ABSTRACT
This paper outlines a PhD project that focuses on bodily interaction. The project is grounded in interaction design informed by psychology, sports psychology, kinesiology, cognitive science and phenomenology and explored within the context of competitive sports, leisure/fun and education. As the project is in its initial stages this paper presents the approach of the project and outlines some of the core questions that are going to be addressed in the future work.

Categories and Subject Descriptors
H.5.2 [Information Interfaces and presentation]: User Interfaces – interaction styles, evaluation/methodology.

General Terms
Design, Experimentation, Theory.

Keywords
Interaction Design, Kinesthetic Empathy Interaction, Kinesthetic Interaction, psychomotor abilities, design.

1. INTRODUCTION
There is an increasing interest within the interaction community to address the body’s central role in interaction design. Interaction design as defined by Terry Winograd [16] has grown out of the tradition of HCI where the primary focus has been on an efficient interaction between man and machine mediated by an interface. There is a growing interest aimed at shaping technology that enables interaction to become an experience in itself [12].

Instead of seeing interaction only as mouse clicks, interaction designers are working with entire interactive and social spaces as well as physical artifacts. Designing for these new contexts calls for novel ways of interaction.

The scope of this PhD project is to substantiate and broaden design research within interaction design community by exploring the possibilities of Kinesthetic Empathy Interaction. Throughout the process I wish to get a better understanding of the following:

How we perceive through bodily movement?
How tacit knowledge is embedded in the body?
How interaction design can be informed by Kinesthetic Empathy Interaction?

The experimental layout of the PhD project will be grounded in the following three venues, competitive sports, leisure/fun, and learning environments (such as schools), all targeted at children. By doing design cases within these venues the project explores, both from a theoretical point of view and through empirical studies, the boundaries and possibilities of Kinesthetic Empathy Interaction. The expected outcome is general knowledge about how interaction designers can include the different dimensions of the body when designing, so that the body is naturally integrated in interactions with artifacts and spaces as well as in the design process. The contribution will be in the form of design methods and approaches for designing with and for the human body reflected and exemplified the three design cases.

2. EXPLORING THE POSSIBILITIES OF PSYCHOMOTOR ABILITIES
The mystery of body and mind has long occupied researchers within fields such as phenomenology, psychology and cognitive science.

The traditional psychological approach is that the relationship is dualistic. The faculty of reason is separate from and independent of what we do with our bodies. Which means that reason must be independent of perception and bodily movements. Intelligence is here seen as the ability to think abstractly, combine and solve mental problems. The theory was put forth as a way of distinguishing humans from animals, before the emergence of the evolutionary theory, which showed that human capacities grow out of animal capacities [9].

Today it is becoming a well-known and generally accepted thesis that human beings perceive, learn and experience through bodily movement [9, 10]. George Lakoff and Mark Johnson states in the Philosophy In The Flesh that “Our sense of what is real begins with and depends crucially upon our bodies, especially our sensorimotor apparatus, which enables us to perceive, move and manipulate...”. In that way our bodies are the foundation for the way we experience and interact with our surroundings.

2.1 Kinesthetic Interaction
The way we perform and the activities that we choose to engage in are highly dependent upon the neurological feedback we receive from the body. We use various sensory feedbacks to determine an adequate response to our surrounding
environment. This is similar to the way we use the five senses
smell, sight, touch, hearing and taste. For example, as the way
we use sight in order to know when to stretch out our arm and
catch a ball [13, 15].

The anatomic definition of kinesthesia or kinesthesia is the
perception of the position and movement of one’s body parts in
space. If you close your eyes and then place your index finger
on your nose, you are utilizing your kinesthetic sense. Kinesthesia is part of the sensory capacities dealing with bodily
perception and is part of the somatosensory system. The
somatosensory system is conscious bodily perception which
includes all skin sensation, proprioception, and the perception
of the internal organs. When talking about Kinesthetic
Interaction, the proprioception is often included because both
kinesthesia and proprioception deal with the perception of
bodily movement. The difference between the two is that
kinesthesia is kinetic motion, while the proprioception is the
sensory faculty of being aware of the position of the limbs and
the state of internal organs. It is the bodily intelligence that
allows us to react intuitively without having to think about
every single movement [13, 14, 15]. Through Kinesthetic
Interaction with artifacts and spaces, focus is on the awareness
of the body, the perception of the body’s movements and how
these interact and influence each other, an example of this type of
interaction is the BodyBug designed by Jin Moen [11].

![Figure 1. BodyBug](image)

The BodyBug is a small digital device that can move up and
down a metal wire attached to one user or suspended between
two users. The device senses the users movement and responds
by moving up and down the wire. The meaning of the bodyBug
is for the users to generate new and otherwise unexplored
movements. By utilizing the bodily interaction, you invite the user to explore and challenge
the body through a kinesthetic experience based on emotional
and physical input, thus enhancing the body’s kinesthetic

2.2 Introducing psychomotor abilities

The focus on psychomotor abilities is a yet unexplored area
within kinesthetic interaction. Motor activity is much more than
learned movements executed in space and time. When talking
about motor learning, it is mandatory to be aware of both the
physical and the psychological aspects of the term [5].

