. We chose these two children because of their varied interactions with the CCTs, which in turn shed light on the experiences of the other children as well. We ultimately chose the video clips based upon their inclusion of those glimpses and camera angles which most clearly demonstrated varied activity, including actions and both physical and emotional reactions.

Short presentation of Ulla and Frode

These two happy and engaged twelve-year-olds entirely lack verbal language and exist at a developmental level that is correspondingly lower than their age. They both use sign-to-speech in their everyday communication, but Frode does so more than Ulla. Frode can walk and is very active, and he communicates primarily through his body, signs and laughter. He is moving all the time and often addresses the adults around him. He is also interested in technology and likes to explore his surroundings. Though she relies upon a wheelchair, Ulla can also be very communicative; she displays this by assuming an attentive attitude. She can be very persistent when she becomes interested in something, and she is particularly curious about sounds. Ulla has received individual music therapy lessons for years, which may have increased her appetite for exploring and playing with sounds.

Both children were known to one of the present authors, who worked for years as a music therapist in the Haug School and Resource Centre.

ORFI: the video analysis

The following video analysis is based upon two almost equally long excerpts of video footage of Ulla and Frode. The six Ulla clips total 1:03 minutes. They are all taken from her final session, which contained the greatest variation in interaction with the co-creative tangibles. The five Frode clips total 1:17 minutes. They are taken from three different sessions, in order to reflect the ways in which he

developed his interaction with the CCTs as he became more familiar with the setting.

The analysis places the individual clips into the following categories:

- a) Description of events
- b) Sequences of action
- c) Emotional action
- d) Interpretation

In (a) we describe everything that happens, while in (b) we focus specifically on the action that occurs. In (c) we describe the affects and emotions which we observe, and in (d) we interpret our observations. By ordering the categories horizontally, the relations between them become more obvious, as for example in the following analysis of a sequence from a clip of Frode:

Description of events	Sequences of actions	Emotion actions	Interpretation
F throws the pillow forward at the same time as he falls heavily down onto his butt while he laughs softly with an open, smiley mouth—and sends a look and gestures at the adult.	Throws pillows forward, falls down onto his butt, laughs softly, sends a look and gestures at the adult.	Laughs softly, lands on his butt, gesticulates at the adult.	He is comfortable in the setting; he is vitalised; and he communicates humour through his body when he approaches the adult.

Figure 2: Analysis categories

By looking at the interrelations that generate our interpretations, we can try to determine the degree to which they apply to the different AQR modi.

Analysis of Ulla with ORFI

We will next relate our different interpretations to the levels in AQR, beginning with the Ulla material.

- Clip 1: Is open and wandering while she explores the pillows.
Conscious action when she bends the wings on the pillows, as if she knows that there will be a sound response.
Addresses A and expects that A will 'play' with her.¹⁶
Becomes bodily and mentally stimulated, senses a surplus, and seems like she at times dances to the sound and with the pillows.
- Clip 2: Is safe (knows something about what is going to happen?) and shows expectation.
Filled with pleasure and accompanies sound and interaction with dancing movements with her head.
A lot of expression with head and upper part of body. When she turns her head downwards (towards her pillow), she focuses on what she hears (from all the pillows and the one that is held directly in front of one of her ears).
When she turns her head upwards and out into the room, she takes in everything that happens and at the same time shows (to A) that she is actively involved. When she senses the pleasure, surplus and motivation, she 'dances' with her head while the upper part of her body follows the movement.
Relates actively to the things, sound/music – and A.
- Clip 3: Focuses and listens in an engaged fashion, breaks out in laughter, experiences a surplus and listens intensely and with expectation. Does she experience flow?
- Clip 4: An intimate and intense moment – she is confident and safe and seems to think that this is exciting. She listens intensely and with expectation both at the sounds and the initiatives from A. High intensity – peak experiences. Senses that both are making sounds and that they are interacting. Shares feelings with A.
Intersubjective actions, turns to both the pillows (the co-creative tangibles), the other (A), and also inwards. Strong experience of sharing, seeks confirmation from A and gets lots of pleasure.
- Clip 5: Is engaged. Does she imitate the saxophone?
Does she recognise her own voice, and does this lead to her using her own

¹⁶ The abbreviation 'A' refers to her adult caretaker, while 'l' is left and 'r' is right.

voice? Does she experience mastery when she laughs and nods her head afterwards?

