What is the Lega?
Exploring the use of a movement-based interactive artifact in an art exhibition

Stina Andrén
2011-08-29

Department of Computer and Information Science
Linköpings Universitet

LIU-IDA/KOGVET-A--11/015--SE

Supervisors: Jarmo Laaksolahti, Jakob Tholander
Abstract

This thesis explores the use of an interactive artifact designed to let friends physically share their experiences with each other in an art exhibition. The device, called “the Lega” is a research prototype designed with an interest in bodily interaction and visitors’ interactions in museum environments. The Lega is a handheld device which has an ovoid shape that fits in the palm of a user’s hand. By moving and touching the Lega in different ways the users can create tactile traces of their experiences that can be received by their friends.

The thesis presents results from a qualitative analysis of material from a user observation conducted with the Lega at the Vårsalonten exhibition at Liljevalchs in the spring 2010. The analysis investigates how the visitors used the Lega in experiencing the art and to express themselves as well as their social behavior around the Lega, and how the Lega became a part of their art hall visit. Findings on different ways that users create an understanding of and finds meaning in an ambiguous artifact are presented, as well as different ways users use the body to establish a relationship with the artifact. Among these findings are those of users inventing a language of movements to express themselves with the Lega and users who mimic art pieces with the Lega.
Preface

Without the help and encouragement of the following people this thesis would have been far from as good as it is.

First of all, a big TACK to my main supervisor Jarmo Laaksolahti for great supervision and mental support when I needed it the most.

Second, thank you to my supervisor Jakob Tholander for great supervision.

I would also like to thank Nils Dahlbäck for wise advice.

A special and huge thank you to my thesis colleague, friend and encourager Johanna Mercurio!

Last but absolutely not least I would like to thank all the awesome people at Mobile Life for providing such an inspiring, open-minded, international and fun environment to write my thesis in. I have learned and experienced so much from being a part of Mobile Life.
Table of contents

1. Introduction ................................................................................................................................. 1

2. Background and analytical starting points .................................................................................. 3
   2.1 Third wave HCI .......................................................................................................................... 3
      2.1.1 Bodily interaction .................................................................................................................. 3
      2.1.2 Designing for ambiguity ....................................................................................................... 5
   2.2 Interactivity and social interaction in museums .......................................................................... 6
   2.3 Goodwin’s semiotic fields ......................................................................................................... 7

3. The Lega and its development ......................................................................................................... 8
   3.1 The Lega .................................................................................................................................. 8
   3.2 Design of the Lega ...................................................................................................................... 10
      3.2.1 Design process ...................................................................................................................... 10
   3.3 Vårsalongen at Liljevalchs ........................................................................................................ 11
   3.4 User observation at Vårsalongen 2010 ....................................................................................... 12

4. Method .......................................................................................................................................... 14
   4.1 Material .................................................................................................................................... 14
   4.2 Analysis .................................................................................................................................... 14

5. Analysis of the Lega observations ................................................................................................. 16
   5.1 The Lega users ............................................................................................................................ 16
   5.2 Themes ..................................................................................................................................... 17
   5.3 The Lega as a part of the Liljevalchs visit ................................................................................... 17
      5.3.1 The Lega's role changing ....................................................................................................... 17
      5.3.2 Incorporating the Lega .......................................................................................................... 20
      5.3.3 The absorbing Lega ............................................................................................................... 22
      5.3.4 Flow with the Lega ............................................................................................................... 23
      5.3.5 Findings from 'The Lega as a part of the Liljevalchs visit' ...................................................... 24
   5.4 Expression with the Lega ........................................................................................................... 25
      5.4.1 A broad repertory of expressions ......................................................................................... 25
      5.4.2 Evaluating the art .................................................................................................................. 28
      5.4.3 Procedure with the Lega ....................................................................................................... 30
      5.4.4 Findings from 'Expression with the Lega' ............................................................................ 31
   5.5 Social use of the Lega ................................................................................................................. 32
      5.5.1 Individual leaving, shared experiencing ............................................................................... 32
      5.5.2 A kinesthetic dialogue ......................................................................................................... 35
      5.5.3 Forming each other’s experience ......................................................................................... 37
5.5.4 Findings from ‘Social use of the Lega’ .................................................................38
6. Discussion ..................................................................................................................40
7. References ..................................................................................................................43

List of figures

3.1 The Legas ...................................................................................................................8
3.2 Anatomy of the Lega .................................................................................................9
3.3 Exploded view of the Lega .........................................................................................9
3.4 Liljevalchs exterior, art pieces of Vårsalongen and Liljevalchs interior ..................12
3.5 The sensual evaluation instrument ..........................................................................13
Frank and his friend are standing together in front of a sculpture depicting a thin man holding his arms straight out from his body. They are discussing it for a moment with a laugh. Then they start making movements in the air with their Legas. Frank is shaking it up and down with both hands, first rather slowly in moderately big movements, and then whilst laughing and looking at his friend he exaggerates his movements and shakes the Lega up and down from over his head till down to his thighs. Simultaneously his friend is shaking the Lega back and forth frenetically, mostly looking at the Lega. When he finished off his movements he looks at Frank and laughs. Afterwards they walk further in different directions.

– Group 5 12.44
1. Introduction

The past decade has seen a spread of technology from workplaces to our homes, everyday lives and culture. Computers are becoming ubiquitous, adopting different shapes and interaction modalities such as tangible interfaces, augmented reality and pervasive technologies. This development has lead to that technology is used in a much wider range of contexts, ranging from work to leisure, affecting us in different ways. These new and changing use contexts pose new questions for design of technology and for the area of Human-Computer Interaction (HCI).

The focus of HCI in previous years has been on work environments and interaction within well-established communities of practice, aiming to make efficient and usable systems. In the past decade context became increasingly important for analysis and design, and theories like situated action, distributed cognition and activity theory were used to analyze systems. Rigid guidelines and formal methods were at this point largely replaced by participatory design workshops, prototyping and contextual inquiries. This development in HCI is commonly referred to as “Second wave HCI”.

However, with technology spreading to new, broader and mixed contexts as well as using new interaction modalities such as touch and gestures, the area of HCI is evolving. Mobile, tangible and leisure technology all have different types of demands, creating new use contexts which are both differing and unpredictable. Since these new use contexts can vary from work environments to home environments and outdoor activities and travelling, the requirements on technology are not any longer only to be efficient and usable but also to entertain and create engaging experiences as well as to fit in smoothly into the activities of people. In leisure contexts the purpose of technology is not necessarily to be as efficient as possible, but more to create an experience for the user. In these contexts technology has not got one single purpose, but many, and varying with the context. With this development the requirements of technology shift towards how to engage and entertain users and how technology can become an integral part of people’s everyday life. Therefore the focus of HCI has shifted from focus on rationality and purposefulness towards social and cultural aspects and interest in emotions and experiences; HCI has evolved into its Third Wave.

Since the technological development has opened up for use of new interaction modalities like touch and gesturing, the area of bodily interaction has developed with the rise of third wave HCI. In HCI body movements have traditionally had functional purposes, such as typing on the keyboard and dragging and dropping objects with the mouse. The role of the body in technology interaction has been that of an instrument used to perform tasks, rather than being seen as something that affects the experience of interacting with technology. However, with the third wave of HCI bodily interaction in a wider sense has become possible. Focus has shifted from functional aspects of bodily interaction towards the experiential aspects; how it feels to interact bodily with an artifact, and how bodily interaction changes the user’s experience of the world and the artifact.

The development of mobile technology has opened up for the use of digital devices in public environments and cultural contexts. A context where interactive and mobile technology is now widespread is the museum environment. Different types of museum guides and interactive exhibitions can be found in nearly any larger museum or art hall. Interactivity is seen as an important resource in enhancing interpretation and creating new forms of engagement with museum collections.

An example of an interactive device used in an art hall context is an artifact called “the Lega”. The Lega is a research prototype designed with an interest in how bodily interaction can affect visitors’
experiences in an art hall. It is designed to let friends physically share their experiences with each other in an art exhibition. The Lega is a handheld device which has an ovoid shape that fits in the palm of a user’s hand. By moving and touching the Lega in different ways the users can create tactile traces of their experiences that can be received by their friends.

This thesis explores the art hall visitors’ use of the Lega. The analysis includes how the visitors used the Lega in experiencing the art and to express themselves as well as their social behavior around the Lega, and how the Lega became a part of their art hall visit. The analysis is done using different theoretical perspectives from HCI as well as theories of human interaction.

In the first part of the thesis the theoretical background of the Lega is described together with the analytical starting points of the analysis of the use of the Lega. In the second part the Lega is presented together with a description of its use context Liljevalchs. The design vision and process of the Lega is described, as well as the user observation conducted at Vårslongen 2010. In the third part the method is presented followed by the analysis. The analysis is the main part of the thesis, containing a narration of the studied Lega users and three themes. Each theme explores a different aspect of the art hall visitors’ use of the Lega, and consists of a number of subthemes depicting behaviors of users. The themes are all concluded with a theoretical discussion of the findings from the particular theme. The analysis is followed by a concluding discussion.
2. Background and analytical starting points

The Lega is an artifact designed within the paradigm of third wave HCI. It is a device designed with an interest in bodily interaction and visitors’ interactions in museum environments.

The analysis of the art hall visitors’ use of the Lega is done using multiple theoretical perspectives. The analysis has its basis in third wave HCI and uses HCI theories of bodily interaction and interpretation of systems as analytical starting points. Research on social interaction in museums is also used as an analytical tool as well as Charles Goodwin’s research on human interaction.

The background begins with a short description of third wave HCI. Within the part of third wave HCI, the area of bodily interaction is described and a theory of the role the body plays in experiencing technology is presented. This is followed by a presentation of interpretation of systems and a theory of designing for ambiguity. The second part of the background presents research on social interaction and interactivity in museums. The third and last part describes Charles Goodwin’s research on human language and interaction.

2.1 Third wave HCI

Third wave HCI is characterized by an interest in experiences and emotions as well as social and cultural aspects of technology. Since technology is used in a wide range of contexts varying from work environments to public and domestic environments, the focus of HCI has widened from focus on rationality and purposefulness towards how to engage and entertain users and how technology can become an integral part of people’s everyday life. In e.g. leisure contexts the purpose of technology is not necessarily to be as efficient as possible, but more to create an experience for the user. In these contexts technology has not one single purpose, but many, and varying with the context. Two areas of interest within third wave HCI are experiential bodily interaction and designing for ambiguity. These areas are described below.

2.1.1 Bodily interaction

The body is an integral part of the experience of technology. We experience technologies through our body. Especially technologies that use new interaction modalities such as touch and gestures pose questions about what role body movements play in interaction. Therefore, bodily interaction is an emerging field within third wave HCI. This area focuses on how it feels to interact bodily with an artifact, and how bodily interaction changes the user’s experience of the world and the artifact.

Experiential bodily interaction research uses phenomenology as a basis to study and understand technology use and to develop design concepts. Especially the phenomenology of the philosopher Maurice Merleau-Ponty is used as an inspiration. Merleau-Ponty (Merleau-Ponty, 1962 in Höök, 2010) had a body-centered view of perception and saw human experience as constructed through action. Humans perceive the world through active interaction with the environment rather than passively perceiving stimuli from it. Perceiving the world and acting in it do not belong to two separate domains, but are part of the same experiential world. Sensory information guides our movements, but our movements also direct our perception; e.g. we turn our heads to hear or to see. Therefore the body is integral to how we interpret and make sense of the world. Merleau-Ponty states that “The body is not an object. It is instead the condition and context through which I am in the world” (Merleau-Ponty, 1962 in Höök, 2010, p. 9).

---

1 Based on Bödker (2006).
Bodily interaction research spans over many different fields, from theoretical frameworks for understanding the body in the design process to more practical examples of designing for bodily potential. In an attempt to unify these different types of research, Fogtmann et al. (2008) present the concept of Kinesthetic Interaction as a concept for describing the body in motion as a foundation for designing interactive systems. They define their concept as “when the body in motion experiences the world through interactive technologies”. The concept of kinesthetic interaction arises in the intersection of the kinesthetic sense, interactive technologies and kinesthetic experience. The kinesthetic sense is the perception of the position and movements of one’s body parts in space and kinesthetic experience is how we experience the world through our bodies. Since our experience of the world is always rooted in the body the kinesthetic sense is the backbone of our perception of the world.