While the common factor between the two is movement, the
physical aspect of motor learning is neurological based. The
nervous system has a motor component and it is the motor
nerves that activate muscle contractions, which makes us move.
So when a person has performed a specific movement enough
times a nerve pathway is formed and the movement becomes
automated. A lot of our coarse motor skills are automated.

When walking, we don’t have to think about lifting up the foot
and setting it back down again, it’s happens automatically.

The psychological aspect of motor learning, known as
psychomotor abilities, is the cognitive part of the motor system.
Psychomotor skills results from organized muscle activity in
response to stimuli from the environment. Whereas the physical
part of motor learning is concentrated around reflex actions,
psychomotor skills are complex movement patterns that have to
be practiced [1, 3, 5].

To get a better understanding of psychomotor abilities it is
profitable to look at the term in context. For a soccer player to
crake the game, it is not enough for him to be able to kick the
ball precisely or kick it hard. He also needs a sophisticated
insight into the game. He continuously needs to be able to
decode and react on his teammates and opponents movements
around the field, and from that choose an adequate responds [4,
5, 6].

When engaged in any form for sport, the notion of psychomotor
abilities will be more or less present. In a sport like fencing, like
any other combat sport, elements such as tactics and
psychomotor abilities are of greater importance than any other
skill. It is not only vital to know how to execute a certain
action, but also to know where and when to apply it. This is the
empathic part of our innate bodily intelligence [2].

3. THREE TYPES OF KINESTHETIC INTERACTION

Kinesthetic Empathy Interaction is focused around specific and
controlled movement patterns executed in relation to other
people and the surrounding environment. This differs from
what Jin Moen has done with the BodyBug in the way that the
bodyBug generates free movements not necessary specific to
the surrounding environment. Kinesthetic Interaction can be
divided into three categories, individual, joint and opposed, the
last two are variations of Kinesthetic Empathy Interaction.

![Figure 2. Three types of Kinesthetic Interaction](image)

Individual kinesthetic interaction is where one person is
interacting with a space or artifact. The BodyBug is an example
of this type of interaction. Joint interaction is where two or
more people collaborate through Kinesthetic Empathy
Interaction to reach a common goal. It is crucial for the players
to be able to read, react and build on each other’s actions.
Opposed interaction is where two or more people are battling to
reach the same goal. Tactics plays a huge role and is the most
complex of the 3 types of interaction. The players not only have
to focus on the goal but also on thwarting the opposite player or
players. It is crucial for the players to be able to indicate intent
without the signals being intercepted by the opponents.
3.1 Designing for Kinesthetic Empathy Interaction
When designing for Kinesthetic Empathy Interaction, the values embedded in the users psychomotor abilities should be taken into consideration. Some of the skills defined as being part of ones psychomotor abilities are: timing, tactics, sense of surprise, response ability, speed (slow, fast), type of action and level of attention [2]. The object of psychomotor ability is to organize muscle activity in response to stimuli from the environment, and is done by combining several of these skills at the same time. When designing for Kinesthetic Empathy Interaction one should be careful to solely focus on one of the elements, because there is a significant risk, that the type of interaction achieved becomes fragmented and doesn’t encompass the body as a whole. The key to designing for Kinesthetic Empathy Interaction is to open up for the users to access several skills and plan which combination makes for the most optimal response to a given situation.

Furthermore for an artifact/installation to remain relevant it should be able to change as the users continually becomes more and more skilled. Otherwise the users will quickly lose interest in the product.

3.2 Bounce – an analog example of Kinesthetic Empathy Interaction
The playground equipment Bounce is an example of how psychomotor abilities can be utilized when generating bodily interaction.

The motivation for the project was children’s decreasing level of physical activity throughout the day. The advancement of TV, computers and other sedentary activities take up more and more time, which leaves little time for physical development. As described earlier humans explore and experience through the body. The goal of this project is to explore how artifacts can encourage physical activity and help children explore and challenge their bodies while engaging in meaningful experiences with other children. By exploiting the users innate psychomotor ability, the interaction becomes intuitive and easy to decode.

In short terms, Bounce is best described as a cross between a swing and a bumper car. It is opposed interaction where three players battle each other by bouncing into one another. The object of the game is to hit the other players by swinging a bounce unit into theirs while avoiding being hit (See figure 3).

