The Musical Steps Final Report

INF3260/INF4260 fall 2007

By: Espen Skorve, Bjørnar Lassen, Karsten Jansen, and Ingunn Rønningen

Table of Contents:

1. Problem Domain

Making an exhibition in The Norwegian Children's Museum, which is contributing to children's exploratory and learning abilities.

We understand The Norwegian Children's Museum as an initiative rooted in the visions of physicist Frank Oppenheimer, who conceived the San Francisco Exploratorium. As opposed to the "don't-touch" nature of more conventional museum exhibitions, the Exploratorium is based on the idea of creating learning experiences through interaction.

"*The Exploratorium's mission is to create a culture of learning through innovative environments, programs, and tools that help people nurture their curiosity about the world around them*" (http://www.exploratorium.edu/about/fact_sheet.html).

In addition to the aspect of learning through exploring, the Norwegian initiative emphasizes the boundary crossing potential of the basic concept through creating environments for interactions across the boundaries of language, culture and other segregating factors.

2. Methodological approach

We have had the opportunity to try out a variety of different qualitative approaches to data gathering during this project. These include document studies, observation, experiments, focus groups and interviews, all according to the different objectives of our research along the way.

2.1 Document studies

The internet has been an abundant source of information relevant to our project. According to Katie Coughlin, the project leader for Oslo Barnemuseum, the initiative is rooted in the US tradition of Exploratoriums. It was therefore a natural step to spend some effort on digging into what this tradition is about, and how it is manifested in the various existing Exploratoriums around the world.

As none of the members of our project group is experts on sensor technique, the internet has also been a source to information about how our concept can be realized in a final installation.

There is a lot of research going on related to technology that might be relevant. In addition we have stumbled upon projects out there that are very similar to our idea.

2.2 Observation

Our main focus has not been on the design of the technical solution, but on the design of interaction. As we were more concerned with how an environment can influence interaction between children than with how they interact with the installation itself, we needed to take a closer look at some existing environments in order to establish a framework for understanding. Our choice fell upon Frognerborgen in Frognerparken, Vitensenteret at Teknisk museum and the playroom at IKEA. By observing the way children were using these installations, focusing on child to child interaction, we were hoping to gain some conceptual ideas for how to analyze the various designs according to our objectives.

2.3 Experiments

Qualitative research methods have their origins within the social sciences. Apart from the field of psychology, running experiments has not been a central approach within the social sciences, partly due to ethical considerations. Within the field of design however, the concept of prototyping can be seen as a revival for research trough experiments.

This far we have conducted two experiments, both very informing to our project. On October 18th we tested a pilot of our design idea on the children of one of the project team members. The design was then altered according to our observations during the pilot, and on October 25th we ran a test of the modified prototype at Lakkegata SFO. Both these experiments were videotaped, and are described in further detail later in this report.

2.4 Focus groups and interviews

We were planning to arrange focus groups as an extension to our visit at Lakkegata SFO, but the situation didn't really allow for a full scale version of this. However we did manage to acquire some collective feedback from the different groups of children before they were dispatched in favor of letting a new group into the room where we conducted our experiment. In addition to this, an ongoing dialogue with Trine Merete Sjølyst from Oslo Barnemuseum has been very helpful in informing our project. We also intend to interview other stakeholders, like parents and SFO employees.

3. Understanding Use and Users

Getting to know which people that will be affected by your product is essential in the development process. Many interaction devices suffer from a lack of acknowledging the user early in the design process (Rogers et. al. 2007:4,9). Therefore, we have chosen a user-centered approach (Gould & Lewis 1985 in Rogers et. al. 2007:425), with an early focus on the users and tasks, empirical measurement, and following an iterative design process. Determining how the users will use the product is just as important. After research data has been gathered, one may work with the data in order to establish a number of requirements that the interactive product should meet.

3.1 Who are the users?

The 'users' of an interactive product include of course those who interact directly with it, but during the design process, it may be beneficial to think of the term in a wider scope. Here, we will see the users as 'stakeholders', defined as "people or organizations who will be affected by the system and who have a direct or indirect influence on the system requirements" (Kotonya & Sommerville 1998 quoted in Rogers et. al. 2007:430). One way of seeing this is by dividing users up into primary, secondary and tertiary users: Primary users are those interacting directly, secondary users are possible, occasional or mediated participants, and "tertiary users are those affected by the introduction of the system or who will influence its purchase" (Eason 1987 in Rogers et. al. 2007:430).

Preliminary research in defining the users was established by examining what has been said about similar installations at Eureka (http://www.eureka.org.uk/SoundGarden.htm) and Universeum (http://www.universeum.se/, http://sydsvenskan.se/lund/article271987.ece). Further discussion on this topic went on at a meeting with Oslo Barnemuseum, where we for instance discussed to what extent parents should participate in the installation. We have come up with the following possible users and stakeholders in our project:

- Children aged 0-12 visiting the children's museum. These are the primary users.
- Other museum visitors, such as parents. These are secondary users.
- The project leaders and founders of Oslo Barnemuseum
- The children and staff at Lakkegata SFO, where the prototype is tested
- The museum guards and maintenance workers

3.2 Field Studies

Having identified a number of users, we studied how similar installations and settings were exploited. This research was done by observing Frognerborgen playground, the children's area at IKEA Furuset, and interactive installations at Norsk Teknisk Museum. Our main focus was to see how children used their surroundings through play and exploration, and to see what, if any, cooperation took place between the children.

3.2.1 Frognerborgen

The main purpose of conducting an observation at Frognerborgen was to see how the installation facilitates – or fails to facilitate – interaction between the children. The main objective then is not to study how children interact with the installation it self, but to study how the installation mediates the children's interactions with each other. In this perspective our observations became somewhat of a disappointment.