Clip 6: Intimate moment – shares feelings.

When A stops, she understands what is happening, smiles as she acknowledges it and seeks confirmation from A – and gets it.

If we compare these interpretations from clip 1 with the AQR, we find that they all fit well with modus 3, because Ulla explores the pillows and further seems to recognise them as potential ‘musical instruments’ that she can play, listen to and ‘watch’ (on the screen). Her affective state – she ‘becomes bodily and mentally stimulated, senses a surplus’, and further ‘dances to the sound and with the pillows’ (see above) – could be seen as a sign that she has become vitalised. We see this state when the responses she produces from correctly bending the wings on the pillows directly affect her body and feelings. The process of vitalisation intensifies in clip 2. Here, she brings her experiences forward as well, because she indicates *expectations*. Music therapist Ulla Holck writes that expectations are fundamental to meaningful interaction:

Expectations make it possible to recognize a *departure from the expected*, and thus the child will recognise humour, building of intensity, surprise, teasing, frustration, or aversion, depending on his/her intersubjective development (Holck, 2004, p. 8).

Expectations are therefore essential to vitalisation. We also see through Ulla’s laughter and intensive listening in clip 4 that she experiences the events with pleasure and even humour. When she begins to expect a response from the co-creative tangibles, she is relating to them in an intersubjective fashion. The sound becomes a social phenomenon, thereby evoking both AQR’s modus 4 and 5, because ‘the instrument is played in the form of a dialogue, as in question and answer games’ (Schumacher & Calvet 2007:83).

When it comes to Ulla’s intersubjective relation to her close other, we are able to discern its impact throughout, from clip 1, when she ‘addresses A and expects that A shall ‘play with her’, to clip 6, when she ‘shares feelings’. In this way, she also evokes modus 6, because she establishes a space for interaction through the CCTs where she can be together with her close other. The CCTs in this modus represent what Schumacher & Calvet (2007, p. 83) label a playful way to demonstrate an affective state.

Analysis of Frode with ORFI

When we extract the various clip interpretations from the video analysis of Frode, we produce the following summary:

- Clip 1: Is attentive and wandering while he explores the pillows, the screen and the interrelation between them. He tries out several ways to handle the pillows. *Are they heavy?* He seems to think it that this is exciting and wants to communicate this to A. He wants A to share this experience with him – he both wants and needs validation from A? Speaks and gesticulates through the pillow (when he ‘bends-points’ with it). Is excited and wants to share feelings with A.
- Clip 2: Thinks this is exciting. Associates the pillow with a drum.
Gets aroused and feels surplus – is stimulated to creativity and imagination, which leads him to musicalise his movements by ‘playing drum’ on things and people around him.
Becomes energised. Transposes and transfers the idea of playing music on body and surroundings. After playing on the pillow he explores the possibility of playing on his own body (stomach); when he stretches his stomach in the air, he makes his own body visible to himself as a ‘drum head’. At the same time this becomes a way for him to place himself in the background and his ‘musicking’ in the foreground. Do we glimpse, for a moment, ‘flow’? He challenges A and wants to share experiences with her.
- Clip 3: He becomes engaged bodily and more daring in his exploration of the co-creative tangibles.
He seems to think that the sound/music is exciting and funny. He explores body and balance (vestibular sense).
Plays actively with himself and with A. He mirrors himself in A (who mirrors him) and invites a dialogue when he claps his thigh and laughs, then looks at A, as if to say ‘this is funny!’
He wants A to verbalise for him.
- Clip 4: Is safe in the situation and getting ‘warmed up’.
Explores both alone and together with A, through body and senses (hearing, sight, touch, movement and vestibular [balance-related] experiments) – everything with increasing energy and greater intensity.
- Clip 5: He presents himself with vitality and is exploratory using his body, while the pillows stay in the background. He uses a funny bodily language, including ways of landing on his butt.

