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Designing four generations of 'Musicking Tangibles'

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This article, which builds on several conference papers, describes what we call 'Musicking Tangibles', a novel approach towards *understanding* and *design* of *interactive music technology* for people with special needs.[1] The health values of music are well documented, but so far little research on interactive music technology has been developed for music therapy and health improvement in everyday situations. In our opinion, the music technology that has been used exploits little of the potential that current computer technology has to offer these fields because it is designed and used within a narrow perspective on technology and its potential. With our long experience from design and development of interactive music technology, especially from the interdisciplinary research project RHYME (rhyme.no), we present and argue for a broader understanding of music technology for empowerment and health improvement, building on a multidisciplinary approach with perspectives from tangible interaction design and inspiration from resource oriented music therapy and empowerment thinking. We hereby suggest the notion, *Musicking Tangibles*, inspired by Christopher Small's (1998) term 'musicking', as a label for our understanding.[2] Based on our experiences and user observations from the RHYME project we argue that the Musicking Tangibles have unique empowering qualities with health potentials.

1 This article, in contrast to the other articles in this volume, is not peer-reviewed. However, it is a revision of many peer-reviewed papers and conference proceedings created and held by the authors.

2 The notion, Musicking Tangibles, relates sometimes to what several other authors have described as the 'co-creative tangibles' (CCTs) in the RHYME project. Read about the CCTs and the RHYME project in the empirical articles of Eide (2014), Stensæth & Ruud (2014), Stensæth (2014a, b) or elsewhere in this volume.

Introduction

Music and music related activities promote vital experiences for human beings and should be a right in every person's life (Rolvsjord, 2006). The health value of music, for a number of diseases, has been well documented within biomedical and humanistic health research over the last 15 years (Bjursell, 2008; Blaxter, 2010). Currently we know many ways in which music can empower people and promote vitality and health (Bruscia, 1998, 1987; Rolvsjord, 2010; Ruud 2010; Stensæth 2008). Musical instruments, with or without computer technology, represent and offer various cultural and interactional possibilities. However, when research on music technology for people with special needs focuses on the abilities of the people using it and not the computer technology, there is a chance that potential health values are overlooked. In this article we rethink music technology's potential for empowering the users. By keeping the design and the development of the technology and its potentials for promoting interaction and vitality in the centre of our attention, we suggest new ways of designing this technology for health improvement. The article is structured as follows; first we present the related work we build on in developing our notion of the Musicking Tangibles. Then we present the RHYME project, followed by the four generations Musicking Tangibles prototypes we have developed. Thereafter follows a discussion on the differences between an approach that includes our understanding of the Musicking Tangibles and traditional and current instrument- and switch-oriented perspectives. In the conclusion, we summarise our contribution to the field of design of interactive music technology for people with special needs.

From musical instruments to Musicking Tangibles

Tangible interaction and computational artefacts[3]

Tangible interaction (Dourish, 2004) is one of many labels of the design of physical things with computer capabilities. Our focus is on the design and interaction possibilities that lie in the physical, "hybrid" artefact (Latour, 1999), the tangibles, when including computer components, such as sensors, network, hardware and software, into cultural artefacts and everyday objects and things. The computational artefact, the tangibles, embodies cultural interpretation possibilities, which we build on when designing and in using artefacts (Dourish, 2004; Appadurai, 1986).

3 See also Ruud's (2014) discussion on the RHYME artefacts elsewhere in this volume.

Computer based instruments

Musical instruments are artefacts, and computer technology has for a long time been used to enrich musical instruments. Many computer-based instruments can be found in Toy stores and assistive technology shops, including software to make any computer into a musical instrument. Some of the most advanced computer based instruments on the market, such as the music game Guitar Hero (Harmonix Music Systems, 2005) and Reactable (Reactable, 2009; Jordà, 2003) are results of research within the field. Compared to acoustic music instruments, with their material-based stimuli-response, computer-based music interfaces don't require direct relation between input and output (Cappelen & Andersson, 2008; Magee & Burland, 2008). For people with special needs, music technology therefore offers new and adaptable ways to interact (Magee, 2011; Magee & Burland, 2008). Potentially, when it is designed in a thoughtful way, this makes music experiences more accessible for people with special needs.