The feel dimension of technology interaction

To explore how the Lega users established a bodily relationship to the Lega, Larssen et al.’s (2007) explorations of the role the body plays in experiencing technology is used as an analytical starting point in the analysis of the Lega.

Larssen et al explore the role that the kinesthetic sense plays in experiencing tangible devices. They call this kinesthetic experience “the feel dimension” of technology interaction; how it feels to interact with tangible devices. Merleau-Ponty said that vision is the brain’s way of touching, in the same manner Larssen et al say that touching is the body’s way of seeing. For the body to perceive is to act, otherwise the body cannot perceive. Therefore our actions guide our perception as much as our perception guides our actions in the world.

Larssen et al explore how our bodies establish relationships with artifacts and the process of using our kinesthetic sense when incorporating an artifact into the bodily space so that it becomes an extension of the body. The bodily space is our spatial perception of our own body in space. When we reach down to scratch a knee, we act within the bodily space. When a person uses an artifact with skill, for example a tennis racket, the bodily space is extended to include the artifact. The person is now able to serve a tennis ball hard across the tennis court, which she couldn’t do without the racket. The tennis racket has extended her potential for action in the world, and hence her bodily space. Our bodily space is constituted by our potential for action in the world.

In conceptualizing the relationship between body and things, Larssen et al use Merleau-Ponty’s blind man’s stick and Heidegger’s hammer as explanations. The stick of the blind man becomes an extension of his body; the perceived world does not begin at the point where his hand holds the stick, but at the tip of the stick. If the hammer is used with skill it becomes invisible, an extension of the body, it becomes ready-to-hand, to use Heidegger’s terminology. But if the hammer stops working or is misused, the hammer becomes an object in the world again, it becomes present-at-hand. The world appears in the form of objects and their potential for use. In both examples the body and the artifact are experienced as a moving couple. We are absorbed by the activity and don’t think about the properties of the artifact as long as the interaction is working well, but if the activity is interrupted our focus goes back to the tool rather than being fully engaged in the activity.

In the process of incorporating an artifact into the bodily space there is according to Larssen et al a dialogue between our kinesthetic sense and the artifact, where movement is the mode of communication. In the dialogue our potential for action is gradually changed. There are different ways in which we attend to the artifact when establishing the dialogue. When the artifact is present-at-hand Larssen et al say that we are attending to the artifact and acting on the artifact. We are focusing on it
and very much aware of it. This is often the case of a new or broken device. If the artifact becomes ready-to-hand Larssen et al say that we are acting through the artifact. We have incorporated the artifact and are unaware of it, like the blind man feeling the end of the stick. We can also be attending to the artifact and acting through it. In this situation we are aware of the artifact but it is not the focus of our attention, it allows us to focus on the environment, it has become a mediator.

The feel dimension of technology interaction is this ongoing and changing dialogue between the body and the artifact. It is the process of using our kinesthetic sense when incorporating a tool into our bodily space, so that it becomes an extension of our body.

2.1.2 Designing for ambiguity

The Lega is an artifact designed to be open for interpretation. This passage describes Sengers’ and Gaver’s (2006) theory of designing for ambiguity, which has inspired the design of the Lega and is used as an analytical starting point when exploring the behavior of the Lega users.

Interpretation is the process by which users, nonusers and designers come to assign meaning to the structures and functions of systems, e.g. what a button press might do or what relevance the system has in the life of the user. Users’ interpretation of systems occurs at a variety of levels. The lower levels of interpretation deal with finding out how to complete a task with the system or which button does what. Higher levels of interpretation include questions like: What is this system intended to be used for? What role can it play in my life? Interpretation at all levels is strongly dependent on social and cultural context.

Hence another dimension that can come into play when designing systems is how to relate to the process of meaning making and interpretation of a system. According to Sengers and Gaver the focus of HCI has in the past been on developing systems that convey one single, clear interpretation of what they are for and how they should be used and experienced. In third wave HCI this focus has changed. Systems are now used in an increasing variety of contexts, ranging from domestic to public and work environments. Technology is adopting different shapes and interaction modalities and is increasingly influenced by the arts and humanities. This spread of technology to new and changing use contexts means that systems may be interpreted in different ways depending on the context and that multiple interpretations of a system can coexist.

Therefore, in certain contexts, it is no longer meaningful to design a system for a single goal or a single user interpretation. Rather, systems should be designed to allow for multiple interpretations; to design for ambiguity. A system which allows for multiple interpretations may more fully address the complexity, dynamics and interplay of user, system and designer interpretation. Leisure and public domains are often more open ended than the workplace, without a specific or singular purpose. Systems that have a singular interpretation constrain the repertory of use in these contexts. A system that is open for interpretation doesn’t need to be tailored to fit every possible niche audience, instead the same system may support many ways of experiencing and acting in the world.

People appropriate and reinterpret systems to produce their own uses and meanings, and these are therefore often incompatible with design expectations and inconsistent within and across groups. Systems that can be interpreted in multiple ways allow users to define their own meanings for them, rather than just accepting those imposed by the designers. If users are allowed to play an important role in determining the meaning of a system, they will be actively engaged in the process of understanding both the system and the situation of use and feel more responsible.
A system can be open for interpretation in different ways and to different degrees. For example, the functionality of a system can be specified precisely, but it is up to the users to decide how to use it and how it should relate to their lives. Another way for a system to be open for interpretation is that the system is suggesting a topic that it is intended to be about, while not specifying how users should relate to that topic.

Systems that are very open for interpretation shift the focus in technology design from conveying a particular design vision to exploring the ways in which users take up an artifact. In these cases technology design simultaneously becomes social science research. Even though the use of such systems is situated the results can still be useful understandings of how future technologies should be designed.

An ambiguous system needs to be evaluated in a different way than a system that has a singular purpose. Since the goal no longer only is to compare the outcome of the system with the intended goal of the system, it is useful to use many different methods to evaluate the use of the system, to capture how many different interpretations the system generates and why it does so. It might also be useful to have a diversity of interpreters from different backgrounds, who all have different perspectives. Long term studies are needed to find out how the systems affect users’ lives in a deeper sense, while short term studies cover more superficial interpretations.

2.2 Interactivity and social interaction in museums

The development of mobile technology has opened up for the use of digital devices in public environments and cultural contexts. A context where interactive and mobile technology is now widespread is the museum environment. Different types of museum guides and interactive exhibitions can be found in nearly any larger museum. Interactivity is increasingly seen as an important resource in enhancing interpretation and creating new forms of engagement with museum collections. In addition to the development of new technology, the trend towards interactivity in museums also depends on that research has shown the importance of social interaction in learning. This has lead to an emphasis on the situated, interactional and informal learning. It is suggested that interactives provide important resources in engaging people in exhibits (Heath & vom Lehn, 2009).

Heath and vom Lehn (Heath & vom Lehn, 2009; vom Lehn, 2008) have made research on how museum visitors explore museums and what effect interactive devices have on their behavior. Their video-based studies draw on ethnomethodology and conversation analysis. The research suggests that social interaction is critical for people’s experience of exhibitions, and that museums can act as social arenas where people go to spend time together. People explore and make sense of exhibitions in and through social interaction. Interaction with others affects what they choose to look at, how they approach exhibits and the ways they explore particular art pieces. Experience of exhibits is produced in the social and bodily interaction between visitors. When visitors look at art pieces together - discussing, pointing to details of interest and gesturing - they are creating and altering each other’s experience of the art.

Interactive artifacts in museums are most often directed to an individual person and her individual experience. Since research has shown that most people experience exhibitions in collaboration with others (vom Lehn, 2008), the behavior of visitors do not match with how the interactives are designed. This often results in interactives undermining the collaboration between visitors and intervening with the social interaction in the group. Therefore, interactive museum artifacts should be designed to create shared experiences of and around the art rather than individual experiences.
2.3 Goodwin’s semiotic fields

To provide a different and profound theoretical perspective on the analysis of the users’ interaction with the Lega, Goodwin’s research on human interaction is used as an analytical lens. In the paper “Action and embodiment within situated human interaction” (1999) Goodwin analyses human language and interaction. He argues that human interaction is built through simultaneous use of a number of different kinds of semiotic resources, such as speech, gestures and structures in the environment. Goodwin views cognition as a situated, social process embedded in a historically shaped material world, rather than a process of the individual’s mental life. He claims that language is not an isolated, autonomous activity that occurs separately from the environment, but an activity that is part of human interaction among other sign systems.

Goodwin describes actions like speaking, gesturing and walking as different sign systems that are created through using specific properties of a certain medium. Speaking uses the mouth in a specific way, gesturing uses the body in one way and walking uses it in another. These sign systems he calls semiotic fields. Even structures in the environment can be semiotic fields, for instance a basketball game uses specific properties of the court and a floorball game uses other. Structures in the environment provide a framework for action, without which the action loses its meaning.

Different actions combine different semiotic fields that mutually elaborate each other. The particular semiotic fields that are used in a situation can be called a contextual configuration. The contextual configuration frames actions and makes them visible and relevant. When actions are performed new semiotic fields can be added and others treated as no longer relevant, which makes the contextual configuration undergo a continuous process of change.

When speaking of social interaction Goodwin emphasizes that gestures are not simply a visual mirror of the content of talk, but a semiotic resource in their own right that can enhance and amplify the force of the action. To use gestures to build social action, a person needs to use their body to structure the local environment in such a way that the gestures can themselves count as forms of social action. For example to actively position the hand gestures so that they will be perceived by the other person. Gesture has not only visual, but also crucial kinesthetic components, and these may be crucial to the way in which the body knows the world through the hand.
3. The Lega and its development

The Lega system is presented and a description of the vision and design process of the Lega is made, followed by a description of the Vårsalongen exhibition at Liljevalchs and the user observation conducted by Mobile Life researchers at Vårsalongen 2010.

3.1 The Lega

The Lega - named after the Swedish word “lega”: a trace in the grass where you can see that an animal has slept - is a research prototype designed and developed at the Mobile Life Centre in Stockholm. It is an interactive artifact designed to let friends physically share their experiences with each other in an art exhibition. The Lega is designed to be something to unify the users, to give them a shared experience even though they are not in the same place.

The Lega is the result of the first iteration of the project “Designing systems for supple interaction”, which is planned to have three iterations. The supple project builds on the concept of suppleness (Isbister & Höök, 2009). In short, suppleness is a use quality that emerges in systems where the interaction between user and system is physical, emotional and highly engaging. A system that fits smoothly into the social and situational context and enables and possibly also enhances the subtle social signals of humans, such as body movements and emotions, is considered to be supple according to Isbister and Höök. The goal of the supple project is to explore how to design interactive systems that create a physical, emotional and highly engaging interaction with the users through building systems that pick up on subtle human signals such as body movements and emotions. The devices designed in the project combine custom-built hardware, sensor technology and wireless communication and also explore novel materials such as fabric and paper.

The Lega concept also builds on experiences from two earlier prototypes designed within the same research group. The two systems, eMoto (Sundström et al., 2007) and FriendSense (Sundström et al., 2009) share with the Lega the focus on bodily interaction as well as interaction and shared experience among friends.

The Lega is a handheld device which has an ovoid shape that fits in the palm of a user’s hand and a soft cloth surface. All Legas have the same grey color, but each of them has a different color of a number of LEDs shining through the translucent cloth. By moving and touching the Lega in different ways, e.g. shaking or squeezing it, and pressing the Lega’s button the users can create tactile traces of their experiences. The Lega records the movement and touch and leaves a digital trace at the spot. When another Lega user enters the area where the trace was left they will receive the trace as a pattern of vibrations and lights on their Lega. That a trace is found is indicated by the button moving down,
and the Lega’s LEDs enlightening in the color of the person who left the trace and vibrating in a pattern and with an intensity roughly corresponding to the pattern and intensity with which the Lega was touched or moved.

