

# BEING THERE

Exploring the Role of 'Presence' in Designing  
Engaging Product/System Experiences

A thesis submitted to the School of Design, Carnegie Mellon  
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# ABSTRACT

Contrary to the perception of connecting people and enhancing and extending the human experience, technology has made us more disconnected from each other and disoriented in our activities. The focus on building technical functionality, coupled with a lack of consideration for different user contexts and circumstances, has affected technology-mediated experiences through incoherent and inappropriate human-product interactions.

The cohesiveness of function, context and action allows for a 'present' experience in which users are engaged on a cognitive, physical and psychological level. When there is a lack of cohesion, focus and clarity on the activity is replaced by continued attention on the enabling technology. This loss of 'presence' results in inefficient, disjointed and disengaging experiences.

The objectives of this thesis are to 1) describe the loss of 'presence' in human-product interactions; 2) explore sources of knowledge relating to 'presence' and its applicability to interaction design; 3) present a framework for approaching design for 'presence' based on movement; and 4) apply this framework in a design exemplar.

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# 1 Introduction

Thirty years ago, the application of computing technology in our every day lives was limited. People turned rotary dials to connect with those far and near. Local sports leagues or art classes were opportunities for new experiences and new relationships. Dinner was a time for family and conversation. Traveling meant disconnecting oneself from everything familiar. About the only interactions we had with computers involved video game missiles, aliens and asteroids. Home computers only existed in the lives of the most ardent hobbyists because if you wanted one, you probably built it yourself. For the rest of us, the notion itself barely even registered in our consciousness. Bill Gates' vision of a computer on every desk and in every home seemed almost fantastical (Microsoft 2002).

Today, technology is woven into the fabric of our existence and has advanced far beyond what many originally envisioned. The desktop home computer is becoming a thing of the past and among the twenty-somethings, e-mail is already on its way out. In their place, mobile technology accompanies us everywhere we go and holds the promise of instant and continual connectivity. Cars autocorrect when we steer outside of our driving lanes; they can even park themselves. Smart microwaves know exactly how much power to apply and how long to cook to deliver the 'perfect' baked potato. From dating to cooking, technology has a great influence on how we experience life. With the touch of a finger, we can do anything and connect with anyone from anywhere.

Whether intended or not, designed products are built with behaviors that dictate how we interact with them. The relationship between form, function, action and context determines whether products effectively communicate and collaborate. When there is a lack of 'coherence', confusion and frustration arise in the user.

## COMPLEXITY & CONFUSION

The focus on building technical functionality, coupled with a lack of consideration for different user contexts and circumstances, has affected technology-mediated

experiences through incoherent and inappropriate human-product interactions. The technology- and feature- driven approach has resulted in products that are confusing by nature, frustrating in use, and disruptive to engagement. These products are designed to appeal to users by enabling them to do more; however, the result is a loss of focus and clarity in experience.

Many of our activities are not simple. A mobile phone, for example, is used to make and receive calls. But beyond that, there is also the need to store the contact information of frequently called people and to know when a call has been missed. Then there's the want to send and receive text messages, play music, take photographs, etc. - the list of desirable activities continually grows. Complexity is a necessary part of the quest for rich and satisfying lives.

Products are complex because life is complex (Norman 2011, 2). The cockpit of an airplane was not purposely designed to be complex. Rather, the complexity is a natural consequence of all that is needed to properly and safely fly a plane through any number of possible conditions and scenarios. Despite a call for simplicity, we actually do need this complexity in our lives.

The problem with our products lies not in their complexity, but rather, in the way that complexity is managed (Norman 2011, 4). Interactions are the behaviors built into the product that allow access to their rich and myriad functionalities. "Difficulties arise when there are conflicts between the principles, demands and operation of technology with the tasks that we are accustomed to doing and with the habits and styles of human behavior and social interaction in general (Norman, 6)."

As most technology is designed by engineers who concern themselves largely with operational logic and precision, the welfare of the user is often forgotten.

The result is an interaction paradigm that relies heavily on people's cognitive skills – and their ability to "just figure it out." Consider the many great digital cameras available today. Contained in the compact enclosure is a rich set of features, which would allow even novice photographers to take very good pictures. But the initial enthusiasm to use these features is quickly destroyed because of the learning hurdles of first use. The lengthy and complex manuals are perhaps the most salient indicators of the cognitive demands of our technology.