Assistive music technology

Most music technology used in the assistive technology field is MIDI-based, containing hard plastic contact switches, such as the piano – like Paletto (Kikre, 2005). Other frequently used electronic instruments have ultrasound sensors like Soundbeam (Soundbeam Project, 1989) and Optimusic's Opti-beam (Optimusic, 2011), where the speaker can be placed anywhere in the room, separate from the input sensors. The fact that most of these instruments are MIDI-based represents an aesthetical limitation of the musical output. Furthermore, most of the instruments are shaped as toys, which expresses – design vice – what and who they are designed for. We considered them therefore to be aesthetically and socially limited.

Music for health and empowerment

In the humanist health approach – an approach which inspires us – health is an experience of wellbeing rather than a cure from illness (Blaxter, 2010). Music then becomes a resource for health promotion (Ruud, 2010). The music therapist and researcher Randi Rolvsjord has thoroughly presented and argued for a resource and empowerment oriented perspective in music therapy (Rolvsjord, 2010). From this perspective the focus is on the abilities and strengths of the person, not on their diagnosis or weaknesses. The goal is to improve vitality, self-esteem, social relationships and participation, through mutual and equal, positive relation building

musical experiences (Rolvsjord, 2010; Ruud, 2010). To design music technology with such goals, the challenges shift from the interface design, to the relation building potentialities of the tangibles. The focus shifts from controlling the interface to motivating social interaction, co-creation and 'musicking' (Small, 1998).

Musicking

The word musicking, which is developed by the composer and musicologist Christopher Small, focuses on the equal, meaning making and relation building activities related to music, such as listening, playing, composing and dancing.[4] When designing for people with different abilities, motivations and activity intensities, we need to design for many possibilities to music in order to resonate with their specific ways of approaching the artefacts and their ways of interacting and sharing experiences with other people.[5] In other words, we must design music technology artefacts, tangibles that are open to many interpretations, relations and musical actions. Therefore we call them *Musicking Tangibles*.

Switch-oriented, instrument approach

In a study of music therapists' use of MIDI-based electronic instruments like SoundBeam, Magee and Burland (2008) conclude that the client has to first understand the cause and effect of switches, before being able to operate complex musical interactions and music making. They also point at the challenges with fatigue and decreasing motivation, caused by too strong a focus on trying and failing to master the interface switches. In our notion of the artefacts as Musicking Tangibles, the focus is different: Rather than focusing on making the users understand how the switch works technically, because they consider the technology as an instrument for controlling, we instead emphasize the technology as a potential arena (Stensæth & Ruud, 2012) or actor (Cappelen & Andersson, 2011) for positive musicking experiences. This actor or arena should motivate the users to take part and co-create in a manner that is positive and empowering (see also Stensæth & Ruud, 2012, 2014; Stensæth, 2013). Importantly, to keep up the motivation and interest among the users, the Musicking Tangibles could be programmed as actors to act and 'improvise' musically and 'intelligently' on their own terms. This is what we have tried to do in RHYME (Andersson & Cappelen, 2014; Eide, 2014; Stensæth & Ruud, 2014; Stensæth, 2014a, b).

4 See also Andersson & Cappelen (2014) or elsewhere in this volume.

5 Read about this in Andersson & Cappelen (2014), or in the empirical articles of Eide (2014), Stensæth & Ruud (2014), Stensæth (2014a, b), or elsewhere in this volume.