The Lega consists of two parts; a top and a bottom part. The LEDs are arranged in a roughly circular pattern embedded in the top part. The top side also houses the Lega’s button, which is covered with cloth and blends in seamlessly to the surface only seen as an indentation. The bottom part has two layers of memory foam beneath the cloth, which makes the Lega soft and shapeable. The bottom part contains the touch sensors to pick up on the user’s touching, and vibrators to enable receiving different patterns of vibration. The Lega also contains an accelerometer which measures changes in movement, e.g. acceleration.

The Legas find the traces through communicating with radio beacons that were placed all over Liljevalchs. Liljevalchs has twelve rooms and a lobby, and in each room two to three beacons were placed, creating different zones in each room where traces could be left. Therefore each zone does not correspond to one art piece, but to an area containing a number of art pieces. When a visitor leaves a trace it is uploaded to the radio beacon closest to the position of their Lega. This trace is later picked up by other Lega’s entering the same zone. Radio signals are affected by objects that are in their way or in the vicinity, therefore the radio communication between Legas and beacons was affected by the number of people and things in the rooms at Liljevalchs. This resulted in that the Lega at times selected a more distant beacon as the closest one than the accurate one.

The Lega constantly records signals from the touch sensors and the accelerometer. When a user decides to leave a trace and pushes the button the trace is transferred to the closest radio beacon. The trace consists of the recordings of how the Lega has been moved and touched during the five seconds preceding the press of the button. The button stays down and the LEDs shine for a couple of seconds when a trace is left. When the trace has been transmitted to the closest beacon the button resumes its original position and the lights stop shining.

When a user receives a trace the Lega vibrates with
certain intensity and in a certain pattern. There are three different types of vibration pattern that the Lega can choose from depending on how energetic the movement of the Lega was and the number of touch sensors that were activated as well as the rate of change in touch sensor activation, in other words how fast the user moved her hand across the sensors when leaving the trace. The three different vibration patterns differ in the number of vibrators that are activated as well as the intensity of the vibration and the sequence of activation. The duration of received traces is five seconds.

3.2 Design of the Lega

The concept of the Lega builds on research in experiential bodily interaction which has a body-centered view of perception and sees human experience as constructed through action (Höök, 2010). The Lega concept builds on the theory that emotions and experiences are social and cultural products that are created in interaction. This is known as the interactional approach to emotion and is a critique to the more traditional view that emotions are internal states in human beings (Boehner et al., 2007). With this view of emotion as a starting point, the experience or sharing of emotion cannot be seen as an individual act but rather a part of an ongoing socially mediated experience. Therefore, instead of attempting to sense and transmit emotion, systems that aim to support emotional experiences should let users engage in understanding, interpreting and experiencing emotion in its full complexity and ambiguity (Boehner et al., 2007). Systems that are inspired by the interactional approach to emotion and that aim to support social engagement and emotional experiences are called socio-affective systems, whereof the Lega is one.

The design vision of the Lega is also based on research on the social aspects of museum experiences that has guided the development of interactive artifacts into being more directed towards social interaction around art rather than the individual experience of the art (vom Lehn, 2008). The Lega concept builds on the observation that museum visitors create shared experiences around art pieces. Because it is not possible to predict around which art pieces the visitors will create shared experiences, neither in what way they will form the experience, it was decided that the users would be able to leave a trace for any art piece, making any different kind of movement or touch. The trace would be subtle and ambiguous, for the recipient to be able to interpret it. The thought was that the trace would work as a starting point for the recipient to reflect upon the meaning of the trace, using memories and associations they have with their friend. This was the motivation for focusing on people who know each other well; that they will be better able to use context and previous knowledge about their friend to interpret the Lega traces. The thought was also that the traces would be something to trigger discussion among the group members when they meet up again.

The Lega is designed to be simple and intuitive to use, to allow the user to interact with it while focusing on the environment or to quickly attend to it and then direct the attention back to the art. The idea was for the user to have a dynamic flow of attention back and forth between the Lega and the art; from time to time attending to the Lega and then easily directing the attention back to the environment. The shape and size of the Lega are designed for it to fit in the palm of the hand and to be light enough to carry when walking through the exhibition space. The Lega’s softness and cloth material are designed to invite touching and squeezing it.

3.2.1 Design process

The design process of the Lega started with an initial ethnographical study at Liljevalchs during Vårsalongen 2009. Five groups of visitors were videotaped and audio recorded as they walked through the exhibition. The observations showed that the art hall worked as a place where the visitors spent time with each other in a relaxed manner, where they shifted between experiencing the art together and
alone. At times the visitors engaged more in the art and at times more in socializing with other group members, the engagement with the art was also different from group to group. The groups of visitors consisted in general of two to five people.

The video recordings of the groups were analyzed using interaction analysis. Focus of the interaction analysis lay in the details of visitors’ bodily interaction and expression with and around the art and with each other as well as in relation to other unknown visitors. Ten interesting findings from the material were turned into short descriptions of activities accompanied by photos; so-called body cards (Tholander & Jaensson, 2010). The body cards are aimed at transferring qualities from ethnographical findings of bodily experiences into practical design work. The findings turned into body cards concerned mainly social and collaborative interaction in the exhibition space, for example how the actions of other visitors, friends as well as strangers, shape how the art is experienced and how visitors use their bodies to almost touch sculptures and paintings, to create an imaginary experience of touching the art.

The ten resulting body cards from the ethnographical study were in August 2009 used in two two-day design workshops. The workshops were held at Liljevalchs in order to be able to test the resulting prototypes in the right use context. The design team consisted of about 15 persons; interaction and industrial designers, hardware-, sensor- and software engineers as well as HCI-specialists. During the workshops the design team engaged in different design exercises and lo-fi prototyping, which resulted in 35 design ideas. The ideas were analyzed according to the goals of the suppleness project, which eventually resulted in three ideas being further developed into lo-fi prototypes that were tested on visitors of Liljevalchs. After testing and further analyzing according to suppleness and the context of use, the idea and prototype that later on would turn into the Lega was chosen as the one to implement.

During the autumn of 2009 the design process of the Lega continued. Different shapes and materials of the Lega were explored and evaluated. Eventually the current shape was chosen because it fit the user’s palm and was comfortable to carry. The cloth material was chosen because of its translucency and softness. Different mechanisms for alerting somebody that there was a trace close by were tried out as well, e.g. sound, temperature, size, shape and vibration. Finally vibration was chosen as mechanism because it suited the museum environment well and was not too difficult or expensive to implement in a hi-fi prototype.

### 3.3 Vårsalongen at Liljevalchs

Vårsalongen (spring exhibition) is an annual exhibition that takes place from January until March at Liljevalchs art gallery in Stockholm (www.liljevachs.se). Anyone, professionals as well as amateurs, over the age of 18 can exhibit their work at Vårsalongen, however a jury judges which works are to be exhibited. Each year there are about 2000 applications and only around 150 are accepted. Vårsalongen has taken place annually since 1921 and is a very popular exhibition; it is each year visited by approximately 40 to 50 000 people. All art pieces exhibited are for sale.

The applicants to Vårsalongen can use any kind of artistic technique and genre, for example graphic design, crafts and oil painting. This results in a diverse collection of art pieces that are often engaging, provocative and controversial. Vårsalongen attracts all sorts of visitors ranging from people with a strong interest in art to people who have a yearly tradition to visit Vårsalongen but rarely visit any other art exhibition. Vårsalongen is commonly known to stir up emotion and engagement from both visitors and media.
Vårsalongen was chosen as the context to design for because it was a good match between the research group’s interest in emotional and bodily communication of experiences among friends, and an emotionally evocative event mainly visited by small groups of friends.

3.4 User observation at Vårsalongen 2010

User observations with the Lega were conducted by a team of five Mobile Life researchers throughout the whole two-month duration of Vårsalongen 2010. Five Legas were used in the study and 27 groups of visitors tested the Legas. The size of the groups ranged from two to nine persons, on average with three to four persons per group. Visitors of all ages tried out the Lega. The majority, 73 percent, of the users was people in the age 50-70 years old, and 64 percent of the users were female. Five of the groups were English speaking, and the rest spoke Swedish.

Liljevalchs advertised the Lega at their website as a feature of Vårsalongen encouraging visitors to try it. Visitors had the possibility to schedule a time to use the Lega directly on the website. This became the primary resource for recruitment of participants. Another way for the researchers to recruit visitors was to approach people at the entrance of Liljevalchs who showed interest in the Lega. The researchers were provided with open access to the exhibition during the time of testing, and also with rooms to conduct interviews in.

The researchers made a very brief presentation of the Lega to all groups that would use it, explaining that they could leave traces of their experiences to their friends through bodily gestures and that these traces would be found as vibrations. The researchers were trying to avoid biasing the users to interact with the Lega in a certain way, so that the users could make their own interpretation of how to interact with it.

The users were asked if they agreed to be video recorded while using the Lega, and they were also given the option to wear a dictaphone. As the groups were allowed to use the Lega for as long as they pleased, they spent from thirty minutes up to one and a half hour in the exhibition. When finished with their visit to the exhibition the groups were asked if they agreed to be interviewed. 25 out of 27 groups agreed to be interviewed. The interviews were made by three Mobile Life researchers and were either audio or video recorded. Swedish speaking groups were given all explanations and interviews in Swedish and English speaking groups in English.

Since the Lega is an artifact that is designed to be open for interpretation, the goal of the evaluation methods in the user observation was not to compare the outcome of the system with the intended goal of the system but instead to capture different interpretations and perspectives that the users had of the system. Therefore multiple different evaluation methods were used, described below. The researchers also attempted to use a diversity of interpreters including a documentary photographer who videotaped two of the groups.
Different groups were asked to use different methods for evaluating their experience with the Lega. Some methods aimed at catching the experience of the Lega during use, while other methods aimed at letting the user reflect upon the use of the Lega immediately after using it.

The methods used during the users’ visit to Liljevalchs included videotaping or audio recording the group, either one of the recording methods or both, depending on permission from the users. Some groups of users were asked to send one or a few text messages to the researchers during their use of the Lega, to tell something about their experience. Some groups were given a video camera to film each other using the Lega, others were given a dictaphone and were asked to use it from time to time to tell about their experience in the exhibition and of using the Lega. A few users were also asked to try to express their experience with the Lega through choosing among a number of small sculpted objects of different shapes. They were asked to choose the figure that they thought corresponded the most to their feeling as they interacted with the Lega. The figures are called Sensual Evaluation Instrument (SEI) and are a tool for self-assessment of affect while interacting with computer systems (Isbister et al., 2006). The users would carry the SEI in a bag on their shoulder and from time to time choose one of the figures to express their experience in the moment.

Interviews with all groups were done after the visit. Some groups were given sheets of paper and different colored pencils and asked to attempt to draw their experience with the Lega. Other groups were asked to try to express their experience with the Lega through the SEI. All users were also given the opportunity to enter a “confession booth” after their visit, where they, while video recorded, could tell about their experience with the Lega without the presence of the researchers.

The resulting material of the user observation at Vårsalongen 2010 was the basis of my analysis of Lega use at Liljevalchs.
4. Method

The material chosen for analysis is presented, followed by a description of the method for analysis of the material.

4.1 Material

27 groups of users tested the Lega in the user observation conducted by Mobile Life researchers at Liljevalchs. The size of the groups ranged from two to nine persons, on average with three to four persons per group, which resulted in a documentation of about 90 persons using the Lega. The users were of all ages. The majority, 73 percent, of the users was people in the age of 50-70, and 64 percent of the users were female. Five of the groups were English speaking, and the rest spoke Swedish.

In order to get an overview and thorough understanding of the interaction with the Lega, I chose the video recordings of visitors using the Lega as the primary resource of analysis. As a complement to the video recordings I also chose to have the interviews with the groups as a secondary resource of analysis.

During the observation, many groups were followed by a researcher with a video camera, which might have affected the behavior of the users. Permission was asked from the participants to be video recorded while interacting with the Lega. Since only one camera was used per group, the entire interaction of every user was not captured. Since the users often spread out in the exhibition space, the photographer chose to follow different users at different points in time. The aim of the video recording was to show mainly the whole body of the users in interaction with the Lega, therefore detailed, close up interaction with the Lega was most of the time not captured in the video recordings. Since the photographer was often standing at some distance from the users, in order to capture the full body interaction, users’ discussions were often not audible. However, at times when the photographer was closer to the participants their discussions were captured, and also the interviews provide a rich material of users’ thoughts and opinions.