The children don't play much with each other in Frognerborgen. Most activities are exclusively an interaction between the singular child and the installation. Even the parts of the installation that initially could invite to cooperation fail in creating child-to-child interaction. In some cases you can find children assisting their smaller siblings, but the majority of human-to-human interaction is dominated by parent-to-child relations.

When children are playing, they normally represent a resource to each other's experience. In Frognerborgen that does not seem to be the case. Here other children mainly represent a factor whose only contribution is to suspend your own experience because you have to wait until they are finished using the particular part of the installation you want to try.

So what is it about the design of Frogneborgen that is causing this? For one it offers very few opportunities for the children to influence each others experiences in a positive direction. Rather, the other children are more of an annoyance, either because you have to wait in line or because their activities make your own activities more difficult. . The most important

knowledge the observation conveys is maybe the importance of enabling the children to positively affect each others experiences through the interaction with the installation.

3.2.2 IKEA Furuset

When the children entered the playroom, they became a part of a group of children, without parents. Although they were still being supervised by employees, that may have given them the liberty to act more open, and independent. The children spent little time to get comfortable and engage in play.

An activity was exciting when at least one child were engaged in it. This attracted other children to join in. They were open to everyone, and including. Everything seemed very light and natural. The interaction was conducted through body language, and not verbal language.

3.2.3 Norsk Teknisk Museum

The results from our observation varied greatly, depending the installation being studied. The installations in question were remote controlled robots, a collection of telephone noises, "make your own ringtone", shiploading, and an interactive fish pond. The collection of telephone noises and "make your own ringtone" did a not provide large number of data about users and usage, but did provide some very important technical requirements of how sound should be implemented in our project. The children seemed to cooperate a bit with the remote controlled robots, the shiploading, and in the interactive fish pond. However, the environment put restrictions on the interaction, mainly because of how things seemed very technical. The fish pond seemed to be the most playful installation, perhaps due to a combination of location and the ways the interactive experiences was mediated.

3.3 Establishing requirements

"it is always useful to start [a search for requirements] by understanding similar behavior that is already established"(Rogers et. al. 2007:433)

It is good to establish requirements, because it is much cheaper to fix something during the requirements activity than late in the development cycle. (Rogers et. al. 2007:475)

"A requirement is a statement about an intended product that specifies what it should do or how it should perform"(Rogers et. al. 2007:476)

Here are the requirements we have found, categorized in five main requirement types (Rogers et. al. 2007:478-485):

- Functional requirements
    - Should mediate children's spacial exploration through music, and possibly other senses
    - Should stimulate cross-cultural learning through exploration, play and cooperation
- Data requirements
    - Should not require the knowledge of any data, the emphasis will be on exploration
    - If data is given to the users, it should be in the lines of:
      "In this room, interesting things happen when you move around"
    - The sounds and maybe the sensor placement should change at either regular intervals or according to variables given by the system (the number of users, etc.)
- Environmental requirements
    - There should be enough space for the users to move around freely
    - Sensors should be placed in a pattern that does not encourage running around in circles or in any other obvious chronological order
    - Should avoid dangerous elements that may lead to injuries caused by things like slippery sensors or children running into each other
    - Should not be so noisy that it becomes a problem for non-participants, while at the same time it must tempt non-participants into participating
    - Should have size restrictions that limit the degree of of parental involvement
- User characteristics
    - Should include children across cultures and be disability-friendly
    - Should allow children to regulate the use by themselves
    - Should allow increasing sense of mastery through use
    - Should provide a challenge at all levels of mastery
    - The installation should be conducive to learning from each other, making experienced kids role models for others
- Usability and user experience
    - As long as the sensors are visible, the system must give immediate audible response!
    - Should operate autonomously without adult surveillance or intervention, which includes a proper error handling if sensors are blocked or go haywire.

3.4 Scenario

Imagine a child; let's call her Ann, entering an empty room. As she enters she walks into a blue circle on the floor, and a subtle sequence of African drums starts playing. As she steps out of the circle, the sound of the drums slowly fades away. She steps back in the circle and the drumming starts again. Beginning to sense a pattern she then sees a smaller blue circle on the wall a couple of feet away from her, and she walks over to it. Touching it produces the sound of an Indian tabla drum receiving a single stroke to the rim. She touches it again, and this time the tabla is struck in the middle, producing a very different sound.

By this time a second child, Peter, has entered the room, crossing the blue circle on the floor. The African drum loop starts playing again, adding to the sound of Ann trying out the different sounds of the tabla. She decides that one drummer is enough and moves on to stroke her hand along a thick, red line on the wall, thus triggering the sound of an Australian didgeridoo. That blends in pretty cool with the African drums, but now she is tempted to try out all the other different figures spread around the floor and the walls of the room. So she moves on, leaving the didgeridoo to a third child who has just entered the room.

After a while, several more children have arrived in the room, and Ann has tried out most of the figures and instruments. So she moves on to the next room. It looks pretty much like the room she came from, but there are no figures on the floor or on the walls. Despite of this, a lush sound of someone singing is triggered when she enters. She starts moving about in the room, stepping and touching randomly. As she suspected, several spots around the floor and walls seems to have the same magical effect as in the previous room. Then Peter arrives in the second room. As they have both broken the code of the installation, they start exploring together where the magical spots are, and how they can make different combinations of the sounds they trigger.

4. Prototyping and Design

This section describes our approach to the design of a prototype. After a general discussion, we move on to describing our pilot and prototype testing. Central issues covered are what we learned during the process, and how that informed the evolution of our design.

4.1 The design process

Due to the nature of our mandate, it was obvious early on that we would need to take an iterative approach to the design process. It was equally obvious that we were very much dependant on the participation of potential future users in order to do so. Trying to predict how children will use our prototype, and how different aspects and variations of the prototype would influence this usage, would be impossible for us to do in any other way.