Musicking Tangibles for empowerment

Based on a resource oriented and empowerment view we argue that music technology should offer a multitude of positive musicking experiences simultaneously. The Musicking Tangibles have to be open to many interpretations, interaction forms and activity levels, where there are no wrong actions. They have to offer many possible roles that can be taken (Cappelen & Andersson, 2011b).
The software should build on musical, narrative and communicative principles in order to motivate and develop musical competence and musicking experiences for many users over a long period of time (Ibid.). In this way, Musicking Tangibles is not just a notion but also suggests an approach for *understanding* and *designing* health improving music technology for people with special needs. The aim is that people with diverse abilities and motivations can experience vitality, mastering, empowerment, participation and co-creation through their musicking (Small, 1998; Rolvsjord, 2010, Stensæth, 2013). To achieve these ambitions the Musicking Tangibles should:

- Evoke interest and positive emotions relevant to diverse people's interpretation of the tangibles and the situation
- Dynamically offer many roles to take, many musicking actions to make and many ways of self-expression
- Offer aesthetically consistent responses and build relevant cross-media expectations and challenges over time and space, consistent with their character
- Offer many relations to make to people, things, experiences, events, places

Technically this means that the Musicking Tangibles should be able to respond to several types of events and to evoke interest and positive emotions. The Musicking Tangibles hold musical and rhetoric knowledge (programmed musical, narrative and communicative rules) and competence, remembering earlier user interactions in order to respond aesthetically consistently over time and to create coherent expectations. They can, physically or wirelessly, be networked to other actors – people or things (Latour, 1999) – in order to exchange value and to build relations over time. The Musicking Tangibles have physically and musically attractive qualities related to material, shape, texture, character and identity, social and/or cultural (Cappelen & Andersson, 2011a). Further on we will present the project context in which we design, evaluate and discuss Musicking Tangibles.

The RHYME project [6] and the Musicking Tangibles

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.[7] 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, 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, to be developed in collaboration with the Haug School and Resource Centre, the users 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.

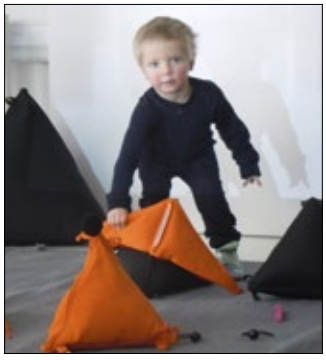
Through multidisciplinary action oriented empirical studies, multidisciplinary discussions and reflections, RHYME has developed new generations of Musicking Tangibles and related knowledge. The first empirical study in the RHYME project was of the Musicking Tangibles that we have called ORFI (see picture 1).
The second was of WAVE (see picture 2), the third of REFLECT (picture 4, 5, and 6) and the fourth of POLLY (picture 7, 8, 9, 10, 11). From the RHYME experiments (which we call 'actions'), we have moved from one action to the other, making changes and development based on the previous action, weekly user surveys, observations and multidisciplinary discussions. All sessions were video recorded from several angels to capture as much as possible of the situations.

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

7 For more about the health potential found in the testing of the CCTs, see elsewhere in this anthology or in Eide (2014), Stensæth & Ruud (2014) or/and Stensæth (2014a, b).

First generation – ORFI

The first generation of Musicking Tangibles is called ORFI and was created earlier by RHYME's development team in 2007 (MusicalFieldsForever, 2000; Rhyme, 2010). ORFI consists of 26 soft pyramid shaped tangibles, pillow like modules in three different sizes ranging from 30 to 90 centimetres. The modules are made in black textile. Most of the pyramids have orange origami shaped 'wings' with bend sensors, and an orange transparent light stick along one side, which gives a high-tech expression. Every module can communicate wirelessly with the others. The modules can be connected together in a Lego-like manner into large interctive landscapes. By interacting with the orange wings (see picture 1) the user creates changes in light, dynamic graphics and music. Some modules contain speakers so that one can experience the vibrations from the sound by sitting or holding a module in one's lap. ORFI currently offers eight different music genres. Two orange pyramids contain microphones, which in the Voxx-genre create live music, based on the users' input. ORFI has a full wall projection of dynamic graphics, expressing visually the music genre and the interaction (see picture 1). We have designed ORFI based on the ideal of Eco's Open work in order to offer as many interpretations, actions and experiences as possible, where there are no wrongs or failing possibilities (Cappelen & Andersson 2011; Eide, 2014).[8]



Picture 1: *Boy interacting with an ORFI wing,*

Picture 2: *The whole family musicking in their own manner in front of the wall projection*

8 More details on the interactive Musicking Tangibles ORFI are presented earlier on (Andersson & Cappelen, 2008; Cappelen & Andersson, 2011b). Read also about Eco and his theories in Eide (2014) or elsewhere in this volume.