17 out of 27 groups were videotaped while walking through the exhibition with the Lega. Out of the 17 videotaped groups, two groups experienced technical issues with the Lega and three groups did not actively interact with the Lega. Therefore I did not consider these five groups as adequate for analysis. The remaining twelve videos showed groups who actively interacted with the Lega in different manners. In general, out of the twelve groups, eight groups used mainly touch to interact with the Lega, while four groups included some individuals who used bigger movements when interacting with the Lega. However, each individual had a personal way of interacting with the Lega even though similarities could be detected. For example some users invented a “language” to interact with the Lega, this behavior could be seen in three groups, but in different manners.

After a review of the twelve groups I chose to focus on four groups, and more exactly five users. The users were two mature females, a mature male, an adult female and a young female. The two mature females were in the same group and the three other users in different groups. The five users were chosen because they were representing a span of different ways of interacting with the Lega.

4.2 Analysis

The video recordings of the chosen groups were analyzed using interaction analysis (Jordan & Henderson, 1995). With its’ focus on analysis of video recordings of human interaction and use of artifacts, the method suited the material and aim of the analysis well.
Interaction analysis (Jordan & Henderson, 1995) is an interdisciplinary method with roots in ethnography, sociolinguistics, ethnomethodology, conversation analysis, kinesics, proxemics and ethology. Interaction analysis investigates human activities such as speaking, nonverbal interaction and the use of artifacts and technologies. The goal of interaction analysis is to identify regularities in the ways in which humans utilize the resources of the complex social and material world they inhabit. The method relies heavily on the availability of video recorded data, because it gives the opportunity to replay sequences of interaction which allows for scrutinizing a situation, which is required for interaction analysis. The basic assumption in interaction analysis is that knowledge and action are fundamentally social and situated in origin. Therefore expert knowledge and practice are not seen as located in the heads of individuals, but situated in the interaction between persons engaged with the environment. The data used for theorizing about knowledge and practice is found in the details of social interaction. Interaction analysis requires that the analyst attempts to “bracket out” preexisting theories and interpretations of people’s behavior while constructing the analysis. The introduction of categories to account for behaviors should only take place when their relevance can be empirically demonstrated by the participants’ talk and activities in the video material.

In order to gain a profound and nuanced understanding of the material, the interaction analysis was partly done in collaboration with two experienced researchers in the supple systems research group. In the interaction analysis, we made a number of observations of interesting video sequences depicting behaviors that occurred around the use of the Lega. In a grounded theory (Strauss & Corbin, 1998) approach, I categorized the observations into different concepts. Each concept consists of one or a few observations of a certain behavior of a user or several users. Thereafter, I organized the concepts into three themes. The themes evolved around topics that unify the different behaviors of Lega users. The concepts, or subthemes, are depictions of different behaviors occurring around the common topic of the theme.
5. Analysis of the Lega observations

The five Lega users chosen for the analysis are presented with short narrations. Thereafter the structure and content of the themes are described and subsequently the themes are gone through one after one.

5.1 The Lega users

The five users have diverse ways of interacting with the Lega and their fellow users. Each of them has their own personal way of interacting with the Lega, with great differences in visual expressivity and movement pattern. The users and their groups are introduced with a short description.

Anna visits Liljevalchs with her sister, brother and his son. The siblings are all about forty years of age, and the son about five years old. The group alternate between walking together and splitting up in the exhibition space, except for Anna’s brother and his son who walk together during the whole visit. When meeting up they often discuss the Lega traces; how they felt in the palms of the hands and what they might have meant. Anna is often the person commenting on the traces. Anna is a very visually expressive Lega user, often making big, rhythmical movements in the air with the Lega. When leaving traces she often first looks carefully at the art piece for a while before making her trace. Every trace she leaves is one of a kind, whether touching or moving the Lega, none of them are alike.

Frank visits Liljevalchs with his wife and another couple, all four of them are about sixty years of age. In the beginning of their visit Frank and the other man walk together and the two women walk together. Later on all of them alternate between walking alone and together with whoever in the group is close by. Frank and his friend discuss a lot when they walk together. On several occasions they simultaneously make traces standing next to each other. These traces are often made in a playful manner, laughing and talking while making the traces. The two men develop a similar way of leaving traces, with mainly two ways of expressing themselves with the Lega; either they shake it up and down or from side to side. Frank leaves many traces, sometimes for all paintings in a room. He is eager to share his way of leaving traces with the others, on two occasions he shows the other group members how he leaves traces.

Karin visits Liljevalchs together with Kristin and their other friend. All three women are about fifty years of age. When walking around in the exhibition space they mostly walk by themselves and just meet up for small chats every once in a while. Karin holds the Lega carefully in front of her in the palms of her two hands when walking around in the exhibition. She makes two different types of movements with the Lega, which are done in the same manner each time. When leaving her traces she looks at the Lega and either spans it around five times with a certain rhythm, or scratches it on the underside. The movements Karin makes with the Lega take only two to three seconds and are careful and at the same time clear.

Kristin walks around in the exhibition space with the Lega in the strap around her neck, holding it tight to her body with her hands grasped around the Lega, most of the time stroking it on the top side with her thumb. This way of holding the Lega makes it less visible for others, and it might not be obvious for other visitors that she is holding something in her hands. She leaves traces in a subtle manner. When she makes traces she keeps the Lega in the same position as when she is walking with it. She makes her traces by squeezing and petting the Lega on the underside with small, barely noticeable movements. Kristin barely looks at the Lega at all during her visit.
Emma visits Liljevalchs with her sister, mother and aunt. The girls are teenagers and the women around fifty years old. When walking around in the exhibition they walk alone most of the time, but keeping close to each other, frequently gathering to chat. Emma is an active and attentive Lega user; she leaves many traces and attends to most of the incoming traces. When walking with the Lega she holds it in front of her in the palms of her both hands. Immediately when Emma approaches an art piece she finds interesting she starts to touch the Lega, keeping her gaze on the art. For every trace she leaves, she invents a new type of touch interaction. She pets it, squeezes it, strokes it, scratches it, rocks it, draws patterns on it with her index finger, twists it, pats it, pinches it and snaps it.

5.2 Themes
The analysis is divided into three themes; ‘The Lega as a part of the Liljevalchs visit’, ‘Expression with the Lega’ and ‘Social use of the Lega’. Each theme contains a number of subthemes. The subthemes consist of one or a few observations of a certain behavior of a user or several users. Each observation is depicted with an excerpt and a couple of snapshots from the video recordings. Each theme is wrapped up with a discussion of findings from the subthemes as seen through different theoretical perspectives.

5.3 The Lega as a part of the Liljevalchs visit
The Lega users had a variety of ways of interacting with and attending to the Lega. It had a different role in each user’s visit to Liljevalchs. This theme explores the different ways the Lega became a part of the users’ visit to Vårsalongen. The theme consists of four subthemes and is wrapped up with a discussion where the findings of the theme are seen through the lens of the Feel dimension of Larssen, Robertson and Edwards.

5.3.1 The Lega’s role changing
This subtheme deals with how the role of the Lega evolves throughout Emma’s visit to Liljevalchs. The Lega had one role in the beginning and then gradually transformed into becoming an object with different qualities. The first part of the theme describes Emma’s interaction with the Lega in the beginning of the visit to Liljevalchs and the second part describes how the interaction changed towards the end of the visit.

Exploring and integrating the Lega
Very quickly after receiving the Lega, Emma seems comfortable with it and starts to explore what she can do with it. Only after a couple of minutes she has developed a certain style, or system, of interacting with the Lega when she leaves traces, which becomes her way of leaving traces throughout her visit. The following excerpt\(^\text{2}\) is typical for Emma’s way of leaving traces:

Emma approaches an art piece with the Lega in front of her, holding it in the palms of her both hands. While approaching, she starts scratching and simultaneously squeezing the Lega with both hands with her gaze focused on the art piece. After about ten seconds she looks down at the Lega and then to the right, distracted by some other visitors close by. She looks at them for a moment, touching the Lega in the same manner, and subsequently looks back at the art piece. She keeps on looking and simultaneously squeezing and scratching the Lega for a while, and then she decidedly presses the button. After pressing the button she looks down at the Lega and then back up while at the same time turning round to walk further.

---

\(^{2}\) All excerpts are transcribed and translated from Swedish by the author.
1. Scratching and squeezing the Lega

2. Looking at other visitors while squeezing the Lega

3. Looking at the Lega when trace is recorded

4. Looks up and turns round to walk further

Emma’s way of interacting with the Lega is characterized by her starting to touch the Lega immediately when approaching an art piece. Simultaneously as touching the Lega she is looking, often intensely, at the art. She usually spends quite long time making her traces, often more than ten seconds. When she has finished her movements and pressed the button she always looks down at the Lega to see the LEDs light up.

After finishing her movements and pressing the button, when Emma looks down at the Lega to see the LEDs light up the Lega shifts from being an instrument she uses to leave traces into becoming an object shining in her hand. When she turns around to walk away the Lega becomes more peripheral to her attention. She is still keeping it in her hands in front of her, but her attention is directed towards the environment; towards the next art piece she finds interesting or a person in the group who is close by.

These aforementioned actions together create Emma’s style of interacting with the Lega, which she keeps throughout her visit. However there is one thing that differs for each trace she leaves; her movements with the Lega. She invents a new way of touching the Lega each time, for example squeezing, stroking or scratching the Lega in different ways. Unlike other Lega users she doesn’t observe the art piece for a while before she starts interacting with the Lega; she does it immediately. She does not take time to prepare which type of movement she will do, rather it seems like she is spontaneously creating these movements, doing what comes into her mind, seemingly without effort.

Emma pays much attention to the traces she receives from the other Lega users. The traces often trigger Emma to interact socially with group members who are close by, commenting or laughing about the traces, as in the following excerpt:

Emma is looking at a painting, holding the Lega in front of her in both hands, rocking it back and forth. She receives a trace, bursts out “Ooh!” and looks down at the Lega. Her mother, who was standing behind her walks up next to her and Emma turns to her and says: “Mum, I found you” and subsequently looks back down at the Lega, smiling. The mother looks at Emma’s Lega and smiles. 

– Group 2 05.03
Through lightening up, the Lega mediates to Emma that another person has been in the same area and left a trace. When Emma discovers that the trace is from her mother, she says to her mother: “Mum, I found you”. This expression suggests that Emma does not only interpret that the Lega is sending a digital signal which was created by her mother’s Lega, but that the Lega is mediating her mother’s presence.

The excerpt below is another example of how receiving traces trigger Emma to interact socially:

Emma is standing in front of a large painting looking down at the Lega which receives a pink trace. When the trace is finished she looks up and into the camera, laughs and turns round to talk to her sister: “This is fun!” she says, whilst laughing. – Group 2 03.26

The two excerpts demonstrate the social interaction around the Lega in Emma’s group. When receiving a trace, Emma looks down at the Lega and when the trace is over she directs her attention to the environment, often turning to another group member to comment on the trace. Her comments of traces are often about simply telling that she found a trace and who it was from, she seldom asks about what the trace was referring to. This suggests that Emma is not particularly interested in finding out what the traces might have meant but settles for establishing that there was a trace.

By sharing her experience of receiving traces with others Emma is integrating the Lega into her social activity; it becomes a trigger for her to interact with the others. She integrates it in a playful manner, laughing and having fun around the Lega.

**The Lega gets out of time**

On multiple occasions towards the end of the visit Emma’s Lega is receiving traces continuously, which often prevents her from leaving her own traces, as in the following excerpt:

Emma’s group is standing together looking at a sculpture. Emma’s Lega is receiving several traces in a row. She says to her mother:

“Mum, you’re not allowed to press several times on the same [art piece]!”

“But I haven’t!”

“Yes you have, there are so many [traces] coming.”

“You can do whatever you want!” Emma’s aunt puts in.

“But it’s annoying, because then I can’t press [the button] myself!” says Emma.
“Try to shout them down then!” Emma’s mother bursts out.
After the discussion Emma looks down at the Lega, stroking, petting and rocking it while it is receiving even more traces.