This emphasis on cognition is also a consequence of the way in which products have evolved. As technology has advanced, products have transformed from being largely mechanical to being computerized. Knobs, crankshafts, and levers have been replaced by micro-controllers and touch screen displays. A toaster used to have a knob to control the level of toasting and a lever to lower the bread into position. Today, some toasters are equipped with an LCD panel to display an overwhelming menu of possibilities. Essentially, mechanical parts have been replaced by electronic components; shifting the physical into the virtual. "Products have become 'intelligent,' and intelligence has no form (Overbeeke, Djajadiningrat, Hummels and Wensveen 2002, 9-10)."

With the unquestioned use of the graphical user interface (GUI) for interacting with products, much of the richness and subtlety of our activities have disappeared (Ishii and Ullmer 1997, 234-241). Product form factors have decreased as the user interface has become increasingly limited to control screens with graphical user interfaces and (virtual or physical) push buttons. The one-function-per-control approach of yesterday is replaced by the many-functions-per-control approach. The set of possible user actions have narrowed down to one, namely, pushing, and feedback is strictly visual. This 'display

+ push button' interface relies heavily on the user having the correct mental model, requiring users to explicitly and methodically learn and remember. Products have become nondescript in communication and interaction.

## 'PRESENCE'

To be 'present' is to be in the moment, to be engaged, and to be connected. Our engagement happens simultaneously on multiple levels, allowing us to connect physically, psychologically, and cognitively. But the engagement is also focused on absolutely something - another human being, playing with a toy, listening to music, reading a book. Everything disappears into the background when you are engaged in some activity; you are connected to your actions and objects, and the objects are connected to you. Engagement is a dialogue; a give-and-take relationship.

Products are becoming increasingly confusing by nature and frustrating in use contributing to a loss of 'presence' in activity, and thus resulting in less meaningful experiences. We are constantly removed from the actual activity and instead, forced to tend to the medium/means of interaction. As mentioned in the previous section, the problem lies in the designed interactions between humans and products.

Form emerges out of the relationship between action and function within a specific context. A New York Times review of Le Corbusier's Church of St. Pierre writes:

The floor slopes gently, almost imperceptibly downward, drawing you toward the altar. From there, you turn to face asymmetrical rows of pews that climb up to the sweeping balcony at the rear. The procession ends with a narrow stairway that leads you back down from the balcony to the worship space and out into the world.

What makes this potent architecture is its ability to draw you through these spaces without any coercion. There is no single path, but you intuitively know where to go. (Ouroussoff 2006)

In this place of quiet reflection, the architectural form is a direct consequence of the intended function (the purpose of the architecture) and user action (what the user does). "Intuitively know[ing] where to go," one is 'present' in that experience.

In many of our product experiences, that sense of 'presence' is lost because of a broken link in the function-form-action-context relationship. With increasingly standardized controls, there is a decreasing expressiveness in appearance. In the car, whether you are trying to start the car, turn on the radio, unlock the doors, turn on the seat warmers, you are told to "push the button." The problem is: which button and where is it. Different functions are accessed in similar actions through similar controls resulting in similarly looking output. The form, both input and output, and the accompanying actions have no direct consequences for our actions (Djajadin-ingrat, Matthews and Stienstra 2007, 660-661); that is, there is no guide for how to interact with the functions of the product.

Context presents an added challenge. Environmental and contextual changes can have an effect on human behavior not unlike the effects that physical or cognitive impairments can have on users with disabilities (Choi 2008, 665). Texting through a keypad in the dark is very different than in daylight. Sears et al. introduced the concept of situationally-induced impairments and disabilities to describe the difficulties that may arise as a result of working with devices in a situation that constrain the user's abilities (Sears, Lin, Jacko and Xiao 2003, 1298-1302). The relationship between form, function and action must be coherent and appropriate to the context of interaction.