Second generation – WAVE

WAVE is the second generation of Musicking Tangibles, which we have designed based on the requirements from the experiences of the ORFI actions. WAVE is an attempt to explore the most advanced *wired multimedia technology* available at the time (2011). It is therefore a very different technology than the wireless ORFI technology from 2007.

The WAVE Carpet is a seven-branched, wired, interactive, soft, dark carpet (see picture 3), with orange velvet tips that glow when the user interacts with the carpet's 'arm'. One arm of the carpet, which is central, contains a microphone. Two arms contain movement sensors (accelerometers) that change the recorded sound, while two other arms contain bend sensors that create the rhythmical background music. In one of the arms there is a web-camera that the users can play with. Currently WAVE contains 5 software programs, offering different music and dynamic graphics to show with the Pico projector embedded in one arm, or on the full wall projection. The WAVE carpet contains two robust speakers and a strong vibrator placed as a soft "stomach" in the middle of the carpet.

We have also created a glowing soft velvet 'bubble field' in the dark WAVE carpet. The bubbles contain IR-sensors and RGB LEDs that represent an aesthetically and sensorially unique device.[9] With its size, shape, texture and input and

Picture 3: *Family musicking in WAVE: Father sings into microphone and gets glowing response. The daughter interacts with the 'bubble field' while the son dances to the wall projection.*

9 Design details are documented in a separate paper (see Cappelen & Andersson, 2011a).

output possibilities WAVE offers infinite ways in which to interact and co-create musicking experiences.

We have made many design choices and solutions when creating WAVE. Choices and solutions that were based on the ideas, wishes and demands from the users of ORFI and others, joined together with our Musicking Tangibles qualities. We also designed WAVE to evoke interest and positive emotions by making a soft, glowing, velvet surface and a strong, characteristic shape with many arms that invite different forms of interaction and intensity levels. In addition, we designed WAVE to offer many roles to play. On one level it is only a carpet to sleep on with a strong, sensorially stimulating and musical vibrator in the centre. On another level WAVE is designed as a giant console game where two people can sit on each side and compete with each other. The WAVE Carpet can also be interpreted as a big seven-armed octopus that you can sing with, get responses from and improvise music together with.

Lastly, we designed WAVE to offer many ways in which to express oneself, both physically, musically and visually. One example of the latter is by playing with the user's picture and reflection, alternating between the camera and the handheld projector. By designing WAVE to be an interactive landscape on the floor we wanted it to become a cosy meeting place, arena and initiator for sharing and creating relations between all members of the family.

Third generation – REFLECT

REFLECT is one of many Musicking Tangibles designed within the third generation of tangibles in the RHYME project. In this third generation we focused on mobile and wireless technology.

REFLECT consists of a lumber-like soft thing, shaped as an abstract glowing head with a trunk or an arm. The user can play with REFLECT on the floor, hold it in her arms, or over the shoulder while dancing. But the user can also carry it over their shoulder playing it like a soft glowing guitar. When designing it we have we have tried to shape REFLECT to be as ambiguous as possible to motivate different interpretations and interaction forms (Gaver, 2003). Data from RHYME, including the interviews with the children's siblings and parents, the focus groups and the RHYME researchers' dialogues gave input to the selection of music, i.e. what kind of music and musical tunes they wanted to include in REFLECT.[10]

10 See Stensæth's analysis of REFLECT in Stensæth (2014b) or elsewhere in this volume.

Picture 4: *REFLECT's lumber-like soft things with RFID-tagged scene cards and tagged things to create choir sounds*

REFLECT 's embedded sensors, such as touchable glowing stars, its speakers and lighting makes it possible for the user to create dynamic music and light experiences.