Emma gets increasingly annoyed because she is neither able to concentrate on looking at the art, nor to leave traces, because of all the traces her Lega receives. However she does not get annoyed with the Lega as technical artifact, but with her group members. She accuses them of leaving too many traces, and that they are preventing her from leaving her own traces.

There are two interesting things to note in this observation. The first thing is, as mentioned above, that Emma is accusing her group mates of leaving too many traces, instead of accusing the Lega system of being faulty. This suggests that she within a short period of time has developed trust with the system, which makes it hard for her to question the functionality of the Lega system. However, since Emma’s group was only the second group to try out the Lega there was at this time still some technical issues with the prototype. Therefore the probability that the Lega system was faulty at this point is high.

The second thing to note is that the Lega at this point in time has become a somewhat different type of object compared to what it was in the beginning of the visit. In the beginning and for the major part of the Liljevalchs visit the Lega was in time to Emma. When she wanted to leave a trace the Lega received her movements and through the shining LEDs it let her know that it registered them. From time to time the Lega received a trace, alerting Emma through vibrating and shining. Emma’s interaction with the Lega can be seen as a dialogue where Emma talks to the Lega through movements, the Lega answers with lightening up the LEDs, and when a trace is found it talks to her through vibration and light and Emma answers through looking down at the Lega.

However, when the Lega starts receiving rows of traces it gets out of time with Emma and the dialogue between Emma and the Lega is disrupted. Instead of receiving her bodily expressions it interrupts her not only in leaving traces but also in looking at the art. Instead of enriching her art hall experience the Lega becomes an artifact that competes with the art for Emma’s attention. The character of the Lega as interactive artifact has altered into being an object buzzing and shining, refusing to receive her expressions. However, even though the Lega is not working as it should, interrupting her constantly, Emma doesn’t seem to lose her willingness to try to interact with it. This suggests that the relation she developed to the Lega in the beginning of the visit was quite strong and that it takes a lot to disrupt the relation.

5.3.2 Incorporating the Lega
At a first glance it might seem as if Kristin is not using the Lega while walking through Liljevalchs. She keeps it in the strap around her neck holding it tight to her body with her hands grasped around it, which at times make it hard to notice that she has a Lega. However, Kristin is actively using the Lega
throughout her art gallery visit, but she does it in a subtle and at times barely noticeable way. She rarely looks down at the Lega; she keeps her visual focus at the art or at the environment. The following excerpt depicts Kristin’s interaction with the Lega when leaving a trace:

Kristin is standing at some distance from an art piece, keeping the Lega in the strap around her neck, holding it with both hands close to her chest. She stands in the same position, looking at the art piece for around twenty seconds. After this she takes a step forward, stops again and starts to touch and squeeze the Lega on the underside with both hands in a very slight way for about ten seconds. Then she puts her thumb on the button, waits for a while and then presses the button slowly, in a way that is barely noticeable. Kristin doesn’t look down at the Lega at all; she keeps her gaze on the art piece. After pressing the button she stays at the same spot for a moment, then she slowly walks towards the art piece, looks at the description of it for a couple of seconds, and then slowly turns around and walks towards the next work. – Group 8 00.37

Kristin is looking at the art piece for a long while before she leaves her trace. When she does, she does not change the position of the Lega, but simply squeezes it in a subtle way that is barely noticeable for a spectator. When she pushes the button she does not do it immediately but puts her thumb on the button for a moment before pushing it, slowly. During the whole interaction she does not look at the Lega at all. The excerpt below describes Kristin when leaving another trace:

Kristin is holding the Lega tight to her chest, stroking it on the upper side with her thumb and index finger for about half a minute, walking in front of a series of art pieces belonging to the same art work, looking at the art. When backing off from the art pieces, still keeping her gaze on the art, she strokes the Lega on the underside and then decidedly, although subtly, pushes the button. After pressing the button she takes a step back, looks at the art from a distance and pets the Lega on the top side again. Subsequently she walks into the next room, still stroking the Lega on the top side. – Group 8 16.00

As the excerpt depicts, Kristin is constantly stroking the Lega on the top side when not leaving traces. Just like in preceding excerpt, Kristin does not change the position of the Lega when making her trace, and although she decidedly pushes the button, it is in a barely noticeable way, since she doesn’t look at the Lega or change the position of the Lega.
Unlike many other Lega users, Kristin hasn’t got a certain order or system of interacting with the Lega when she leaves traces; her way of leaving traces is irregular and differs from trace to trace. She leaves traces while walking, sitting or standing still, always looking intensely at the art, and very rarely looking down at the Lega. It is hard to notice when she leaves traces because she keeps the Lega in the same position during the whole Liljevalchs visit, and she most of the time strokes the Lega also while not leaving traces. This blurs the difference between leaving traces and just walking with the Lega. This makes her different from most other Lega users, in whose interaction the difference between leaving traces and not is clear.

5.3.3 The absorbing Lega

Karin, who visits Liljevalchs together with Kristin, has a somewhat opposite behavior to her friend. The Lega absorbs a great deal of Karin’s visual and bodily attention and she rarely interacts with the Lega at the same time as looking at the art. When walking through Liljevalchs she carries the Lega carefully in front of her in her both hands. The following excerpt describes Karin when leaving a trace:

Karin is walking in front of three art pieces belonging to the same series, looking at them. She stops in front of the last painting in the row, looks down at the Lega and after a few seconds she starts to scratch it on the underside. After scratching for a couple of seconds she pushes the button. She keeps on looking at the Lega when the LEDs are shining and subsequently looks up and turns round to walk further. – Group 8 19.19

When interacting with the Lega to leave a trace Karin looks at the Lega, unlike most other Lega users who look at the art. Interacting with the Lega and looking at the art are two different activities for her since she does not make them simultaneously but sequentially, as opposed to most other Lega users who merge the two activities into one. When leaving traces Karin does not have a flow of attention back and forth between the Lega and the art, instead she focuses fully on the thing she is interacting with for the moment, and then changes her focus to the other one. Also when Karin is receiving traces she pays a lot of attention to the Lega, as in the following excerpt where Karin is receiving several traces in a row:

Karin receives a trace, looking at the Lega during the whole trace, holding it in front of her in both hands. When the trace is finished she looks up at the painting in front of her. After a couple of seconds she receives another trace; she jerks with her upper body and looks down at the Lega. In the middle of receiving the trace she turns round for a couple of seconds, looking around the room. Then she resumes the original position for a couple of seconds, and then turns around again to look at the paintings to her right. Afterwards she seems to receive yet another trace, because she stops and looks down at the Lega for about ten seconds. Then she turns around to walk away, first looking up and then looking down at the Lega while walking, even though she is not receiving a trace at that moment. – Group 8 01.17
1. Receiving a trace 2. Jerks with her upper body 3. Turns to her right

As depicted by the excerpt, Karin pays a lot of attention to incoming traces. After or during each trace she receives in the excerpt, she looks at the art around her or, seemingly to try to interpret which art piece the trace was referring to. Usually when Karin receives a trace she stops walking, orients her body to the Lega and looks down at it.

Throughout her visit to Liljevalchs Karin seems very much aware of the Lega, she orients her body to it through holding it carefully in front of her in her both hands, as if the Lega was guiding her through the exhibition. The Lega absorbs much of her visual attention both when leaving and receiving traces.

5.3.4 Flow with the Lega

Frank uses the Lega actively throughout his visit to Liljevalchs. Towards the end of his visit he uses the Lega very comfortably, leaving traces in what could be described as a flow:

Frank is standing a couple of meters from an art piece, holding the Lega in both hands. After a few seconds he takes the Lega in his right hand and starts to shake it back and forth in a slow, relaxed manner. Meanwhile shaking the Lega he looks at the painting and then turns his head to look at two other visitors standing beside him. Simultaneously as turning his head to look at the painting again he pushes the Lega’s button in an accustomed way, keeping his gaze on the art, and then looks down at the Lega for an instant to see the LEDs lighten. Afterwards he puts one hand over and one hand under the Lega, stroking it. He slowly starts walking while looking at the painting he just left a trace for and the paintings next to it. He stops in front of the last painting in the row and immediately starts shaking the Lega back and forth with his right hand, faster and more decidedly than previous trace, although still in the same relaxed manner, looking at the painting. After shaking it for some seconds he determinedly presses the button, still looking at the painting. He keeps looking for a short moment and then turns round to walk further. He walks past a sculpture and on his way he looks at it and shakes the Lega back and forth with his right hand in the same relaxed manner as before. He stops for a moment, looking at the sculpture, pushing the button with the index finger of the same hand as he is holding the Lega with. Immediately after pushing the button he turns round to walk towards the next painting, without looking at the Lega.

– Group 5 20.47

1. Shaking the Lega back and forth 2. Pushes the button
Within 45 seconds Frank looks at a whole bunch of art pieces, walking through one of Liljevalchs rooms. He leaves three traces, each trace referring to one singular art piece or multiple art pieces. This means he spent on average 15 seconds leaving a trace, which is a fast pace of leaving traces. All three traces are left in the same manner; shaking the Lega back and forth in a relaxed, almost negligent way. He shakes the Lega with a difference in intensity and speed; which can be interpreted as if Frank is more decided on some and less interested in some of the art pieces.

There is no clear break, or pause, in between his leaving of traces where his attention is directed toward something else than the art. Throughout the sequence of traces he keeps his visual focus on the art, only with a few short moments of glancing at the Lega or at other visitors. After these short breaks his gaze goes immediately back to the art. In a way he is leaving the traces in a flow, where he leaves them on the go or standing still, making his movements in the same manner, with his attention to the art. When one trace is done he moves further to make the next one and immediately after the second one he turns round to see the next art piece, ready to make the next trace.

With the Lega Frank is making like a running commentary of the art, he is expressing his view of the art while experiencing it. He does not take time to ponder about the paintings; instead he spontaneously expresses what he thinks about the paintings through moving the Lega. He seems dedicated when expressing himself with the Lega and it seems he knows immediately what to think of the art pieces. He moves comfortably with the Lega, seems habituated to it and that it is not an effort for him to make a trace. It seems Frank is in a state of mind where the Lega has become a part of what he does; of his way of viewing the art in the exhibition. The Lega becomes an object through which he is expressing his view of the art, an object which is mediating his experience of the art to the environment in a different way; by letting him express himself with gestures.

5.3.5 Findings from ‘The Lega as a part of the Liljevalchs visit’
As depicted in the subthemes, users had different ways of making the Lega a part of their Liljevalchs visit. They paid different amounts of attention to the Lega and used it in different ways. Some users very quickly seemed accustomed to the Lega, while others took longer time to get to know it and some didn’t seem comfortable with it at all.

Larssen, Robertson and Edwards (2007) explore how our bodies establish relationships with artifacts. Seen through the lens of their Feel dimension, the Lega users had different ways of establishing a bodily relationship to the Lega. The next section describes the different ways users had of attending to the Lega when establishing the dialogue between their kinesthetic sense and the Lega:

Emma became accustomed to the Lega very quickly and interacted with it creatively, making many different types of movements while looking intensely at the art. Emma’s interaction with the Lega can be described as she was attending to and acting through the Lega. She was aware of the Lega but it was not the focus of her attention. When she received traces the Lega became the focus of her
attention, and afterwards she directed her attention back to the art or environment. In this way the Lega shifted between being ready-to-hand when leaving traces and becoming present-at-hand when receiving traces. This is a pattern that goes for many Lega users. However, towards the end of Emma’s visit when the Lega started receiving rows of traces, Emma increasingly focused on the Lega instead of on the art or environment. The relationship she had established with the Lega, with attention flowing between the Lega and the surroundings, in this way changed character towards more focus on the Lega.

Throughout her visit Karin paid much attention to the Lega and oriented her body to it. Her interaction with the Lega can be described as she was attending to the Lega and acting on the Lega. Unlike most other Lega users she looked at the Lega when she was leaving traces. It seems the Lega most of the time was present-at-hand for her, it was an object shining in her hand, that she acted on and not through. Karin and the Lega were two entities; it never became an extension to her body.