Breakdown in communication and collaboration between humans and products also contributes to diminished engagement. Without the back-and-forth that characterizes a dialogue, there is no real communication. The command-and-response structure of human-product exchanges results in two monologues and “[t]wo monologues do not make a dialogue (Norman 2007, 4).” Collaboration involves agreeing on one’s intentions and synchronizing one’s activities. Human and product need to be engaged in some form of teamwork, which “requires coordination and communication, plus a good sense of what to expect, a good understanding of why things are, or are not happening (Norman 2007, 136).” In the absence of effective communication and collaboration, we find ourselves continually frustrated as we struggle to do what we want.

In the 1950s, psychologist J.C.R. Licklider investigated how human and machines could engage in a “symbiotic relationship,” one in which they could interact seamlessly in a partnership that would enhance lives (Licklider 1960, 4-11). To regain ‘presence’ in our experiences, a more natural form of interaction - one in which the communication is clear, implicit, effortless and part of a dialogue - is needed.

## MOVEMENT AS COMMUNICATION

Every language transfers messages on a certain level. Though verbal language was developed to allow for clearer and more effective communication, the majority of time, our communication is nonverbal. We can stop speaking, but we never stop communicating as the body is always in motion (Goffman 1963). Movement is the most basic and nuanced form of human communication.

The human body is extremely expressive

and our proprioceptive, exteroceptive and kinesthetic senses are highly attuned to this subtle expression. Through body language alone, we can get a read on the emotional state and intentions of an individual or group. How someone stands, the tone of their voice, the expression on their face - these are all cues that give a certain richness to the communication and allow people to connect in a deeper, more empathic way.

Successful communication requires coordination between the participants. Movements within oneself and in relation to one’s environment function as physical cues that shape the flow of an exchange. By stepping back, for example, the degree of intimacy is decreased and the opened-up space invites others into the interaction. Nonverbal behavior in human-human interactions is therefore involved in regulating the initiation, development and termination of interactions. These physical cues allow for an implicit coordination between participants that lend a naturalness and smoothness to our interactions.

At the onset of an interaction, nonverbal behavior serves to regulate the degree of intimacy between participants. The initiating actions set the stage for the depth of involvement of each individual (Heslin and Patterson 1982, 71). As the interaction progresses, the function of nonverbal behavior shifts to one of facilitating flow. Particularly with regards to awkward, offensive or even demeaning matters, cues such as glances, tone of voice, body positioning, and others allow for implicit communication of intentions (Goffman, 88). We are so attune to these nonverbal cues that when one participant is unresponsive to them, we find the interaction very difficult. Eventually, the interaction draws to a close and nonverbal behavior allows the participants to coordinate a mutual and amicable break.

The conventions of nonverbal behavior give designers a new way of looking at

human-product interactions by considering products as social actors. Products need to be more than intelligent, they need to be socialized; they need to improve the way they communicate and interact. By enhancing coordination and cooperation between humans and products through an awareness of nonverbal cues, interactions can be made more smooth and fluid. Further, product interactions must be designed for the way people naturally behave so that training is not required.

## TERMINOLOGY + SCOPE

This thesis discusses factors that lead to a loss of 'presence' in our everyday experiences and their relationship to the design of product interactions. Products that fail to clearly communicate, effectively collaborate and behave appropriately in a given context, affect users by introducing confusion into human-product interactions. The challenge is to find methods of designing interactions that are coherent and natural, and to develop criteria for analyzing and validating design artifacts.

One method for regaining 'presence' in technology-mediated experiences is to design according to the conventions of nonverbal behavior enacted through physical movement. Acting method theory, such as those developed by Stanislavski, Laban and Bogart, present techniques to explore and understand the physicality of behavior. This understanding is translated into a design framework that designers can use to generate interaction concepts and behaviors for any product. The design framework is applied to the redesign of mobile phone interactions for a more 'present' experience through natural and coordinated interactions.

## 2 Theoretical Notions

In the last decade, the fields of human computer interaction and interaction design have broadened their focus from one on functionality, efficiency and usability to aspects related to user experience and quality of product/system interactions. While various aspects of experience have been explored (including aesthetics (Hummels and Overbeeke 2000), affection (Picard 2000), and emotions (Norman 2005)) ‘presence’ presents yet another avenue. This chapter starts with a discussion of the philosophical thinking behind the notion of ‘presence’. As this thesis is concerned with interaction design, I pull together perspectives that provide insight on how human-product interactions might be reconsidered. Conceptual themes and practical theories from acting provide notions for describing ‘presence’ and a vocabulary for articulating physical movement. This chapter ends with a discussion of the conventions of nonverbal communication around spatiality. Together, these ideas will serve as a foundation for a framework of ‘presence’.