REFLECT has several embedded sensors, such as touchable glowing stars and with its speakers and lighting, it is possible for the user to create dynamic music and light experiences. REFLECT has a RFID-reader at the end of its trunk (see picture 4) so the user can select music tunes by choosing RFID-tagged Scene cards looking like CD Covers, and dynamically change the music by interacting with the tagged things (see picture 5 and 6). The user can further dynamically manipulate, distort and add effects to the sound samples while interacting with touch and bend sensors.

The software in REFLECT is written in the object oriented programming language SuperCollider (SuperCollider 1996) and is running on an iPod Touch. The hardware is a mixture of custom-built circuits for sensors and light, and standard mobile phone technology such as portable speaker and battery pack. This makes the platform self-sufficient and wireless, and offers high quality sound experiences compared to current instruments and assistive music technology.

REFLECT is an attempt to join together input and ideas from workshops, user studies[11] and other user inputs, in order to realise a *mobile computer platform*. We

11 See Stensæth's analysis of REFLECT in Stensæth (2014b) or elsewhere in this volume.

***Picture 5 and 6**: Maracas and Monkey with white RFID-tags*

designed REFLECT in order to offer the user a multitude of ways in which to interact and regulate their emotions and actions. For instance this could be done by selecting the kind of music they liked, by varying the volume level and by choosing among many objects to play with in order to take part in the musical activities (see picture 5 and 6).[12] From the earlier RHYME actions we also knew that we needed to give the user direct light and sound response at the same place as the user interacted.

We have made many design choices and solutions when creating REFLECT. Design choices and solutions that in the mobile REFLECT is an attempt to answer to all the ideas, wishes and demands joined together with the Musicking Tangible qualities described above. We chose to make REFLECT in soft black wool with contrasting white lighting fields to stimulate the tactile and visual senses and to motivate different forms of interaction. The thick soft wool made it robust and cozy to hug, sleep on and dance with. The contrasting, bubbly, yellow velvet stars made it magic to touch because of its softness and immediate light and sound response. We gave REFLECT an ambiguous soft shape with head and trunk to make it easy to interpret in many ways, and to offer many roles to take. For instance, the user can hold it upwards as a partner while dancing with it, or to play on it as a guitar with its strap over the shoulder. Furthermore, the user can sleep on it as a glowing cushion, or beside it as a giggly sounding bedmate.

12 Learn how Petronella and family played with these in Stensæth (2014b) or elsewhere in this volume.

We chose to use RFID-technology in REFLECT as an important design solution. RFID-tags are often used in keycards, where the RFID-reader is the door lock, or as security marking of goods in stores. We used RFID-technology in order to offer the user of REFLECT many forms of interaction, self-expression and self-regulation. Firstly, it made it easy for the user to choose a RFID-tagged CD-cover-card to choose the kind of music she wanted to make and play, according to her mood and liking. The CD-cover-card concept was an attempt to build on the user's knowledge and experience of CD-covers and similar laminated cards often used within Augmented and Alternative communication. We linked the CD-cover-card with the white, round RFID-tag onto a contrasting black textile. We designed the tag 'eye-like' (see picture 5 and 6), to make it easy to see and similar to the white end of the black trunk where we placed the RFID-reader.

Secondly we added a lot of different ordinary things with this eye-like RFID-tag to catch diverse users' interest, evoke positive emotions and motivation to interact with REFLECT. We added musical instruments like maracas and drums, on which the users had previous experience of playing. Furthermore, we also added objects like pots and pans that made sounds while playing on them, and soft slippers and several soft toys that obviously did not create a sound of their own, but by putting the RFID-tag onto the end of the trunk they added a synthetic musical layer. The RFID-tag could also be connected to the user's own things to include them into the musicking experience. All of this was in order to offer the users many ways in which to interact, create music, express themselves and relate to things. Some things, like the slippers, could be worn as a form of self-expression. Other things could be played on and with, in order to extend the musical experience and challenge musical mastery. The interaction knowledge the user achieved on one level could be built into more complex musical mastery later, because of its consistency.