An iterative approach would allow us to learn what works and what doesn't, to continuously analyze the effects of different conceptual models and to make improvements and new models according to what we learn (Rogers et. al. 2007:428). By involving representatives for target users, we would be able to gain experiences related to use that closely resembles the context of the final design. User participation is in general a useful approach to informing technology design (Bjerknes & Bratteteig 1995:74).

We chose to develop a low-fidelity prototype (Rogers et. al. 2007:531), as it was the interaction and not the technical solution that was our main objective for creating it. This allowed us to come up with a "working" installation a lot faster than if we were to develop a more technically advanced prototype. It was important to us to get out there as quickly as possible, so that we could generate some real life experience to base our iterations on.

It is hard to categorize our prototype as either horizontal or vertical (Rogers et. al. 2007:537). As mentioned, our main focus was on the interaction, not on the technicalities. As such, our prototype supported pretty much the full range of potential usage of a final installation, indicating little compromise in both dimensions. Regarding the technicalities, our prototype can be considered a compromise in both dimensions. Choosing to ignore the element of visual feedback points towards classifying it as a vertical prototype, rendering visibility as a future expansion. Our "Wizard of Oz" approach (Rogers et. al. 2007:535), where the functionality is emulated rather than implemented, could point towards classifying it as a horizontal prototype. As a result of this, we don't really find this classification scheme very useful for our case.

4.2 Pilot

On October 18th with simple technology to play our sound images, and wax cloth figures as sensors, we ran a pilot test on three kids age 1, 6 and 7. Our test consisted of three different sound images, with five minutes exposure each. A video tape of this pilot test is available http://homepage.mac.com/bjornarlassen/MusicalStepsPrototype1.mp4. Our goals of executing this pilot test were to get extensive information about the user experience, the sound design, and the physical design, to optimize our prototype.

As our test progressed we recognized that we had to consider placements of the wax figures, and to further improve our sound sets. The children however, enjoyed themselves, and often expressed their joy and curiosity when exploring the installation. Since it was us pushing buttons as the children triggered the sensors, we found that we also needed to consider, in a greater extent, that human reaction and concentration is not as good as computers, resulting in each group member being responsible for maximum two sensors.

4.3 Prototype Test at Lakkegata SFO

Building from the setup in the pilot, we conducted a prototype test on Thurstay, October 25th at Lakkegata SFO. Two modifications were made from the pilot. First, the make-believe wax cloth sensors were now organized in a manner that did not encourage fast running in circles. Second, we made modifications to our sound sets. The most chaotic sound set from the pilot was removed. Two new melodic sound sets were used in addition to the existing two sample-based sound sets.

Various combinations of children groups and sound sets were used (see Appendix C), varying from two to five participating children, and often presenting a group of children with more than one sound set to see how they responded when they used their pre-existing knowledge on a sound set that had different rules for producing sounds. It seemed like group size had an effect on how quickly the kids adapted to the interface, the more the merrier.

The chrildren used the installation in several different ways. Some went wild and wanted to trigger all the sensors one after another. Other groups took a more exploratory approach, and wanted to identify the various sounds that could be heard. While some saw the installation as

a playground, others thought it was more of a puzzle game that was to be solved. When questioned after the experience, reactions were ranging from alienation to amazement. A link to the video from the event can be found in Appendix A.

5. Evaluation

The DECIDE framework for evaluation provides a useful checklist for planning an evaluation.

5.1 Determine the goals

Determining the goals of an evaluation defines the scope of it, as well as the methods used throughout.

Oslo Barnemuseum states a number of overarching design criteria, namely:

1. No language or reading required
2. No (or minimal) queues or waiting
3. Engage multiple senses
4. Bring strangers together for meaningful interaction
5. Built in child-sized proportions (everything easy to reach)
6. Project phase: easy transport, low cost

The goal of this evaluation then, is to see whether our design as implemented in the prototype fulfills these criteria.

5.2 Explore the questions

In order to find out whether the goals are met, specific questions must be articulated. In our case, the following need to be answered, regarding the specific design criteria:

1. Do the children understand how to use the installation without requiring spoken or textual instruction?
2. Are some of the children idle some or all of the time because of limits inherent in the design?
3. Does the installation provide feedback or activate senses other than hearing?

4. Do kids that don't know each other play together in the installation? Is there a possibility of conflict?
5. Does everyone reach every sensor in the installation? Is this true for every age group?
6. Is the prototype affordable? Could Oslo Barnemuseum buy the equipment needed?

5.3 Choose the evaluation approach and methods

Early on we decided that the best way to proceed was to gather data to inform our design. It was our understanding then, that we should build a lo-fi prototype and test it on our target population, first in a pilot study, then in an extended prototype test.
A field study provides understanding of use in the subjects' natural environment, and how products mediate the subjects' activities. Also, it helps establish the requirements for design (Sharp et. al., 2007, p 591-592). This was an ideal approach for us.

The nature of our user base required us to come to the test subjects, but bring our own test environment, so to speak. As such, the prototype unfortunately introduces some unknown elements, as well as our presence, which could disrupt the natural behaviour of our subjects.
The methods used to gather data was mainly recording the session using cameras, then later perusing these recordings. Also, we would ask each group a small set of questions. We debated developing a larger and more rigid questionnaire, which would have given us a different angle, but decided against it due to time limitations.

5.4 Identify the practical issues

5.4.1 Access to users and facilities

Oslo Barnemuseum had an ongoing cooperation with Lakkegata SFO, which provided us with test subjects within the age group 6-9. While naturally within our target range, we had some concerns whether the results were generalizable to the target audience range. Ideally, other age groups should be tested, but we did not find the time nor opportunity for this.
We were allocated one room at Lakkegata, which would set the size limit of our prototype, as well as influence the placement of the cameras.