Each player stands on bouncing unit. By utilizing the whole body the player can control the movements of the unit and bounce it into the other players. Due to the fact, that each unit is suspended by four ropes a unit can swing freely within 360 degrees area, unlike a regular swing that only swings back and forth (see figure 4). The player can control the unit’s movement by utilizing the whole body. For example, to instantly stop a unit the player stretched both arms out to the sides and the unit will stop completely (See figure 5). The type of game strategy is very similar to that of a fencing match. Tactics play a significant role and it is crucial for the player to be able to decode the other player’s movements and from that know when to attack and when to avoid being attacked. Just like fencing the act of surprise is the key to becoming a skilled player.
The future work of this project is to enhance the experience of playing with Bounce by adding a digital layer to each unit. By adding “hit zones” using lights along the sides of each unit, the users will be able to see who has been bounced the most and where the hits have been made. When two units hit each other the lights will go out in the area where the hits are made. When all lights are knocked out on a unit the person has lost. The digital layer calls for at more sophisticated insight into the game. It’s will no longer be enough just to hit the other units without them hitting you too hard, you also have to pay attention to where you aim your hits, whilst protecting yourself.

4. THE EXPERIMENTAL LAYOUT
The approach of the PhD project is to do experimental design cases that can provide me with feedback to what Kinesthetic Empathy Interactions is or can be and how we can design for it. The experimental studies are going to be executed within the research center, Interactive Spaces (www.interactivespaces.net). Interactive Spaces is a trans disciplinary research center where computer science, engineering, media studies, design and architecture are intertwined in several different projects. In order to understand interaction design, it is vital to explore and discover the potentials of interactions and one way of doing this is to build working prototypes. By making actual working prototypes we are able to test how the designs work in “real life”, real domains and in the hands of real people. By making the prototypes it becomes possible to uncover otherwise hidden potentials and afterwards find new ways of utilizing this knowledge. Not by doing extensive quantitative experiments but instead collecting information from qualitative experiments and by doing proof of concepts. The purpose of the project is to uncover a field of potential within the world of sports and drawing the gathered knowledge into unexplored contexts that ultimately will broaden the field of interaction design.

By introducing interaction design into the field of sport I wish to explore how Kinesthetic Empathy Interaction design can enhance the training of athletes, by practicing the generation of complex movement patterns and tactics. The experiences and information gained will then be used as grounds for creating fun interactive bodily experiences. Finally this will be utilized in the context of education to explore how to create fun learning experiences by exploiting the body as a tool of interaction.

5. DISCUSSION
By studying field such as psychology, sports psychology, kinesiology, cognitive science and phenomenology I hope to get a better understanding of how the body works, not just anatomically by also how mind and body relate. This ongoing research will help me form and design the three cases. These will then work as exemplification and clarification of how mind and body relate through Kinesthetic Empathy Interaction.

In the first design case, I will be drawing on already existing knowledge of how psychomotor abilities are used in sports and drawing that knowledge into the field of interaction design to design training devices that will improve athletes performances. The sole purpose of the installations/artifacts will be to enhance the athlete’s skills. I wish to get a better understanding of how specific bodily skills can be trained and improved in a controlled environment by added a digital layer to the athlete’s daily training routines. The knowledge that I gather from that case will then help me shape the next experiment.

By doing a design case within the context of leisure/fun the goal for the user will change from improving a specific skills to acquiring new skills through play. It is very important for children to get a versatile and broad motor training [8] and Kinesthetic Empathy Interaction can be one way of accomplishing this. In this case fun will be the motivating factor for engagement. By drawing on the already known elements of psychomotor ability and on the knowledge of how athletes plan complex movement patterns I wish to explore how to encourage playful psychomotor learning, by the means of Kinesthetic Empathy Interaction.

Children in learning environments such as schools often spend most of their time sitting still while receiving instructions or working on assignments. When a human sits still for too long their cerebral cortex (outer layer of the brain) falls asleep and the brain won’t be able to process new information. Movement is the only way to wake the brain again and it is therefore crucial to get bodily movement incorporated seamlessly into both existing and new learning environments. Interactive technologies can contribute in developing new types of learning experiences that actively engage the children in the learning process by utilizes the body as a tool for interaction. In this design case I wish to explore how Kinesthetic Empathy Interaction can be used in a teaching environment by drawing the objectives of the world of sports and play into the environment. By utilizing Kinesthetic Empathy Interaction, the schooling will be focused around the children’s natural way of utilizing the body.

Kinesthetic Empathy Interaction is one way of looking at bodily interactions founded in cognitive science and the field of sports. It is a way of utilizing kinesthetic interaction as a mean of reaching a higher goal. The bodily interaction gives meaning to or enhances a situation, such as described in the three cases. This could be transferred to other contexts as well. For example, in museums and science centers, where interaction designer are working on shaping technology that enhances and actively engages the users in the experience. One way of getting the users actively involved in shaping their own experiences is to build the interaction on the users inherent bodily movements.

6. REFERENCES