Fourth generation Musicking Tangibles – POLLY

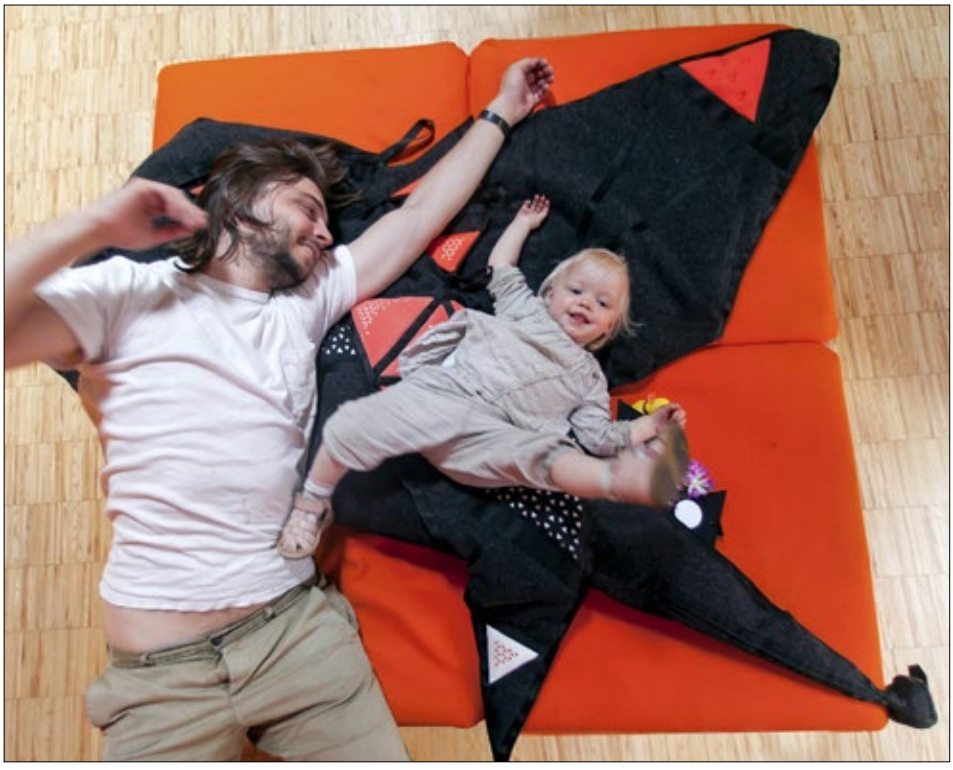
We have chosen to call the last and fourth generation of Musicking Tangibles within the RHYME project, POLLY. The name POLLY comes from "poly", the Greek prefix for 'many'. This suits POLLY in that it is manifold: There are many ways to create music, many musical tunes and visual expressions, many ways to play and interact, many ways to participate socially, many colours, polygon shapes and many possible sensorial experiences, to mention just a few.

The design of POLLY is an attempt to meet all of the demands, suggestions and wishes from the users and experts related to the three earlier generations of RHYME's Musicking Tangibles. In addition it includes social media functionality.

As we experienced from the REFLECT actions, we needed to include a microphone, RFID-functionality and other sensors we had in REFLECT, in order to offer more ways for self-expressions. We also needed more musical choices in order to increase the self-regulating functionality. There were also demands for better sound quality in the mobile Tangibles, regarding both sound frequency range and volume regulation, since some users need stronger and some softer sensory stimulation. Therefore we had to include stronger speakers and better battery solutions into the mobile Tangibles to answer the diverse demands from the users. This increased both size and weight of the mobile tangibles, POLLY Land, POLLY Planet, POLLY Fir and POLLY Ocean in the POLLY World (see pictures 7–11).

Picture 7: *Family interacting in the POLLY Land in the POLLY World*

Picture 8 and 9: *POLLY Planet*



Picture 10*: POLLY Fire*

Picture 11: *POLLY Ocean*

During the RHYME project we have tested several projection solutions. These are full-wall projections, handheld laser projector with dynamic-focus-projection and no projection. The latter solution was experienced as a lack by some of the users. Other users again experienced the full-wall projection as too attention demanding and passivizing.[13] Therefore, as a response to the focus group demands (see Stensæth 2014a), we have developed a closer and more intimate and embodied relation to the video projection, compared to traditional wall projection, TV and Computer Screens. The current screen solution in POLLY is an 80cm x100cm back projection, which can be either hard or soft, depending on the material used to project on (see picture 7).