In contrast to Karin, Kristin seemed very comfortable with the Lega. She interacted with it while looking intensely at the art and very rarely looked at it although interacting actively with it. Kristin’s behavior can be interpreted as she was acting through the Lega. She seems to have incorporated the Lega into her bodily space and seems almost unaware of it. Also Frank seemed to have incorporated the Lega from time to time, for example in the excerpt where he leaves traces in a flow, he seems almost unaware of the Lega, it has become like an extension of his arm.

5.4 Expression with the Lega
When visitors of Liljevalchs were introduced to the Lega they were given a short explanation of what the Lega is. They were told that they could leave traces of their experiences in the exhibition by moving and touching the Lega in different ways, and that their friends would receive these traces as varying patterns of vibrations. However the visitors were not told in what way to move and touch the Lega; they were only told that they could do whichever movements they wanted. The ambiguity of the Lega resulted in a number of personal ways of interacting with it, none alike the other. This theme explores in what ways the visitors moved with the Lega. The theme consists of three subthemes, depicting different ways that users gestured with and touched the Lega. The theme is wrapped up with a discussion where the findings of the theme are seen through the lens of Phoebe Sengers and Bill Gaver’s theory of designing for ambiguity.

5.4.1 A broad repertory of expressions
Anna is one of the most visually expressive Lega users, moving the Lega in various types of ways including waving it rhythmically in the air and touching it carefully. When taking a closer look at what type of movements Anna makes with the Lega mainly two patterns can be found in the way she expresses herself. These two ways of moving are described in the two observations below.

Painting with gestures
On multiple occasions Anna can be seen making gestures that are similar to the art piece she is looking at, as in the following excerpt:

With a smile on her face Anna slowly approaches an art piece depicting a flock of small birds flying over a city. She walks over to it to have a closer look. When standing close to it she starts to peck, or tap, with her index finger on the top side of the Lega, making a pattern of small taps. She keeps on doing this for about ten seconds, looking repeatedly both at the Lega and at the art while doing it. When pressing the button she looks at the Lega, and also when the LEDs shine. Subsequently she puts the Lega back in both hands, looks up, looks for
a short moment on the art piece again, and then walks further.

With great commitment Anna is making a pattern of small pecks on top of the Lega with the tip of her index finger. Her rhythm and manner of making the pecks remind of how a bird would peck for seeds, and the amount of pecks is comparable to the amount of birds on the painting. Another example of Anna’s mimicking behavior is the following:

Anna looks at a glass case containing three squiggly and colorful candelabras, holding the Lega in front of her in both hands. After about 35 seconds of looking thoroughly at them she raises the Lega to a higher position, and after ten more seconds she starts to make rhythmic movements in the air with it. She moves it back and forth with wavy movements, in a pattern reminding of an eternal loop. After a moment she lets go with her right hand and makes bigger wavy movements with the left hand. Afterwards she pushes the button. She keeps on looking for a couple of seconds and then walks further.
The wavy, rhythmic shapes Anna makes in the air with the Lega remind of the squiggly shapes of the candelabras she is looking at.

The two examples above can be interpreted as Anna is “painting” with the Lega what she sees in the art piece. This corresponds to what Anna says in the interview with her group. The group is jointly watching the video recordings of themselves using the Legas. Anna is trying to explain to the others what she is doing in a video clip of her gesturing with the Lega:

“There was a painting which was nonfigurative, I saw it like that, and then I tried to find the depth in that painting, it had like a square (makes a square in the air with her hands), or a shape, and then I sort of tried to (makes wavy movements in the air with her hands, simulating that she is moving with the Lega) draw that into it.” – Interview group 20 00.51

Anna explains how she sees a shape in the nonfigurative painting and how she tries to draw the shape in the air with the Lega to “find the depth in the painting”. It seems, to make gestures similar to the art piece she is looking at might be a way for Anna to reflect on what she thinks about an art piece; a way for her to physically explore what she sees in it and what she feels when looking at it.

**Making associations**

Apart from making movements that are similar to the shapes in the art pieces, Anna is at times making movements that is not at all similar to the art piece but that could be connected to it on a more conceptual level:

Anna stands for about twenty-five seconds watching a large painting from a distance. The painting depicts a rendition of the Last Supper by da Vinci, but with somewhat of a mobster theme. She holds the Lega in front of her in both hands and pets it a bit with her thumb. After a while she changes her body posture, takes a few steps, and suddenly she makes a big, distinct cross in the air in front of her. First she makes one big, straight vertical movement and then one horizontal in the same manner, and immediately after she pushes the button decidedly. While making the movements she has a steady gaze on the art, but looks at the Lega when pushing the button and also when the LEDs are shining. Afterwards she looks back up on the art piece for a short moment, and then starts walking away. – Group 20 22.53
3. Making the vertical movement

4. Making the horizontal movement

The big cross Anna makes in the air with the Lega suggests that she is associating the painting of the Last Supper to the holy cross. Anna is gesturing with the Lega to express an association she makes with the painting.

Apart from mimicking the art and making associations with the Lega Anna moves the Lega in several other ways. She makes a number of different types of gestures and touches the Lega in ways that are more ambiguous. Anna’s way of expressing herself with the Lega alters and evolves during her visit to Liljevalchs. This makes her different from many other Lega users who settle on one way to interact with the Lega, for example using it to express liking or disliking a painting, and who keeps their way of interacting with the Lega throughout their visit to Liljevalchs. Anna is throughout her visit exploring different ways of leaving traces with the Lega, using both gestures and touch. She is broadening her repertory of expressions all along. Her broad repertory makes her one of the most visibly expressive Lega users.

On several occasions Anna tries to explain to her group mates what type of movements she made to create traces, and also in the interview she is keen on telling what type of movements she did and why. She is also at many points trying to analyze traces she receives. It seems Anna really tried to interpret what her group mates wanted to say with their traces. It also seems Anna really put thought into what movements to do with the Lega; that she really wants to express with the Lega what she experiences in the art. In a way it seems like Anna is using the Lega as a tool to explore the art, like she tried to express with gestures what she was experiencing.

5.4.2 Evaluating the art

Frank has a quite different and more limited repertory of expressions than Anna. Very quickly after receiving the Lega Frank develops a system, or language, of interacting with it, which he uses throughout his visit. The language has two kinds of expressions; shaking the Lega up and down when liking a painting, and from side to side when disliking a painting. In the following excerpt from the interview with group 5 Frank shortly explains in what way he interacted with the Lega:

“It was like.. this was good (simulates holding the Lega with both hands, shaking it up and down with wide movements)... sort of.. wow!..ohh.. the Mexican wave.. sort of. And then if I didn't like something, I just did tschh, tschh, tschh (shakes his right hand back and forth while making the tschh-sound) ..like this.”

– Interview group 5 00.48

However, even though he says in the interview that he uses only two kinds of expressions, this is not really the case. Apart from making the two expressions he mentions in the interview Frank also interacts with the Lega in other ways. From time to time he strokes it on the underside when leaving traces and squeezes it when just walking around with it. In the following excerpt Frank is interacting with the Lega in a relaxed manner, leaving a trace and subsequently simply stroking it:
Frank is standing on a couple of meters distance from a few paintings. He walks slowly and looks at them, gazing back and forth between them. Simultaneously he shakes the Lega from side to side with one hand in a relaxed manner for about ten seconds. During the last part of the ten seconds he has stopped walking. He presses the button, and immediately after quickly looks down at the Lega, and then back up at the art pieces again. At this moment he puts his unoccupied hand over the Lega, covering it and stroking it. Afterward he moves on to the next art piece. – Group 5 20.42

1. Shaking the Lega back and forth
2. Looks down at the Lega
3. Puts the hand over the Lega

Frank moves comfortably with the Lega, shaking it back and forth while focusing on the art. He doesn’t seem very engaged with the paintings; he looks at them quickly and then moves on. In the excerpt below Frank shows a lot more engagement with the paintings he is looking at, expressing he is fond of them:

Frank is standing in front of an art piece, holding the Lega in both hands, stroking it. After a few seconds he moves closer to the art piece and starts to shake the Lega slowly up and down with both hands with wide movements, while all the time keeping his gaze on the art piece. At the same time he is taking a few steps backwards, backing off from the painting again. When he is finishing off his movements, after about five seconds, he is also looking at the paintings beside the first one, as if he is leaving his trace for all of the paintings. He is looking back and forth between the paintings. Subsequently he presses the button with his thumb, still looking at the art. After pressing the button he quickly looks down at the Lega, and then back to scan the paintings. Shortly after this he moves on to the next art piece. – Group 5 17.32

1. Shaking the Lega up and down
2. Shaking the Lega up and down
Although Frank has two main expressions with the Lega these are not made in the same manner each time he leaves a trace. He shakes it up and down in various ways and also from side to side in multiple ways. He does it with one or two hands, with more intensity, slower, absent-minded, cautiously and sometimes with more engagement. These variations in his expression make his “language” more complex than just having the two dimensions of expressing liking or disliking an art piece. The different types of movements are in a way reflecting what he feels about the art pieces, in a broader sense than just liking or disliking them. The way he gestures with the Lega tells more about his experience with the art; it might indicate his degree of engagement with the painting, how he feels when he sees it and to what extent he liked it or disliked it. The movements become reflections of what Frank feels about the art.

What also makes Frank’s expressions more complex than simply expressing liking or disliking a painting is his body language and movement pattern while leaving traces. Sometimes he leaves traces standing close up to a painting, looking intensely at it while making decisive movements with the Lega. At other times he just walks by art pieces and makes a laid-back trace on the fly. His body language signifies his engagement with the art, where gesturing with the Lega adds on a further dimension, enabling him more expressiveness in his view of the art.

5.4.3 Procedure with the Lega
Just like Frank, Karin has developed two different expressions with the Lega; one that she uses when she likes the art and another when she dislikes the art. In the interview with group 8, Karin explains how she interacted with the Lega:

“I tried to make two different [movements] to see if they resulted in any difference, so if I didn’t like something I did like this (spanks the Lega on the underside) and if I liked it I did like this (scratches the Lega on the underside). I tried that out.” – Interview group 8 00.13

Karin states that when she likes an art piece she scratches the Lega on the underside, and when she dislikes something she spans it a couple of times on the underside. The following excerpt describes Karin receiving a trace and subsequently leaving a trace using her expression for liking an art piece:

Karin is standing at some distance from an art piece receiving a trace, looking down at the Lega. When the trace is through she looks up at the painting in front of her for a couple of seconds and then looks back down at the Lega and scratches it on the underside for around two seconds and afterwards pushes the button clearly. She looks down at the Lega when the LEDs light up and then turns around to walk away. – Group 8 05.57

Karin scratches the Lega very quickly on the underside when leaving her trace. Although she does it quickly, her movements are clear and distinguishable. The excerpt below describes Karin leaving a
trace using her expression for disliking a piece of art, and then repeating the exact same movements once again:

Karin leaves a trace by spanking the Lega on the underside for a couple of seconds, and then she very distinctly pushes the button and nods while pushing it. All the time she keeps her gaze on the Lega. She puts both hands under it and keeps looking down at it when the LEDs are lit. But something seems to go wrong, as she repeats her spanking with almost the exact same rhythm, and then pushes the button again. This time it seems to work, because immediately after the lights of the Lega has gone out she quickly turns around and walks away. – Group 8 10.02

1. Spanking the Lega on the underside
2. Pushes the button
3. Repeats spanking the Lega

Karin’s way of spanking the Lega is done with the exact same rhythm when she repeats it. Like her scratching, the spanking is done fast, but clearly. In contrast to Frank, who also developed two types of expressions with the Lega, Karin’s expressions do not vary from trace to trace. The intensity and speed of her movements are very similar every time she leaves a trace. The rhythm she uses when spanking the Lega and the approximate time and order of her actions when leaving traces stays the same throughout her visit to Liljevalchs.

Karin’s regularity in making traces can be seen as a procedure. She goes through different steps, which are performed in a certain order, to complete her task. Not only her two types of movements are alike, but also her way of moving is in general very similar from trace to trace.