### EMBODIMENT

Traditionally, interactions between human and technology have been approached from a technological or cognitive point of view. This perspective has been criticized as it ignores other aspects of human interaction. (Hummels and Overbeeke 2000; Picard 2000; Norman 2005; Dourish 2001) Our experiences are much richer and include, in addition to cognition, physical, emotional and social aspects. In response, research in human computer interaction and interaction design has generated new paradigms such as Rich Interactions and Tangible User Interfaces.

Across the different approaches, we find elements of a larger fundamental idea that provides a theoretical starting point for designing for ‘present’ experiences — the notion of embodiment. In his book *Where the Action Is: The Foundations of Embodied Interaction*, HCI researcher Paul Dourish describes embodiment as “the property of our engagement with the world that allows us to make it meaningful (Dourish 2001, 126).” That is, we come to find the world — the physical and social — meaningful through action (the way we encounter the world), not simply

abstract reasoning and theorizing. Embodied phenomenon, then, “are those that by their very nature occur in real time and real space (Dourish 2001, 101).” We encounter embodied phenomenon directly rather than abstractly. But it also means more than just a physical presence in the world, but an active physical and social participation. It includes everything from riding a bicycle to having a conversation. In embodiment, we act in and on the world, and the world acts upon us, and through actions find meaning.

The notion of embodiment finds its roots in the philosophical tradition of phenomenology. Phenomenology considers what it is like to exist as humans in the world. It focuses on lived experiences, that is, the way in which we perceive things as they appear to us (Carel 2008, 10). Grocery shopping is largely a physical activity, one could say, but our experience of it is also shaped by a conversation with the butcher, an argument with a competing customer. Experiences are multidimensional and unfold physically, psychologically and socially. Phenomenology and embodiment are important to our exploration of ‘presence’ because to be ‘present’ requires being embodied.

Embodied interaction then is “the creation, manipulation and sharing of meaning through an engaged interaction with artifacts (Dourish 2001, 126).” As a design principle, embodiment draws from our familiarity with the everyday world to smooth interaction. The aim, however, is not to imitate real-world, but to draw from and incorporate aspects of communication that are familiar to our experiences and allow us to more fully express ourselves. “Conversational” computer systems use natural language processing and rules of turn-taking to try and make human-computer interactions more natural. However, encoding these rules of behavior into systems, though an improvement, still keeps a distance between man and machine. The interaction is not

inhabited the way real human-human interactions are, where gaze, posture and space naturally regulate the conversation. With embodied interaction, the real world is more than a metaphor; it becomes the medium for interaction. In so doing, each interaction is designed with purpose; guided by our physical, intellectual and social experiences; there must be a naturalness in the interactions.

In designing interactions, the focus has largely been on experiencing the outcomes of our actions. With embodiment, the emphasis is placed back into the action themselves. It is about the relationship between what we want to do and how we do it. We want the actions to be natural and free, but the larger goal is to achieve what Heidegger refers to as ready-to-hand — an experience where the tool becomes an extension of our intention and activity. The tools, in essence, disappear. Consider the mouse of yesterday, when they employed a trackball and a mousepad was required. When using the mouse to navigate the menus and icons on the computer screen, the mouse is an extension of my hand. This is ready-to-hand. However, when the tool gets in the way and becomes the focus of our attention, then ready-to-hand is lost and it becomes present-at-hand (Dourish 2001, 109). With the mouse, there are times when we reach the edge of the mousepad and have to lift the mouse and reposition it. Ready-to-hand is lost as our attention shifts from the activity to the mouse. Embodied interaction requires a mutual awareness between the participants.

These perspectives provide a theoretical foundation for approaching the problem of how to design for a ‘present’ experience. In order to apply them to design, one must better understand human movement and nonverbal behavior and the role they play in communication and interaction. How do we move? Why do we move? How does movement regulate interaction? To understand movement,

we look to acting theories and research in nonverbal communication in the following sections.