5.4.2 Resources and know-how

The extent of our testing and prototyping would be limited by our resources, in particular the cost of prototyping, and equipment for the prototype and recordings.
We decided on a lo-tech prototype, utilizing equipment belonging to the group's participants. Total cost of the prototype was now only the price of some wax cloth.
Using group members' equipment also meant that we would experience fewer problems setting up the testing session. In all the setup, while lo-tech and comparatively lo-fi, gave us a brilliant starting point for data gathering.

5.5 Decide how to deal with the ethical issues

The parents were informed that we were conducting a test, and asked whether their child could be videotaped. We only included children who had this permission.

5.6 Evaluate, analyze, interpret, and present the data

5.6.1 Reliability

Reliability does unfortunately suffer during field studies and unstructured interviews.

5.6.2 Validity

As previously stated, the goal of these tests were to gather data and observe use of the prototype. As such, the methods used should yield highly valid results.

5.6.3 Biases

There are some possible ways of introducing biases in our study. The nature of this test setting makes us, the testers, interact with the subjects. The way we act towards them may influence their behavior. Also, since the group have worked together extensively on this project, we may both detect and ignore the same elements when later viewing the video.

5.6.4 Scope

The scope for this test is wide and shallow, as it tests general usability of the main functions of the installation.

5.6.5 Ecological validity

Normally, entering and studying subjects in their natural environment gives an advantage over laboratory studies in terms of ecological validity. Unfortunately, our presence in the room may influence the children to act in a different manner than they usually would. ('Hawthorne effect', Sharp et. al., 2007, p 641). In addition, the room is dominated by an unknown installation.

5.7 Our findings

We conducted a pilot study with a small number of test subjects aged 1, 6 and 7. Important insights were gained, which informed the redesign of a number of features in our prototype test.

Sound sets were replaced or updated. In the pilot, the same sound, but with different pitches could be used for different sensors. This was found to confuse understanding of which sensors generated the sounds. Hence, in the prototype, all sounds were distinct.

The placement of the sensors seemed to influence movement patterns. In particular, kids were found to run in circles, one after the other. Therefore, in the prototype, an effort was made to space the sensors properly, although we were limited by camera and operator placement.

The user experience seemed to be one of absolute joy, showing us we clearly had a worthwhile project on our hands. The children were laughing and running around, really caught up in the experience.

The prototype test had a similar setup, now with tweaked sound sets, as well as two new, instrumental. The number of kids per trial was increased, and we had an older test population, aged 6-9.

A new problem was uncovered, namely a lack of affordance (Sharp et. al., 2007, p 33) in the wax cloths posing as sensors. The kids were clearly unsure of what to make of them, and required instructions. This was only a problem before the first sensor triggered, and the kids grasped the concept easily. Color and shape of the sensors was of minimal

importance, although the longest shape gave different pitches of a sound in one of the sound sets. Some of the kids picked up on this.

Also, some of the groups seemed bothered by our presence, an unfortunate artefact of testing, which may have had a bearing on their performance. It is not clear whether we can eliminate this in further tests.
Group size had an influence on the tempo and pattern of movement. It is important to figure out the optimal number of people for a given number of sensors, or otherwise accommodate multiple users per sensor.

The introduction of the instrumental sound sets showed both assets and drawbacks. Most of the groups seemed to enjoy the coherent music, while at the same time influencing what was played. However, it was more difficult to figure out which sensor caused which sound.

Hardly any speech was used, indicating that language barriers will not be an issue. Body language, both explicit and implicit is observed, having an impact on the interaction between kids.
Although fascinated by their influence on the installation and the sounds produced, showing a substantial user-installation interaction, between-user interaction is heavily represented. Children are often found following each other around, looking at each other when triggering sounds, and even pointing and issuing commands in order to confirm a hypothesis or accomplish some specific sound combination.
Negative interaction is also observed, although very infrequently. A few instances of dominance or 'ownership' over a particular sensor did occur, with mild attempts of physically or verbally removing another child. This is believed to be a negligible problem.

The user experience was once again exceedingly positive in most groups. Laughter and outbursts of joy was heard in mostly all trials, as well as wonder, indicating a unique experience.
Once again, some groups seemed influenced by our presence, and reacted with insecurity and caution. Hopefully, this will not happen in an automated environment.

We are pleased to say we have accomplished many of our goals concerning user requirements. Elements that will need consideration in further testing include testing different age groups and kids with handicaps. The placement and shaping of sensors is once again important, and we should continue to evaluate sound sets.
An important area of testing and design concerns the goals of
- increasing mastery through use
- challenge at all levels of mastery
- an installation conducive to learning from each other, creating role models
The design of sounds sets and physical layout of the installation will have to be informed by solutions to these challenges.

In an automated environment, we will be able to implement additional functionality, things that are not possible with the current prototype. In particular, problems caused by our presence will be eliminated, as well as human errors in sound generation / feedback. Furthermore, we should think about possible future expansions.

5.8 Future expansions

To arrange the installation to best suit disabled children, we could contact the ifield project (ref: www.ifields.org) who have executed a simular project where sensors trigger music aimed at children with various disabilities.
As a way to realize the sensory interface, our project can be integrated into a project like Embodied Interfaces (Engholm & Klastrup 2004:305). In such a setup, temporal variation in boderly location is projected onto a screen. The difference between this and traditional virtual reality is that the body is not separated from the experienced user interface. Thus, it allows the body to become part of the mediated interface, bringing life to an abstract dimension while at the same time present in the real (ibid. 303).

6. Summary

Our group is working on the idea of a musical steps installation. The idea is to have sensors in a room, so that when triggered, they will play a sound. To form a prototype we firstly conducted observations of the user group, and got in contact with Oslo Barnemuseum. They were eager to follow our project, and were able to provide a test group for our prototype.

Based on the data from the observations connected with our idea, we constructed a pilot. We executed the pilot on a small group of volunteer children. This was prior to our prototype test with the test group, with the intention of improving our prototype further before the prototype was tested. These preliminary tasks showed to aid us greatly in constructing a well-defined and beneficial test run of our prototype.