In the POLLY World we have also expanded the musical choices radically, both regarding musical genres, number of music tunes or Scenes as we call it in POLLY, in order to expand the users' possibilities to regulate their emotions and actions.

13 Read about this elsewhere in this volume in Stensæth's (2014a) analysis of Petronella and Dylan interacting with WAVE.

The user can choose a scene by activating the scene card by using the RFID-reader. We call it 'scene' because it also adds a visual dimension to the music, with dynamic graphics and light play in the textile tangibles to extend the sensory experience, compared to what we have in REFLECT.

We have put an effort into creating a richer sensory experience visually, audibly, tangibly and haptically. Much work has also been put into creating a more seamless transition between the material and computational surfaces, the textile surfaces that stimulate senses in a visual and tactile way and surfaces containing computational sensors and activators. This is done in order to always offer the user positive experiences and challenging mastery possibilities, by first being stimulating in a sensorial sense and later by being controllable in an instrumental and computational sense. This is an example of how our Musicking Tangibles approach differs conceptually, in opposition to a 'switch-oriented' and instrumental mindset, where the user first has to understand and learn how the system works before making music.

We have also put considerable work into creating many ways to interact with every sensor. The microphones can for instance just be strapped to a hook or handle or over the hand. The shape and the light weight of the microphone makes it easier to hold but still has the important responsive light when activated. Again, this is done to make it easy and stimulating in multiple ways, and hereby to lower the threshold and increase the mastery possibilities. Since all sensors are built on mathematics they are in principle absolutely precise, and because all music compositions in POLLY are built up of music elements that are based on advanced musical rules, they can be used to build even more complex musical compositions and thereby offer increased mastery levels. This makes POLLY both much simpler and much more complex at the same time. In one sense POLLY is only a pillow, blanket, ball or piece of furniture, but in another sense it is a very complex, collaborative, inviting and musical computational actor or machine.

All the design and development effort in RHYME has been done in order to lower the threshold for always evoking positive experiences, where there are no wrongs or failing possibilities, and simultaneously offer advanced actability and mastery possibilities. Furthermore, the design is developed in this way in order to offer the users a place – and an arena – where they can be together and create together in the same co-creative tangibles, in the same environment. Additionally, the design is developed in order to offer distributed communication by interacting via smartphone or a tablet over the Internet, both in a graphical and text-based interface. In this way the family and their child with disabilities are offered ways in which they can be together, co-create and share positive and meaningful experiences while either being at home or away from home. We have also created functionality for daily and

weekly programs, to use music as a coping, self-actualising and ritualising medium, in the user's everyday life.

Conclusion

In this article we have presented a novel approach for the understanding and the design of interactive health improving music technology, what we call Musicking Tangibles. The Musicking Tangibles approach represents an alternative approach to the traditional instrument, interface and switch-oriented music technology perspective. The Musicking Tangibles approach combines a humanistic, resource and empowerment oriented health approach with an aesthetic and culture based design approach towards music technology. We have presented four empowering and health improving qualities for the Musicking Tangibles. These qualities emphasize:

1) Continually evoking interest and positive emotions relevant to diverse users' interpretation of the tangibles and the situation
2) Dynamically offering the users many roles to take, many musicking actions to make and many ways to express themselves
3) Offering the users aesthetically consistent responses and building relevant cross-media expectations and challenges over time and space, consistent with their character
4) Offering the users many relations to make: to people, things, experiences, events and places

Furthermore, we have presented and argued for some design solutions of the Musicking Tangibles ORFI, WAVE, REFLECT, and the POLLY World from the RHYME-project. In developing POLLY we have tried to put together as many design qualities as possible in order to exemplify our view and current understanding. Lastly, because he is not the co-author of this article, we want to express our gratitude to our co-member of the RHYME development team and MusicalFieldsForever (MusicalFieldsForever 2000), Fredrik Olofsson, for his contribution in the creation of the Musicking Tangibles.

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