## FROM ACTING TO DESIGNING

Designing for present experiences is concerned with the creation of natural and free interactions that unfold in the real world, and the mutual awareness between participants. So why look to acting as a source of knowledge? Actors have a highly attuned sense of kinesthetic awareness. They are trained in the physicality of behavior and how subtle intentions and emotions can be expressed through their bodies. In their preparation for a role, actors explore how to translate the inner lives of their character into physical manifestations of gesture, pose and action. They also investigate the relationship of their character to the larger context of the other characters and the story and consider how those relationships can be communicated through movement in real space and real time. To do so, actors draw on the conventions of nonverbal communication to inform their choices in this difficult task.

What actors do is not so different than what interaction designers must do in the design of 'present' experiences. Designers, too, are concerned with how intentions and emotions are reflected in the user's actions and how products might collaborate better by being sensitive to them. Designers are continually striving to make experiences smoother and more intuitive through clear communication of product behavior and natural user actions. In short, both actors and designers are investigating the relationship between two interactants and exploring how that relationship is communicated and expressed.

In surveying literature in acting training and methodology, three themes emerge as being key to an actor's presence and

are applicable to our interaction problem. These themes are psycho-physical unity; mutual awareness and responsiveness; and context.

### Psycho-physical Unity

Emotions are often viewed as something intangible or "fluffy." But emotions are really very concrete. In the experience of any emotion, there is always a physical response that occurs with it. This relationship between the emotional and the physical though is not one-way, but a reciprocal one. Just as emotions trigger certain physical responses, certain physical actions and sensations can trigger an emotional response. It has been long known that our psychology affects our physicality, but recent scientific evidence is showing that that our physicality also influences our mental state (Ledoux 1998).

Actors have long been aware that all behavior is physically grounded. The basis of acting is action; if you take care of the actions in a way that is consistent with the context, then the emotions will take care of themselves. Acting teacher Sonia Moore writes: "it is a fact that in life the whole complex inner world of a human being, every inner experience, is always expressed physically (Moore 1968, 94)." In their experiences, actors know that moving in a certain way results in an inner experience or emotion. The Russian actor and director, Constantin Stanislavski, developed the Method of Physical Actions to help actors learn to use physical action as the "bait" for emotion. "The first fact is that the elements of the human soul and the particles of a human body are indivisible (Moore 1984, 17)." The basic premise of Stanislavski's method is that the complexity of the human psychological life is expressed through physical actions.

Following this direction, interaction designers should explore the physical manifestations of intentions and emotions and how devices and systems

might be able to detect this. By moving interactions out of the screen and into the physical world, our actions are embodied and become much more expressive of the inner life. In response the ring of an alarm clock, for example, I can poke, slam, wave or use any number of physical actions to silence it. Each action has a different intentional and emotional meaning associated with it. With a virtual button (that is, an graphical icon of a button, displayed on a touchscreen), however, there is one action — touch — and all the richness of expression is lost. With embodied actions, devices can detect the qualities of an action in order to respond more appropriately through a better understanding of the user's goals. In so doing, human and products users are able to collaborate through a shared understanding of expectations. User experience in activity, as a result, is made more present through an engagement on dimensions beyond the cognitive.

### **Mutual Awareness & Responsiveness**

Acting guru Sanford Meisner developed exercises to help actors be more present in their work. By emphasizing actions - what they are doing - and a focused attention on the other actors, the technique helps the actors maintain a sense of connection while simultaneously moving the actors forward with purpose. In his famous repetition exercises, Meisner writes “[d]on’t do anything unless something happens to make you do it. What do you do doesn’t depend on you, it depends on the other fellow (Meisner and Longwell 1987, 34).” At its core, the key to meaningful behavior emerges out of what is happening between the actors, not what each individual is doing. Sonia Moore writes: “you must coordinate your behavior. [...] Ensemble work means continuous inner and external reaction to each other (Moore 1968, 104).”