The test of the prototype was very successful, with plenty of happy kids, and with our goals for the prototype achieved. Although it was limited due to budget, it shows a great potential.

References:

Bjerknes & Bratteteig 1995: *User Participation and Democracy: A Discussion of Scandinavian Research on System Development* Scand J Inf Syst,
Available online: http://www.e-sjis.org/journal/volumes/volume07/articles/no1/04_bjerknes_p73-98.pdf

Engholm, Ida & Klastrup, Lisbeth 2004: *Digitale verdener* Danmark: Gyldendlske Boghandel Nordisk Forlag A/S

Rogers, Yvonne; Sharp, Helen; Preece, Jeniffer 2007: *Interaction Design: beyond human-computer interaction*, 2nd edition. Hoboken, NJ: Wiley & Sons

Appendix:

A. Prototype video available at:

http://www.uio.no/studier/emner/matnat/ifi/INF3260/h07/student%20projects/The%20Musical%20Steps/MusicalStepsPrototype.mp4

B1 – Frognerborgen reflection note

Figure 1: Frognerborgen

Centrally in the idyllic surroundings of Frognerparken we find Frognerborgen; a playground that in 2006 replaced the pirate ship Mathea, previously located at the same spot.

Friluftsetaten of Oslo Kommune is initiator and owner of the installation and their homepage states that

> *"The installation is 20 x 20 meters, includes towers of up to seven meters height and is suited for children aged three to twelve. As much as two hundred children can slide, climb, jump and do acrobatics simultaneously – without ever having their feet on the ground and without crowding each other. The trajectory through the installation includes suspension bridges, slides, walls for climbing and experimental climbing ropes with obstacles. There are challenges for the brave and the careful alike."* [1]

Observing how children actually use the installation seems to be an obvious source of both information and inspiration to the work of creating a suggestion for an installation in Oslo Barnemuseum. The main purpose with such an observation would be to see how the installation facilitates – or fails to facilitate – interaction between the children. The main objective then is not to study how children interact with the installation it self, but to study how the installation mediates the children's interactions with each other. In this perspective our observations became somewhat of a disappointment.

The children don't play much with each other in Frognerborgen. Most activities are exclusively an interaction between the singular child and the installation. Even the parts of the installation that initially could invite to cooperation fail in creating child-to-child interaction. One example is the "one-child-carousel" (figure 2) where the children are dependant on someone else to spin them around when sitting on it.

Figure 2: The one-child-carousel

In some cases you can find children assisting their smaller siblings, but the majority of human-to-human interaction is dominated by parent-to-child relations, both in this activity and in most of the other activities facilitated by the installation. Dialogues overheard during the observation strengthen the impression that Frognerborgen primarily offers solo activities. *"If you can't stay together, we will have to leave"* (a mother yelling at her son for 'loosing' his smaller brother). *"It's not possible to play here. We better see if we can find a playground with less people"* (a

[1] http://www.friluftsetaten.oslo.kommune.no/parker_friomrader/lekeplasser/frognerborgen/

mother dejected by the crowd and the queues). When children are playing, they normally represent a resource to each other's experience. In Frognerborgen that does not seem to be the case. Here other children mainly represent a factor whose only contribution is to suspend your own experience because you have to wait until they are finished using the particular part of the installation you want to try. The observation only revealed one exception to this; a child who had brought a bucket full of sand and a spade into the installation (figure 3). She was soon accompanied by other children, but in an activity that initially wasn't facilitated by the design of the installation. As such, their interaction can be considered more as *in-spite-of* than *because-of* the design.

Figure 3: Bucket and spade

So what is it about the design of Frogneborgen that is causing this? For one it offers very few opportunities for the children to influence each others experiences in a positive direction. Rather, the other children are more of an annoyance, either because you have to wait in line or because their activities make your own activities more difficult. An example of the latter is the rope ladder with several trajectories (figure 4), where it becomes significantly more difficult to climb when there are children in the other trajectories. For coarse motor training this might be an advantage, but in relation to social training it is likely to appeal more to competitiveness and dominance than to cooperation and interaction. And coarse motor training (in addition to security and esthetics) seems to have been the major design criteria for Frognerborgen. The installation offers a wide range of different challenges in this area, suited for a reasonable variation in age. And this probably explains why the installation has gained the popularity is has among the children. But the experience of the parents indicates that some important design parameters might have been disregarded. On our way into the installation we met a family on their way out. The "mater familia", who was an acquaintance, spontaneously exclaimed that *"I hate this place!"*.

Figure 4: Taustigen

The fact that the installation primarily invites individual activities can contribute to explaining why even the parts that could facilitate collaboration fail to do so. Children are experts in perceiving and adjusting to how their environment tries to regulate their own activities. This can be considered as one of the main projects in their process of socialization. When the predominant message of the environment is that the interaction with the installation it self is the objective, a natural consequence is that this message is made valid for the installation as a whole. And it doesn't help that potentially collaborative elements has physical constraints that inhibits child-to-child interaction. The already mentioned one-child-carousel is too heavy for anyone but the oldest children to spin it around, and then only when there is a smaller child sitting on it. As thus, the design seems to be aimed at the parents taking the active part in the interaction.

All in all, Frognerborgen seems to primarily give insight into how not to do it if the primary objective of the installation is to facilitate child-to-child interaction. The most important knowledge the observation conveys is maybe the importance of enabling the children to positively affect each others experiences through the interaction with the installation.

B2 – IKEA Furuset reflection note

IKEA Furuset

A group member went to the children's playroom to observe how they interact without adults present. The playroom is equipped with a variety of activities. The main activities provided are described below.

Drawing table

Setting:
A table with blank pieces of paper, and a basket of colored pencils.

Observations:
The kids sat down silently drawing, with little interaction apart from reaching for a new pencil, followed by a silent quarrel over the chosen color.