He seems confident in the setting and lets himself loose. Shares experiences. When Frode's expressions of vitality are applauded by A, he is encouraged to maintain the intensity of his activities. He challenges his own sense of balance and also uses his body communicatively (as an exclamation mark) when he falls on his butt, as if to say 'this is funny!' He experiences mastery and flow.

As was the case with Ulla, the interpretations from clip 1 first evoke modus 3, because Frode primarily explores how the pillows are functioning, how the sound is created by bending the wings and how the device responds by producing graphics on the screen in front of him. In the same clip, he comes to regard the pillows as musical and as co-players, and he responds to the sounds and images in a positive and adequate way. He also makes social gestures in the situation by addressing the adult for validation as well as to communicate what he is discovering and experiencing. These social gestures evoke modus 4. Perhaps most surprising, he seems to 'speak'/gesticulate through the pillow (when he bends-points it) to remark upon his explorations. It is, of course, possible that Frode, who relies upon simple finger signs in his everyday communication, performs these movements unconsciously – that is, he automatically 'draws' with the pillows because he happens to be holding them while 'speaking'. But it is also possible that Frode in fact finds a 'voice' in the CCTs exemplified by ORFI, evoking modus 5 in AQR, which describes use of the object as part of a form of dialogue in lieu of vocalisation (Schumacher & Calvet, 2007, p. 83). If the CCTs are found to function as an alternative voice, they would clearly be strengthening communication and thus demonstrating a therapeutic potential.

The clips also indicate that Frode becomes vitalised during the testing periods. His state of affect increases from clip to clip, from 'safe and enthusiastic' to 'getting heated'; we find him 'getting loose', and later he 'challenges his sense of balance' when he falls on his butt while trying to be funny (see above).

In these sequences, we interpret all of this behaviour and interaction as an experience of mastery and flow, evoking modus 6 in AQR, which encompasses interaction with the object 'in a consistently positive state of affect, i.e. mostly played with pleasure', because the object 'helps to playfully demonstrate a state of affect' (Schumacher & Calvet, 2007, p. 83). However, we also note that Frode's body is more foregrounded than the CCTs, and that he is exploring with all of his senses. Happily, the CCTs are activating several different parts of him: Frode is challenged both physically (via his senses) and intentionally (when he throws himself into his many different movements) as well as mentally and emotionally. It seems like his

body negotiates his self – that is, when he explores his body (or challenges it), he produces proximal bodily movements, which in turn gives him an experience of flow and an increased sense of self (or sense of mastery, as in our interpretation above). For most children, it is often the case that the body is the focus when the world is to be explored. This may be even more likely when the child is younger and has less verbal skills, or when the child has disabilities. When the body creates a hindrance, it must be overcome, and it therefore represents a potential entry point to healthful aesthetic-creative activities (Stensæth, Wold & Mjelve, 2012).

Another unique event transpires in clip 2, when Frode associates the pillow with a drum he can play on, then transfers this notion to his own body and starts to play his stomach like a drum. As we read above, he stretches his stomach in the air and makes the middle part of the body more visible, positioning his musicking directly in the midst of everything. This activity evokes modus 6 in AQR, where it is said that playing the instrument ‘can lead to associations’.

A last interesting point in the interpretations of the video clips with Frode is the degree to which he enjoys the setting and the way in which he makes his close other verbalise this pleasure for him (see the last sentence in clip 3). It seems as though Frode is at the threshold of those emotional changes that can lead to verbalisation, following modus 7 in AQR: ‘The instrument sets off emotional changes and/or imaginary contents that lead to verbalization (description/reflection)’. We do not believe that anything in this clip qualify for modus 7 as such, but it is nevertheless exciting that our interpretations reveal a potential for the use of verbal language by a child like Frode.