5.4.4 Findings from ‘Expression with the Lega’
Sengers and Gaver (2006) write that systems can be open for interpretation in different ways and to different degrees. For example, the functionality of a system can be specified precisely, but it is up to the users to decide how to use it, or the system can stimulate new interpretations by purposefully blocking expected ones. The Lega is a system that is designed to be, to a certain degree, open for interpretation. The purpose and functionality of the Lega is specified, but not how the users should use it. In the design of the system it is specified that it should be used to leave and receive traces in different parts of Liljevalchs, that leaving traces is done through moving the Lega and pressing the button, and receiving traces is indicated through lights and vibrations. But the design of the Lega does not tell the user in what way to move the Lega, neither do the traces tell the user in what way they should be interpreted. This is up the users to explore for themselves.

The ambiguity of the Lega implied that the users were allowed to play an important role in determining the meaning of the Lega. The users were given a framework, and it was up to them to decide how to use it. In order to understand the Lega the users had to actively engage in exploring how to use the system. This possibly made them more engaged in the interaction with the Lega.

In exploring how to leave traces, the Lega users developed various different ways of interacting with the Lega, as depicted by the three subthemes. Their way of leaving traces varied from making small patterns with the fingers on the underside of the Lega, squeezing the Lega, and rocking the Lega, to
making big movements in the air with the Lega. Some users settled on making the same type of movements throughout their visit, while others changed their way of moving it for every trace they made. Many users stayed with touching the Lega, using only the haptic sense to interact with it, while others apart from touching it also moved it in the air, also including the kinesthetic sense in their interaction with the Lega. Anna and Emma are examples of users where the openness of the Lega enabled them to try out a great number of different ways to move the Lega. Emma explored the Lega using haptics as interaction modality, while Anna used both the haptic and kinesthetic senses to interact with the Lega.

In some groups the users developed similar ways of interacting with the Lega, while in other groups users moved the Lega in completely different ways. This regardless of if the group members walked much together or not. Groups who talked much about how they interacted with the Lega and walked much together didn’t develop a similar way of interacting with it, while others did.

5.5 Social use of the Lega
The Lega was designed to be a tool that the users could socialize through, but when using the Lega the users mostly socialized because of the Lega; on many occasions it triggered social interaction among the Lega users. This theme explores how social interaction around the Lega occurred. The theme consists of three subthemes and is wrapped up with a discussion where the findings of the theme are seen through the lens of Charles Goodwin’s analysis of human language and interaction and Dirk vom Lehn’s research on visitors’ behavior in museums.

5.5.1 Individual leaving, shared experiencing
In several groups of Lega users the receiving of traces often triggered face-to-face interaction among the group members, while leaving traces was something predominantly done individually. Two of the groups where this behavior was commonly occurring were the groups of Emma and Anna. The following excerpt is an example of how the Lega triggered face-to-face interaction in Emma’s group:

Emma and her mother are standing beside each other discussing where they got traces. Suddenly both of them receive a pink trace. They both jerk, quickly look down at the Lega and burst out:

“Oh!” (mother)
“Oii!” (Emma)

Immediately after looking down at her own Lega Emma’s mother turns her head to quickly look at Emma’s Lega and then she looks towards the other corner of the room where Emma’s sister, who left the trace is standing. The mother bursts out:

“Maja!”

Emma looks at her mother’s Lega immediately after looking at her own, then quickly back at her own Lega, and then at her sister Maja.

“Wiiiee!” Emma says whilst laughing, and her mother laughs as well.

“It was there!” says Maja, who is still standing out of view.

“Haven’t you gotten anything from me, then?” the mother asks.

“No.” says Maja.

“That’s weird..” says the mother.

Afterwards they disperse. – Group 2 03.11
When receiving the traces from Maja, Emma and her mother immediately look for Maja, to comment on the traces. This behavior is common in Emma’s group; when members are in the same room they often take the opportunity to comment on each other’s traces while they receive them. The following excerpt depicts the same type of behavior in Anna’s group:

Anna is standing in front of an art piece, a few meters away from her brother and his son. She says:

“Andreas, did you push on this one?” [points to the art piece in front of her]

“No.” says her brother,

“What, really you didn’t?”

“On this one, or?” her brother asks, referring to the same painting.

“Green! It felt like it was saying.. like it was saying poof, poof, poof! It felt like that.. and it was green!” – Group 20 20.34

Commenting and asking about recently or currently received traces happens on several occasions in both Emma’s and Anna’s groups. These discussions deal with finding out where the trace was left or to simply tell that they found a trace or show the shining Lega to the person who left the trace. In discussions about traces Emma’s group settle for establishing that there was a trace and possibly where it might have been left. Anna’s group is more explorative; in their conversations they often discuss what type of movements it seems the person did that made the trace feel a certain way. Especially Anna is often trying to interpret what the trace might have meant, commenting on how it felt in the palms of her hands when she received it.

In order for face-to-face interaction around received traces to happen, the group members should walk rather close to each other in the exhibition, for example being in the same part of a room, for the spontaneous comments and discussions to occur. However, both Emma’s and Anna’s group alternated between walking close to each other and spreading out in the exhibition space when walking through the exhibition. This movement pattern was similar in most groups of Lega users, however not all groups took the opportunity to talk about the traces when they walked close to each other. The fact
that Emma’s and Anna’s group took this opportunity suggests that they showed more interest in received traces than other groups.

When paying attention to and reflecting upon incoming traces it is likely to comment and ask about them when the one who sent the trace is close by. If paying attention to received traces, using the Lega can give users the opportunity to socially interact even though they do not walk together. Through the traces the users can get a sense of presence of the other group members even though they are not physically there. In this way the Lega extends the platform of social interaction out of physical presence and out of real-time, enabling the users to be close to their group mates even though they are not physically there and even though they might have left the trace half an hour ago. This “communication” out of time and place might trigger the group members to interact face-to-face once they meet up again, asking questions and commenting on traces received, which was the case in Emma’s and Anna’s groups.

Although receiving traces many times trigger face-to-face interaction in the groups of Anna and Emma, leaving traces is predominantly an individual act that the group members don’t share with each other. The following excerpt deals with Anna’s shift in attention when she shifts from talking to her brother to leaving a trace:

Anna, her brother and his son are standing in front of a painting discussing it. They point to different details and look closer at the painting whilst talking. During the discussion they alternate between looking at the art and each other. After a while of conversation Anna starts to make a trace. She makes wavy movements in the air with the Lega. Her gaze is now focused on the art. After a couple of seconds her brother starts talking to her again and she stops moving the Lega and turns her head towards him and smiles. Then they all turn round and walk further in different directions. – Group 20 04.23

When Anna is talking about the painting with her brother she alternates between looking at the painting and looking at her brother. However when she is about to leave her trace she changes her body posture so that she stands straight opposite the painting, moving the Lega in the air with her full visual focus on the art piece. When her brother starts to talk to her she stops moving the Lega and turns to him. Afterwards she does not resume moving the Lega.

It seems difficult for Anna to make her trace and talk to her brother simultaneously; she needs to focus on the art while making her trace. Anna seems very committed when making her traces, and she needs to focus on the art while making them. Therefore leaving traces becomes an individual activity, between her and the art. When leaving a trace Anna is actively creating something, but when she is receiving a trace she is reacting on a signal, which goes on for at least five seconds, which makes her able to simultaneously interact with others.
That leaving traces is done individually and receiving traces is something the users often share with their group mates is a pattern reoccurring in many groups. However there are exceptions to the pattern, as described by the following observation.

5.5.2 A kinesthetic dialogue

In the beginning of their Liljevalchs visit Frank and the other man in group 5 are walking together looking at the art pieces. They are on multiple occasions standing next to each other leaving traces. While making their movements they often talk and sometimes exaggerate their movements in a playful manner. A few times they also show and tell each other how they make their traces, as in the following excerpt where Frank is showing his friend how he created the trace his friend is receiving:

Frank and his friend are standing next to each other at some distance from a painting. They are looking at each other, discussing, holding their Legas in one hand in front of them. Frank points towards the painting while talking to his friend who first looks at the painting and then down at his Lega; he is receiving a trace. The trace is blue, which is the color of Frank’s Lega. Frank shows his friend how he created the trace; he shakes the Lega up and down using one hand, then he holds it in both hands and strokes it on the underside and then shakes it up and down again using both hands. While Frank is showing how he moved the Lega his friend is looking repeatedly at Frank, his own Lega and the art. When Frank has finished his movement the friend nods and walks past him to proceed to the next art piece.

– Group 5 10.05

1. Frank points to the painting 2. Shakes the Lega with one hand 3. Shakes the Lega with two hands

When discussing the art piece Frank is pointing to it to highlight a detail. Then, through showing with gestures and explaining Frank is sharing with his friend how he left the trace that the friend is receiving. Frank’s friend seems to listen attentively, looking at the art and looking at Frank. In the excerpt below Frank and his friend are leaving traces standing close to each other, whilst laughing and talking:

Frank and his friend are standing together in front of a sculpture depicting a thin man holding his arms straight out from his body. They are discussing it for a moment with a laugh. Then they start making movements in the air with their Legas. Frank is shaking it up and down with both hands, first rather slowly in moderately big movements, and then whilst laughing and looking at his friend he exaggerates his movements and shakes the Lega up and down from over his head till down to his thighs. Simultaneously his friend is shaking the Lega back and forth frenetically, mostly looking at the Lega. When he finished off his movements he looks at Frank and laughs. After this they separate and walk further in different directions.

– Group 5 12.44
The two men are standing close to each other, frenetically shaking their Legas, Frank looking at the sculpture and his friend at the Lega. In the fourth image Frank can be seen shaking the Lega up and down with wide movements, the arrow pointing to the Lega.

In contrast to many other Lega users Frank and his friend are often leaving traces at the same time, standing next to each other. Many times they are talking and laughing while leaving their traces; they are communicating with each other simultaneously as interacting with their Legas. Therefore leaving traces becomes something social, that they share with one another in a playful manner.

Through talking with each other while making traces, showing each other in retrospect how they made traces and through standing next to each other creating traces they affect each other’s way of leaving traces continuously. These ways of communicating bodily and verbally lead to that Frank and his friend develop a common language, or way of expressing themselves with the Lega. They both shake the Lega back and forth when they dislike a painting, and up and down when they like one. Their common language emerges quickly, already in the beginning of their visit. Both men vary the intensity and speed of their expressions throughout their visit.

The common language allows the two men to communicate in a novel way with each other. Only with a glance at each other’s movements it seems they can immediately get a sense of their friend’s opinion about an art piece. They also have the possibility to answer to their friend’s movements. Their way of leaving traces can be seen as a kind of dialogue, containing elements beyond those of a verbal dialogue. In addition to talk and body language, the Lega adds on a further dimension to their dialogue and social interaction in general. The Lega becomes an additional medium for them to communicate through – however the communication does not happen through leaving and receiving traces from each other – but through interpreting each other’s movements in real-time. The two men are having what one could call a kinesthetic dialogue, which goes on throughout their visit to Liljevalchs.
5.5.3 Forming each other's experience

A number of discussions about received traces occur in Anna’s group. In the conversations the group members are trying to figure out what the traces might have meant and how they felt, as depicted by the following excerpt:

Anna is talking to her sister. They are standing in the doorway between two rooms.
“Now I can sort of feel it buzzing... Are you also trying to mediate a feeling?” Anna asks her sister.
“Yes.”
“Me too! [laughs] It’s hard!”
“But it’s hard to feel what feeling you have been trying to mediate.”
“Oh, okay! Yes, but I’m trying to..” [Anna waves with the Lega]
“Can you interpret..?” The sister asks.
“Now I felt [points to an art piece], here it was like it was pecking under..” [Anna shows with the Lega]
“Yes, that I didn’t like it.”
“Yes!”
“But it was over here, I hit it on the underside!” [the sister shows with the Lega]
Anna’s sister receives a trace from Anna. Anna says, referring to the trace:
“Yes, it was about those [pointing to some art pieces], it was scary.”
“Yes, I can feel that now.” – group 20 07.50

In the beginning of the discussion Anna’s sister has a somewhat skeptic approach to the traces, saying that she thinks it is difficult to feel what feeling Anna has been trying to mediate, asking if Anna is able to interpret the traces. Anna is more optimistic and tries to explain to her sister how the trace felt in her hands. However, towards the end of the discussion her sister’s attitude seems to have changed; when she receives a trace she says that she can actually feel that Anna thought it was scary. Within less than a minute Anna’s sister to some extent seems to change her impression of the traces she receives.
What happens in this discussion is that Anna and her sister through their social interaction are creating a common understanding of what their traces meant. Through their talking and showing with the Lega they are changing each other’s conception of the traces.