Play kitchen
Setting:
A counter in the children's height, with a stove. Miscellaneous kitchen toys.
Observations:
One child was playing with some pans, by himself. That attracted other children to join in. For a short period of time they were a part of a great chaos with kitchen utensils flying about. Then they established roles in the kitchen, where one child was in charge of the stove, another was responsible for the dishes, and so on. They even had one child serving other children pretend beverages. This was all accomplished with body language, and no verbal communication.

Ballroom
Setting:
A room filled with balls, a playground equipment installed in its center.
Observations:
In this room, all the children played with each other, with fun being the primary objective. They would use the slide and play with a child down there, then run along and play with the next child. Some threw balls at each other and body tackled, but without it turning violent. It was clear that they minded the game so that no one would get hurt. In short; Focus on play, without restrictions on with who or what, a delightful chaos.

Pillow Corner:
Setting:
Two couches pinned together with lots of pillows.
Observations:
One boy went over to the empty pillow corner with a drawing, and was viewing it. Another boy approached and asked what he drew. They talked slightly about it, then they started putting on some cloth masks and jumped about in the corner. Shortly after they, two other children joined in on the jumping game.

After the observation:
The group member decided to have a short talk with a parent with a child waiting to join the playroom, and a employee at the playroom.

Conversation parent:
The parent explains that the child is looking forward to go to IKEA to get to play in the playroom. This is because there are other kids he doesn't know there, and fun games to play. The parent said that she felt that the child was safe there, and on many occasions, the child is reluctant to leave the playroom to go home.

Conversation child:
The child was very enthusiastic and eager to enter the playroom. He said he thought it was very fun to be there and the ballroom was fun, and everything was fun. He explains that every time they go to IKEA he is looking forward to going into the playroom very much.

Conversation employee:
The employee said that the children who enters doesn't spend much time on finding someone and something to play with. When siblings enter, they will often part when entering to play with other kids. The employee contemplates whether that is because they are together all the time, and wants to have some "time off". The children in the playroom are also known to be quick to aid each other if they drop something, or fall, but they rarely instruct each other on how to play a game. The game will just unfold naturally. The employee informs that there are children coming from many different nationalities, and often children who cannot speak norwegian. But this has never mattered, when the kids read body language over the spoken word.

B3 – Norsk Teknisk Museum reflection note

Remote controlled robots
What: More or less autonymous small robots placed on the floor inside a 4x4 meter area. Every robot had its own remote control that children could control, and a museum guard supervised and intervened every now and then.
Why: Interesting to see if there were attempts at mediated cooperation when children controlled the robots.
How: The very youngest didn't understand the remote control metaphor, and were more interested in holding the robots in their hands or lifting them up (causing the museum guard to tell them to keep outside the barriers). The slightly older children (5-9 yrs) understood the role of the remote controls, but were frustrated by the number of buttons, and had to steer the robots with their hands every now and then. There were attemps at cooperation: One boy gave an unused remote control to another (probably for them to play together), but the other boy was more interested in steering his robot into an isolated corner. Children who knew each other from before, tried verbal commands among each other in order to get the robots to play together, but the technical steering challenges were in the way.

Collection of telephone noises
What: A collection of telephones in a glass compartment, with a button matrix below where one could press to hear a noise from each telephone. This worked in parallel - there was no limit to how many phone noises you could hear at once, if enough fingers were used. Diodes lit up so one could see which phone was ringing, but the concept is otherwise nothing for the hearing-disabled.
Why: A number of sensors that can be triggered at the same time, to create symphony or cacophony.
How: Children seemed to either try one phone noise and then run on to the next installation, or try every button in chronological order. After one runthrough, the interest went away. The sounds did not stimulate to further exploring, and only created noise (an older girl commented on the noise when some boys wanted to try them all at once). The placement in a narrow passage did also not invite much to spacial exploration.

Make your own ringtone

What: An interface presented on a large computer monitor where you could use the pointer to highlight different sound tracks you wanted to use in a ringtone, record your own voice, and then create a ringtone that you could upload to your cell phone. 12 tracks to choose from, each of them named on the numerical keyboard of the giant telephone that was on the monitor. The sound tracks were identified as rhythm, drums, bass, melody, strings and texture.
Why: Not relevant in a cooperative perspective, but the technology is relevant.
How: Even with all the sound tracks playing at once, there was a rather symphonic sound. However, there was trouble with the feedback to the user. At times there was a long delay between the moment you chose a sound track and the moment it could be heard in the mix, and then it also happened that the rhythm went choppy or started over in offbeat.

Shiploading
What: The best metaphor is probably "Many crane operators inside a single crane". In this installation there was a ship with loading space for different items that were placed on the bottom of the sea. The items had grappling loops, and the box around the installation had four strings that pulled a hook in one direction of their own. One person could not reach to all strings at the same time, so you needed at least one person to do the job.
Why: Cooperation on a high level.
How: Even though cooperation was essential, the installation required you to act on the technology, and not act through it. It was uncertain in what degree language barriers could play a role here - those who understood the technology seemed to do well without communicating. Those with a low skill level had to shout a lot, leading to frustration.

Fish pond
What: An animated fish pond projected onto the concrete floor, with an optical sensor in the ceiling. When you moved across this pond, you could hear splashing noises, the water surface moved, and the fish swam away from you. If the fishes were separated from each other, it took two to three seconds until they regathered.
Why: Movement in time and space in mediated artifacts, with a possibility for exploration and cooperation.
How: Cooperation between people occured in a reactive sense - one needed to adjust when another person entered your area and affected your fish. There were some chain reactions, being one kid starting to chase a fish that another just chased away. One two-year-old tried to scare the fish away by shouting, but that did not work. Another tried fingersnapping, and that worked! Not because of any sound sensor, but because of the arm entering the sensor area. Generally, it seemed like the children were rather dramatic and physical, they jumped and stampeded as if the pond were real. One baby was put on its stomach in the fish pond, and followed a passing fish with its eyes, but showed no signs of acting at a consequence of this.