Summary of the ORFI results

As we have seen, our analyses of both Ulla and Frode place their actions among modi 2 through 6 in the AQR, with an emphasis on the upper part of the scale. This means that Frode and Ulla relate to the CCTs on a basic sensorial level (modus 2) and on a more advanced level, whereby they share feelings with others (interactivity) (modus 6). Though it remains evident that these children are able to explore ORFI only to a limited extent, they clearly bring expectations to the activity: they perceive the objects as co-creative instruments through which they can explore feelings as well as interactions with others. In turn, we have determined that this exploitation of the CCTs leads to different forms and intensities of vitalisation.

Summing up, the ORFI analyses reveal that the CCTs seemed to *vitalise the two observed children both bodily and mentally*:

- 1) The children seemed to be *stimulated to explore through their basic senses*, including hearing, sight, touch, the kinesthetic sense, the proprioceptive sense, and the vestibular sense; in turn,
- 2) *mastery and a sense of agency seemed to be strengthened*, which
- 3) afforded the children new ‘possibilities of actions’ (see Ruud, 1998) and ‘new possibilities of interaction’ (see Stensæth, 2008), which ultimately
- 4) *empowered them* to become creatively and aesthetically engaged.

The vitalisation that accompanied exploration of the CCTs seems to represent their greatest health potential. The fact that the children felt enabled to explore the object in their own way was also significant. Both of these aspects of the analyses correspond to an ecological perspective on health, which asserts it to be an ongoing (active) process that must be reconstructed continuously. The encouragement of personal exploration also corresponded to Bruscia’s ecological health concept, which emphasises the realisation of ‘one’s fullest potential for individual and ecological wholeness’ (1998, p. 84).

Aside from the vitality aspects, our observations likewise encompassed the facts that the two children could experience and develop communication through

- contact with themselves and the feeling of a subjective self,
- contact with the CCTs (objects) and with the co-creative close others (intersubjective aspects),
- developing relations to subjects, objects and environment, and
- *qualitative sharing* of feelings (interaffectivity) (Stensæth & Ruud, 2012).

In addition, it seemed as though the shifting in responses, which is the aspect that most distinguishes the CCTs from other interactive toys and instruments, created much joyful expectation in the children.

Part 4

Discussion

Our initial questions were: *How do Frode and Ulla relate to and interact with the co-creative tangible; in what ways might this be potentially health promoting; and how might music therapy benefit from such interactive music therapy?*

The analyses of the video clips have clearly demonstrated some of the ways in which the children related to and interacted with the CCTs. We see that the CCTs afford Frode and Ulla *something other* than what traditional instruments and toys do. For example, both children seem to relate to the CCTs in a more bodily and sensuous way. They both use their primary senses fairly actively, as is clear when they are stimulated to 'touch', 'dance with', 'play at', 'throw in the air', 'listen to', and 'focus on', for example. With ORFI, Frode even imitates playing a drum, first by using the CCTs as drums and then using his own stomach. The results of our interpretation also demonstrate ORFI's impact on the wider aspects of health, thanks to its ability to

- stimulate increased creativity;
- provide space for the exploration of objects as well as subjectivity;
- build new relations (both to objects and to subjects);
- create new potentials for action and mastery;
- experience meaningful here-and-now situations with objects.

In terms of ORFI's impact on health, we have concluded that subjective experiences such as these are associated with an increase in life quality. The question that remains, then, is this: To what extent does ORFI encourage actions and experiences that can build health for participants?

If we look first at the health-related aspect of *vitality* in the ORFI analyses, the resonance with modus 6 on the AQR scale points to the fact that the CCTs, like ordinary musical instruments, represent a means through which users can express themselves. What becomes clear as well is the relevance of the device to the body in particular. Perhaps the sound, coupled with the experience of the different genres, the open space and the free exploratory form of the device, along with the shifting of its responses, invites bodily involvement?