5.5.4 Findings from ‘Social use of the Lega’
As depicted in the subthemes, the Lega fueled a number of different social behaviors among the users. The commonly occurring pattern in most groups of Lega users was that the receiving of traces triggered face-to-face interaction. Some groups had many discussions around traces, while others didn’t talk as much. In most groups the pattern also was that leaving traces was something done individually, with the exception of Frank and his friend.

To give another perspective on the social behavior of the Lega users, it can be seen through the lens of Goodwin’s analysis of human language and interaction (Goodwin, 1999).

Frank’s and his friend’s kinesthetic dialogue can be seen through this perspective. Goodwin describes actions like speaking, gesturing and walking as different sign systems that are created through using specific properties of a certain medium. Speaking uses the mouth in a specific way, gesturing uses the body in one way and walking uses it in another. These sign systems he calls semiotic fields. Different actions often combine different semiotic fields that mutually elaborate each other. Through using specific properties of the Lega as a medium Frank and his friend have created their language of expression with the Lega and consequently their own semiotic field. In their dialogue they are combining a number of semiotic fields that affect each other. Through standing next to each other with their bodies and gaze directed towards the art piece Frank and his friend create a framework, a mutual orientation where verbal and bodily actions can occur. Their orientation makes them able to see each other in the corner of the eye, which makes it possible for sign systems other than talk to occur, for example Lega movements. In this way they have structured the environment so that their Lega movements can become social actions. The framework is built and sustained by the bodily actions of the two men.

Seen through Goodwin’s lens the Lega system can be described as a structure in the environment that affected and created the users’ social interaction. The Lega system had a great impact on the Liljevalchs environment, adding on further dimensions to it, e.g. Legas, radio signals, lights and vibrations. These things structured the users’ environment in a different way. This new structure gave the users the chance to socially interact across space and time. Moreover, the Lega system also affected the users’ behavior in more dimensions, for example their movement pattern in the exhibition space and their gesturing.

The subtheme about Anna’s discussion with her sister around received traces can be seen through the lens of Dirk vom Lehn’s research on museum visitors’ experience of art (2008). His research suggests that people explore and make sense of exhibitions in and through social interaction. The personal experience of the art is to a large extent under influence of other people. People are continually sensitive to others’ activities and engagement and align their actions with them. Social and bodily actions are reshaping and renewing the context, and when visitors collaboratively consider the art, both socially and bodily, they are creating and continuously shaping each other’s experience of the art. In a similar way Anna and her sister are creating and forming each other’s experience of the traces when they are discussing them.

Anna and her sister’s conversation can also be seen through a different perspective. What Anna and her sister are doing in their conversation can be described as establishing, what Herbert Clark (1996) has labeled common ground, on how to interpret the Lega traces. Common ground can shortly be
described as the mutual knowledge, beliefs and assumptions that is essential for people to coordinate their actions and communicate (Clark, 1996). In order for Anna and her sister to be able to communicate about the Lega, to have a way of talking about interpretations of traces they establish a common ground on the Lega traces. Through talking about how they interpret traces and how the traces feel in their hands Anna and her sister are establishing common assumptions on what the Lega traces are like. They cannot know about the beliefs of the other person, but their common ground is based on their assumptions of what the other person knows (Clark, 1996).
6. Discussion

The Lega is an artifact designed to let friends physically share their experience with each other in an art hall. It was designed to be a device to unify the users, to give them a shared experience even though they are not in the same place. The Lega traces were designed to be subtle and ambiguous, for the recipient to be able to interpret them. The thought was that the trace would work as a starting point for the recipient to reflect upon the meaning of the trace, using memories and associations they have with their friend. The thought was also that the traces would be something to trigger discussion among the group members when they meet up again.

The Lega was designed to be simple and intuitive to use, to allow the user to interact with it while focusing on the environment or to quickly attend to it and then direct the attention back to the art. The idea was for the user to have a dynamic flow of attention back and forth between the Lega and the art; from time to time attending to the Lega and then easily directing the attention back to the environment.

The analysis of the Liljevalchs visitors’ use of the Lega provided interesting findings of how users in a genuine and lively museum environment actually interacted with and around the Lega.

The ambiguity of the Lega resulted in a number of different ways of interacting with it and various ways of interpreting it. The process of exploring how to interpret and use the Lega was something that occurred in the interaction between users rather than something done individually. The groups had different ways of exploring how to use and interpret the Lega. Anna’s group talked a lot about how and why they interacted with the Lega, and used gestures to reinforce their discussions. Frank and his friend both talked about how they interacted with the Lega and left traces together. Emma and her mother walked close to each other, leaving traces close to each other although not pronounced leaving them together. Common for all groups of Lega users is that the users had the opportunity to look at how the co-users interacted with the Lega, even if they were not discussing how to leave and interpret traces. The users were constantly affecting each other’s interpretations of the Lega, either through discussing how to interact with it or through looking at each other. In this way, each group formed their own common understanding of the Lega, through using different methods of sharing their experience.

On many occasions the Lega triggered social interaction among its users. Lega users would socialize around received traces and occasionally also around leaving traces. However, the socializing around the Lega did not occur through the Lega, but more often because of the Lega. For example receiving a trace would trigger discussion and laughter with a user who is close by (regardless of whether that user sent the trace or not) rather than trying to interpret what the user who sent the trace meant.

Rather than trying to interpret the meaning of traces the users often showed more interest in that there was a trace, and often commented on this. Some groups, including Frank’s, didn’t pay much attention at all to incoming traces, but focused all the more on making traces. When asked in the interviews, very few users answered that they tried to interpret the traces, with the exception of Anna, who put more effort than others into interpreting traces.

Instead of occurring through the interpretation of received traces the social interaction around the Lega often occurred in real-time. Either through a user receiving a trace and commenting on this to a user close by, or through making the leaving of traces into a social situation, like Frank and his friend did. Therefore, the Lega most of the time did not create a shared experience mediated through the traces, out of time and space, but rather created a shared experience in real-time and space, triggered by the traces.
A reason why the users didn’t put much effort into trying to interpret traces might have been that the vibration patterns of the traces felt very similar to one another, making it hard to tell the difference of traces. This probably made the traces too ambiguous. The pattern of vibration of the traces didn’t correspond enough to the way the Lega was moved or touched. If the patterns of traces would have corresponded more to the way the user interacted with the Lega, the users might have put more effort into trying to interpret the traces. Another factor that might have affected the users’ interest in received traces is that users often left many traces, which resulted in a large amount of received traces. This often resulted in that users in the beginning of the visit would attend to and show interest in incoming traces, but the interest decreased with the amount of traces received, and towards the end of the visit the users’ interest in traces was significantly lower than in the beginning.

Since most users did not put much effort into interpreting received traces, the interaction with the Lega did not enhance the communication with their friends through the Lega. Rather, the interaction with the Lega created a relation with the Lega itself, not through it to their co-users. In other words it seems many users interacted with the Lega, rather than interacting through the Lega.

This resulted in many users creating a somewhat personal relation to the Lega. This relation took on different shapes with different users. Some users saw the Lega as a pet. When interviewed, these users talked about the Lega in words as: “It is so cute!”, “It was talking to me all the time” the latter referring to the fact that the Lega button makes a small sound when descending, and to the vibrations of the Lega. One user, a young girl, named her Lega “Gullan” in Swedish, which can be translated as “sweetie”. To these users it seems the Lega became somewhat of a living organism, with its own behavior. Other users saw the Lega as something which was more like a friend, keeping them company in the exhibition. At times it seemed like the Lega became a substitute for a person to talk to while walking through the exhibition, which meant that users tended to walk much alone with it. Other users used the Lega more like an instrument to express themselves with, in these interactions the Lega became like an extension of their bodies.

The analysis of Lega users focused on only five users out of a large number of users. Due to restrictions in time and scope, this analysis could not focus on more users, but it would be desirable to investigate the behavior of more Lega users in the Liljevalchs observations to further develop the understanding of the Lega use.

The Lega was on average only used for about one to one and a half hour, and on only one occasion, by the users at Liljevalchs. This means that the users spent a considerable amount of time of their use on exploring and interpreting how to use the Lega. If the Lega would be used on multiple occasions by the same users, during a longer time period, this would most probably fuel a different behavior among the users. At this point we can only speculate about which behaviors would emerge around the Lega if used a longer period of time. For example it would be interesting to explore if the users would develop a more elaborated language to express themselves with the Lega, and in what way these expressions would emerge. Also, the amount of traces users leave could be investigated. In the initial phase of exploring the Lega, the users left a large amount of traces to see what effects it would have. It is probable that during a longer period of use, the users would leave fewer traces since they already know what it means to leave a trace. This would probably have the effect that the few traces left would become more significant and interesting for the receiver. In a longer study, longer and deeper interviews with the users could also be made, in an attempt to capture the subjective dimensions of using the Lega.
I chose video recordings as the primary material for my analysis, this has a number of advantages but also a few disadvantages. Heath (2010) discusses video as a research material. Among the advantages he mentions that video captures a version of an event as it happens and provides opportunities to record aspects of activities in real-time. It is a powerful tool for researchers, since a sequence of video can be replayed an unlimited number of times, which allows for unique scrutiny. It resists reduction to categories and codes and thus preserves the original record for repeated scrutiny. Video also allows data to be shared with colleagues and peers which enables collaborative analytical work. It allows for transparency of research; findings can be discussed with respect to the data on which they are based and an independent judgment of the quality of the analysis can be made. Among the disadvantages of video as material is that video recordings are selective; the position and focus of the camera as well as if it is fixed or follows the action has a large effect on the resulting material and consequently the analysis. Ethical considerations also need to be made when conducting video research. Permission is needed from the participants and in some contexts, for example hospitals, it might be difficult to gain permission to videotape the activities.

Liljevalchs, the context where the Lega was developed and tested, is an open and creative environment where the Lega user observations was welcomed and seen as an interesting addition to the spring exhibition by the art hall staff. Therefore, the researchers were given a lot of freedom of action and the context suited well for video recordings and other explorative methods used by the researchers.

Although the Lega was designed to be used in an art hall environment it would be interesting to explore the use of the Lega in other contexts such as kindergartens and science museums. This would perhaps fuel other ways of using the Lega. It would also be interesting to explore the use of the Lega over larger distances, for example in long distance relationships or family members who live far from each other.

This thesis has explored the behavior that occurred around the Lega at Liljevalchs. The users’ way of paying attention to the Lega, their way of moving and expressing themselves with the Lega as well as the way they socialized around the Lega has been explored. The analysis has shown that the Lega - although it was designed to be open for interpretation - became a somewhat different artifact in use than expected in the design vision. Instead of socializing through the Lega, the users socialized because of the Lega – it triggered social interaction rather than mediating it. The Lega absorbed a bit more attention from the users than expected, and the interaction with it was at times not subtle at all, instead at times very pronounced. Many users were fascinated by the Lega and liked to interact with it, however their interaction can many times be interpreted as directed towards the Lega itself and not through the Lega, towards other users. Every user had a personal and original way of interacting with the Lega, and great imagination was used to create different expressions.

To conclude, the ambiguity of the Lega implied that the users were allowed to play an important role in determining the meaning of the Lega. The users needed to explore how to move with the Lega and how to react on received traces. They had to find out for themselves what the Lega was; what they interpreted the Lega to be. This resulted in a number of different interpretations of the Lega, and consequently a number of different ways of moving with it, attending to it and socializing around it.
7. References


Höök, K. (2010) Transferring qualities from horseback riding to design, *NordiCHI’10 Proceedings*


Liljevalchs konsthall (2011) <www.liljevalchs.se>


Sundström, P., Jaensson, T., Höök, K., Pommeranz, A. (2009) Probing the potential of non-verbal group communication, *GROUP’09 Proceedings*