C. Organization of soundscapes and children in the prototype

	Sound 1 (Scale with distinct noises)	*Sound 2 (Percusion)*	*Sound 3 (Melodic calm)*	*Sound 4 (Melodic Salsa)*
Group 1 (4 children)	X	X		
Group 2 (4 children)			X	X
Group 3 (5 children)			X	X
Group 4 (4 children)	X		X	X
Group 5 (4 children)	X			X
Group 6 (4 children)		X	X	X
Group 7 (4 children)	X			X
Group 8 (2 children)	X		X	
Group 9 (3 children)	X	X		X
Group 10 (2 children)		X		X

D1 Pilot

On October 18th we ran a pilot of our design idea. The setup consisted of three Apple Macintosh computers running the software package Garage Band (supplied for free from Apple), a simple sound amplification system and six wax cloth figures taped to the floor and wall to emulate "hot spots" for triggering the sounds ("triggering" is not completely accurate, as it was us pushing keys on the computer according to the children's movements. The oldest of the children exposed this "fraud" towards the end of the pilot).

The colored figures (two squares, one circle and a triangle at the floor; one circle and a longer rectangle on the wall) were vividly sticking out in the environment. Three of the project members were conducting the pilot, with one of the member's children (aged 1, 6 and 7) as "guinea pigs". The children had been exposed to the idea of the Musical Steps previously, but were otherwise unprepared for their role. A brief reminder was enough to get them going, and they eagerly engaged in exploring the provisional installation. The pilot was conducted in three phases, each trying out a different sound image. The whole 15 minutes session was videotaped from two different angles. An edited version of this recording is available from http://homepage.mac.com/bjornarlassen/MusicalStepsPrototype1.mp4.

Our most important observations during the pilot can be categorized as related to the user experience, the sound design, the physical design and the execution of the pilot. The latter category will bear no significance for the final design (as this will be fully automated), but it is none the less crucial to our continued testing of later prototypes.

4.2.1 User experience

The children had fun! They started out carefully exploring the different hotspots, before moving on to making sequences of the different sounds. Even the one year old tried to join

inn, imitating the actions of his older siblings, and they were eager to assist him. By the end they were running around in circles laughing, and *we* had to bring the session to its end. The children expressed verbally as well that they enjoyed it, and they also wanted to tell us about their findings. *"The long figure on the wall makes the barking sound"* […] *"I have figured out how you do it! You press keys on the keyboard according to where we are"* […] *"You should be careful with those figures, because they are slippery so we could fall and hurt ourselves"*. Even though they started out by exploring the hotspots, their learning seemed to initially focus on the installation as a whole. The acknowledgment of the details mentioned above came gradually during the process, and there were still unexplored territories after we had finished, allowing for further explorations at a later time. The user experience during this pilot is definitely a motivation for continuing the process towards a more elaborated prototype.

4.2.2 The sound design

It was easier for the children to differentiate between the sounds and their respective hotspots when we used clearly distinctive sounds for each spot. Using the same sound (but with different pitches) for several spots seemed to disable them from such differentiation. This should have an impact on the sound design for our next prototype; each hotspot should have its own distinct sound, and variations in pitch should be in time rather than space (meaning that the spot could trigger a different tone of the same sound each time it is visited).

Soft, melodic sounds seemed to create a slower and more exploratory form of interaction, while percussive sounds and sound effects seemed to speed things up considerably. This could also be contributed to the fact that we started out with the softer sound image, and that the children needed some time to "warm up". This needs further exploration before we can make a conclusion.

Using a single sound for each spot can easily result in a cacophony when there are several children participating. If the resulting sound image should be enjoyable in itself we probably need to consider different approaches to this. One way could be to have synchronized sequences of sounds for each spot. This needs to be tested.

4.2.3 The physical design

As one of the children pointed out, the wax cloth figures are not an ideal solution for the hot spots. We chose them because of their affordability, visibility and robustness, but the fact that they are slippery creates a risk as the children's speed increases. Maybe we should have the children wear shoes for later tests?

The distribution of the hotspots in the room is not arbitrary to the resulting interaction. The fact that the children started to run in circles can be attributed to the fact that the placement of the spots invited to (or at least allowed for) that. Careful consideration should be put into the physical design to encourage desirable and prevent undesirable usage, referred to by Donald Norman as affordances and constraints (2002, p.9, 55). This aspect of the installation needs further exploration.

4.2.4 The execution

We quickly learned that it was harder than we expected to emulate the performance of the installation by manually pressing keys according to the children's movements. They were moving fast at times, and we had really not put much consideration into the logical relation between the placement of the spots and locations of the keys on the keyboard. The result was that we frequently pressed the wrong keys, pressed keys when we shouldn't have and didn't

when we should have. This is likely to be an even greater challenge with more children. Before our next test we need to figure out how we can create a better logic for this. Two spots is probably the maximum of what each person can observe.

D2 Prototype

Thursday, october 25, we conducted a prototype test of our Musical Steps installation at Lakkegata SFO. After gaining valuable experience from the pilot study, our setup was reinforced with new sounds, for a total of four different sound sets ('lydbilder').
The hardware now consisted of three Apple Machintosh computers running Garage Band, and two audio mixers. We had, like before, six sensors made of wax cloth, with a seventh in reserve. We found we didn't need this. The scene was recorded by two web-cams and one hand-held camera.

As in the pilot, stepping on or touching the sensors "triggered" sounds, mediated through our pressing keys on the computers / mixers. Two of our sound sets consisted of distinct sounds, either one-shot or sustained, a few with the option of changing pitch according to which part of the sensor was touched. The other two had each sensor assigned to a sound loop of an instrument, all of which combined into a pre-recorded, synced, instrumental melody. When the sensor was triggered, the corresponding loop was faded in through switches on the audio mixer. As such, if all the sensors were triggered continuously, the entire song would be played.