This theme gives us important guidance as to how to think about and design

product behaviors that facilitate collaboration. In place of the rigid command-and-response structure that defines so many product interactions, designers should focus on the “in-between” exchange that happens between the user and the product. Concretely, designers must consider how products engage with and relate, respond, and adapt to their users during interaction. A large part of that involves building a continuous awareness into products so that they can monitor and anticipate our intentions without conscious attention from the user. Repeated behavior in our everyday lives is one such scenario. There are patterns to many of our everyday activities, such as the route we take on the commute to work. Our mobile device can learn this pattern over time and implicitly, start to monitor our commute. When problems in our commute arise, the device can alert us to them and suggest alternatives. Today, technology merely sits around waiting for the next input. The bigger challenge, that follows, is deciding when, what, and how the device or system might act; part of being mutually responsive is knowing when to interrupt and initiate.

### **Context**

Action is always situated in a particular context, and this context exerts a powerful influence on how that action is played out and the meaning behind it. The same action can have substantially different purpose and meaning given different circumstances. Consider the action of “hiding”, Sonia Moore explains:

Do not think of how you will perform it before you have a clear picture of the circumstances in your mind. Different circumstances will make you hide in very different ways. It must be obvious to you that hiding from children in a game is different than hiding from a gangster who is following you. (Moore 1968, 38)

Though we speak often of this notion

of context in interaction design, the designed behaviors in products do not reflect this. An obvious example is found in how our mobile devices interrupt us. Regardless of the context, they ring obnoxiously unless we explicitly indicate we want them to vibrate. But given the multiplicity of technologies available, products can become much more aware of our context and adjust their responses appropriately. Even if the context is one that a device or system is not familiar with, it can always resort to a certain mimicry of the environment in its behaviors.

## LABAN MOVEMENT ANALYSIS

Rudolf Laban (1879-1958) was a pioneer of European modern dance and proponent, teacher, and theorist of movement education. In addition to his work as a choreographer, he developed Kinetography Laban (Labanotation) as well as systems for observing and teaching movement in industry and schools. Today, his life's work is known as Laban Movement Analysis (LMA).

LMA is a way of seeing, describing, experiencing, and notating / recording movement for the purpose of improving awareness, efficiency, and ease of movement, and to enhance communication and expression in everyday and professional life. The system that emerged out of Laban's theories provides a rigorous method for observation and non-invasive assessment of movement, with the particular attribute of analyzing the qualitative features of movement production. Within the Laban system there are four areas of investigation: Body, Effort, Shape, and Space. This method of movement study focuses on the interdependence of thinking, feeling, and action by developing awareness and activating the relationship between personal intention, attention, and action in all that we do and say.

Following the discussion above on psycho-physical unity and mutual awareness, interaction designers are interested in how action is reflective of thinking and feeling. LMA provides a vocabulary and method for exploring this interdependence. Accordingly, it is fertile ground to look towards for a better understanding of how movement can contribute to the design of more 'present' experiences.

## Time, Space, Weight and Flow

From a purely physical point of view, movement is an object's change in position within space and over time. Naturally then, space and time are two important characteristics of movement. In Laban's Effort Theory, he introduced two other notions - weight and flow. Weight describes the amount of force or strength applied, or in other words, the impact of a motion; flow describes how the motion moves. With these four effort actions, Laban presents a framework that unifies the physical and the psychological by relating the more qualitative and expressive aspects of movement to the inner life of the mover.

Specifically, these four effort actions are described by their polarities.

|               |   |
|---------------|---|
| <b>Space</b>  | <i>indirect</i> : deviating, flexible, wandering, multiple focus<br><i>direct</i> : straight, undeviating, channeled, single focus  |
| <b>Time</b>   | <i>sustained</i> : leisurely, lingering, indulging in time<br><i>sudden</i> : hurried, urgent, quick, fleeting  |
| <b>Weight</b> | <i>light</i> : buoyant, floating, weight less, marked by decreasing pressure<br><i>strong</i> : powerful, forceful, vigorous, having an impact, increasing pressure into the movement |
| <b>Flow</b>   | <i>free</i> : uncontrolled, abandoned,  |



fluent

*bounded*: controlled, restrained, contained, rigid

With this vocabulary, actors have a methodical way to explore the qualities of a movement. By varying one aspect while keeping the others fixed, an actor can explore how a movement might change as well as the intention and emotion it expresses. Consider the action of falling: by varying the space through which one falls, the time it takes, the weight on impact and the path through space, different interpretations can be ascribed to this simple action.