If we look at the health-related aspect of relations or bonds with other people, we see that each of the children in the analyses frequently orients him/herself through the accompanying adult. In this sense, the adult becomes an alternative medium through which the child explores the ORFI environment. This is not a new idea as such; children with disabilities are surrounded by caregiving adults. What is significant in this case, as we can see from the video analyses, is the fact that new possibilities for co-created actions emerge in the testing periods, both with and through the interactions among the child, the CCTs and the adult. These possibilities for co-creation in turn produce new and valuable experiences of communication. Thus not only what the subjective self but also a healthful intersubjectivity is

promoted by the device. This means that the child shares the experience of understanding with another person.

In the end, we might expect that the suite of experiences of co-creation and mastery enabled by ORFI give the user new resources and increase the sense of agency or empowerment. The technology accomplishes this by offering the user a new space for action and creation.¹⁷

In clip 4 of Ulla, we note that she experiences *flow*, and we note the same thing in clip 6 of Frode. Flow is a term for an intensive state of affect, one that transcends the everyday. Csikszentmihalyi describes flow as a state that represents a value in itself; it is without any goal and strongly affected by the 'here-and-now', and it makes us feel as though we are operating at our optimal capacity (Csikszentmihalyi, 1985). Flow, which can accompany play as well as creative and aesthetic activities, impacts two aspects of existence: (1) the individual's possibilities for action as well as for challenges, and (2) the individual's efficiency, skills and competencies. In the present context, flow represents an intense experience of vitalisation which both balances and challenges Ulla and Frode's need for action. Flow therefore becomes another indication of health (or optimal capacity).

In light of the ORFI analysis, we might say that reaching a higher modus in the AQR tells us something about the CCTs' potential for health. By associating meaning with health and with the interactions enabled by ORFI we beg the question about the relationship between music and meaning. That is, when we claim that our engagement with music involves the experience of meaning, we are referring to non-propositional forms of meaning. These forms do not rely on language or verbal utterances but are felt as a sort of embodied participation in the world – a felt tension and expectation (Aksnes & Ruud, 2008; Johnson 2007). We experience meaning through our embodied participation in the world when we find ourselves in a state of flow.

Stensæth (2013), in her article on the concept of co-creation, suggest that for co-creation to afford health musicking, we must allow for *combinations* of collaborations among all of the CCTs, the child with disabilities and the close other. For some children participating in RHYME, it is the relation between the child and the close other that creates the most effective collaboration with the CCTs. In the future, when the CCTs are tested at home within core families, it may be that a brother's particular interaction with the CCTs can promote collaboration between him and a sibling with disabilities.

17 See Rolvsjord (2008) on the philosophy of empowerment.

Conclusion

How can we summarise our experiences after our tests with the interactive ORFI objects, and what consequences might they suggest concerning the development of new generations of CCTs and for their use in music therapy? Before we draw any conclusions as such, we must recall that, so far, we have only analysed a positively laden excerpt of a few of the video clips by Ulla and Frode in the two first actions. In these situations, the children were always together with adult close others whom they knew well. Still, it is evident that the different spaces of action and interactive forms of co-creation afforded by ORFI point to something healthful – at the very least, to an empathic shared experience of a meaningful moment. At the same time, they strengthen own subjectivity and agency.

However, we also saw that the CCTs afford forms of interaction and possibilities for use that the children did not manage to appropriate. The plurality of genres and possibilities for creating complex music present many musically interesting challenges for social groups of different ages and cultural background. For this particular group of children with disabilities, the musical complexity might be too great, at least within the timeframe permitted by this testing. At the same time, some of the ORFI responses were not obvious or relevant enough, which occasionally produced confusion and insecurity about the reliability of the CCTs. A more individualised approach for these particular children might have ensured more transparency, better directions and more predictable structures for expectations related to certain music-therapeutic goals.

In short, it is certain that ORFI afford playful and relational interaction. It would further appear to be possible to develop new prototypes that allow for even more individually adapted forms of interaction and expression.

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