The sensors were highly visible, and new to the environment. They were more spaced out than in the pilot, in order to avoid the running-in-circles phenomenon.
The children were aged 6-9, in groups mostly of four, but in some trials two, three or five. In each trial, the groups were presented with two, sometimes three different sound sets.

4.3.1 Usability and physical design
Although the sensors were clearly visible and new to the room, the kids weren't sure what to make of them. Most by far needed prodding, in the form of "what do you think happens if you touch the wax cloths? Want to give it a try?" Even then, they were very careful when trying the first sensor, as if expecting something painful or scary. Additionaly, they seem to stick with their first hypothesis for a little while. For example, when guessing their 'task' is to jump on the wax cloths, it takes a while to understand that a mere touch triggers them. Group size clearly had an effect, as the larger groups on average were quicker to start than smaller groups.
Regardless, after triggering one sensor, they quickly grasped the idea, and proceeded to explore the rest of the sensors. Emphasis should be placed on forming the sensors in a way that is self-explaining to the first-time user ("affordances").

Movement between the sensors was influenced by group size and sensor placement. With fewer kids in a group, we saw a tendency towards either running around like crazy, trying to trigger as many sensors as possible, or the opposite, where the trial never got off the ground. This was perhaps a function of personality and/or being insecure of behaving correctly in an unknown setting or a perceived test setting.
More kids meant less space to move around, so running around was hampered. The kids seemed to go for a free sensor most of the time, or race to be the first to a sensor, but many attempts were made to trigger one sensor simultaneously. The number of sensors in relation to the number of children will probably influence this as well.

The more central sensors seemed to get the most traffic. The kids usually triggered nearby sensors on their way to other ones.

Things that were not tested include varying sounds in relation to number of kids per sensor, light effects, hidden sensors or differently shaped sensors. These are elements that our time and resources could not support at this time. Due to limitations of the test population, we did not have the opportunity to explore how different age groups, children with foreign languages or children with handicaps would react and interact. It would also be interesting to return to Lakkegata SFO in order to explore the longevity of the installation, i.e., will the kids enjoy it as much a second time?

4.3.2 Sound design

Drawing upon experiences from the pilot, new sound sets were added. This time, two were 'sound based', and two were 'instrument based'.
The kids didn't seem overly interested in creating rhythmical or soothing music. When the first two sound sets were in effect, they seemed intrigued by making funny or "strong" noises, some leaning towards the more intense sounds. They clearly understood which sensors caused which sounds. Some sensors were more popular than others, presumably because of a central position on the floor, because of the sound it played, or a combination.

When the two last sound sets were played, the popularity of sensors seemed to be a bit more spread out. This might be because the same song was being played regardless of which sensors were pressed, and no single sensor provided intense sounds, or sounds that could be 'spammed'. Because of the interlinking aspect of the sensors in these sound sets, it might not be entirely clear which sensors caused which sounds. In addition, some loops were quite subtle, and could be mistaken to be part of another sensor's sound loop. A possible fix would be to provide more distinct instruments or sounds. Also, we chose to fade the loops in and out, instead of a fast on or off. Although a quick fade, it might have contributed to confusing the sensors' output.
Even so, these sets seemed more popular with most of the groups. A common explanation given was that making music was easier.

An initial assumption was that the instrumental sound sets would induce calmer trials, since these made more soothing and less intense sounds, as well as hinder any repeating sounds. This assumption held to some degree. Most often however, the children still wanted to try all the sensors, and so ran about with just a hint of reduced speed. The time spent on each sensor did seem to increase somewhat.

4.3.3 User experience

The predominant reactions to the installation were laughter and screams of pure joy. The kids relished the experience, and the effects they themselves caused. Many started out cautiously, but quickly thawed. The enthusiasm was even sometimes improved in the second sound set of the trial, perhaps as an effect of warming up and/or mastery of the mechanisms.

Another common reaction was that of wonder, and a frequent comment was "weird". It suggests that the experience is quite unique.

Some groups seemed hampered or influenced by our precence, an unfortunate, but of course common side effect of these kinds of tests. A few groups were quite passive, doing little or nothing without instructions. Other groups treated the experience as a task to be solved, and presented us with hypotheses and solutions.

A metaphor for this project is 'dance'. Indeed, the kids were running and jumping around in what you could call a sort of primal dance. Dancing to the music, as opposed to making music through the dance, was also observed, although sporadically.

Cooperation is observed, to a much stronger degree than experienced in frognerborgen, teknisk museum or IKEA. It includes some commands and suggestions being made, but more often nonverbal, implicit cooperation. Speech was hardly used, suggesting that language is no barrier in this installation. Cooperation does however seem to be influenced somewhat by whether the children know each other well.

4.3.4 Execution

Only one group member was new to the experience, the others having participated in the pilot. However, the fading of sounds through the audio mixers was new to everyone. Each participant was assigned sensors in close proximity to each other, so that attention could be fixed in that general area. Some minor problems were experienced when view of the sensors was obscured, but this was rare.

Training or not, as fatigue took its toll, accurately pressing keys became a challenge. This, to a certain degree, influenced the quality and dependability of feedback when pressing the sensors, but we have no way of assessing the impact, if any. Once again, this is not an issue when the process is automated.

The suitable number of kids on this prototype containing six sensors proved to be four children. In the groups of two, the sounds didn't emerge as a whole set, and with more than four, it was more of a chaotic race then anything else. The final installation should then contain enough sensors in the room to sustain the suitable amount

The setup is clearly scalable, but would need resources we currently do not have. We are obviously limited by hardware and manpower, but available room space is also an issue. Working autonomously, our group has reached its limit regarding the technical aspect of prototype testing. Further testing in this line of design will se the focus being on improving and tweaking the current setup.