In Laban's view, humans move in response to inner impulses. These aims could be tangible or intangible. As a result, movement reveals a state of mind. Further, these movements are influenced by the context in which it unfolds.

## VIEWPOINTS

Anne Bogart (1951- ) is a prolific American theatre director and educator. An integral part of her work is the Viewpoints - a philosophy of movement translated into a technique for training performers and creating movement on stage. As a technique, the Viewpoints provide a vocabulary for talking about the basic principles of movement and at the same time, serve as points of awareness for the performer as they work (Landau 1995, 20).

### Viewpoints of Time

#### Tempo

the rate of speed at which a movement occurs; how fast or slow something happens on stage.

#### Duration

how long a tempo, movement, sequence of movements, or shape continues before changing.

### Kinesthetic Response

a (impulsive) reaction to some stimuli which occurs outside of you; the response can happen simultaneously with the stimuli or in response (in sequence) to it.

### Repetition

the repeating of something; there are two types of repetition: internal and external. Internal repetition is repeating something within one's body, something self-initiated; External repetition is repeating something - shape, tempo, gesture, etc. - happening around oneself.

### Viewpoints of Space

#### Shape

made up of straight lines and curves, shape defines the outline of a person or thing. In addition, shapes can be stationary or moving through space. Finally, shape can be constructed by a body in space, or a body in relationship to other bodies, or a body in relationship to the architecture in space.

#### Gesture

a movement involving a part of parts of the body. There are two types of gestures: quotidian and expressive. Quotidian gestures are everyday movements that express thought, emotion, etc. They give information about a character and their circumstances. Expressive gestures are unique or abstract movements that emerge from within and express deep inner emotions.

#### Architecture

the physical space and objects that make up the stage and scenery.

#### Spatial Relationships

how close or far apart two things are in space. With spatial relationships, we can explore the questions of how distances between and groupings of things might suggest an emotion or express a dynamic.

#### Floor Pattern

the path of a person as he/she moves



through space.

The Viewpoints are used in a series of improvisation exercises to allow the performers to train their awareness of the different viewpoints and allow them to listen with their entire body (Landau 1995, 24). As a basis for staging, the Viewpoints allow actors as individuals and as an ensemble to choreograph physical actions. Through free exploration, performers are enabled to find possibilities beyond what they might conceive (Landau 1995, 24).

Designing around and with movement is an approach that is likely unfamiliar and even uncomfortable for many designers. To that end, researchers and practitioners have started to explore this question of how to understand and invent movements. But many of the approaches, such as Choreography of Interaction (Klooster and Overbeeke 2005), require a certain unbounded letting-go and creativity that is hard for the non-performer (dance, drama, etc.) to achieve. Furthermore, these approaches do not present an understandable vocabulary in which to articulate movement. From Viewpoints and Laban Movement Analysis, we can draw methodical ways of thinking about, talking about and generating movement.

## SPACE IN NONVERBAL COMMUNICATION

Being 'present' in an experience involves an implicit collaboration between the participants. This collaboration smoothes interaction through the natural physical cues we unconsciously emit to others and receive and process from others. In the previous sections, we looked at movement initiated by or originating from the body. In this section, we consider movement between participants and the role it plays in regulating interaction.

We create zones around us. Anyone who has tried to engage another (romantic interest), particularly in public places such as a bar or a cafe, is familiar with the way in which we handle space. When we spot an attractive individual across the room, we move closer to get a better view. If the situation appears favorable, the gap is closed to within 5 feet, allowing us to listen in on the conversation or make eye contact. As the spatial relationships change, our behavior and interactions also shift. Space plays a fundamental role in the regulation of everyday interactions.

Growing up, people build up a vocabulary of spatial cues. These cues affect us in an almost Pavlovian way, causing us to unconsciously react kinesthetically and emotionally. In normal children, this development occurs in the first 5 years of life and this learning is crucial to successful social communication and interaction (Hall 1973, 165). Autistic children, by contrast, lack these social skills and have great difficulty apprehending social situations. They lack orientation to people's focus of attention and do not understand the different zones of interaction that dictate people's social behavior.

Different cultures conceive of space differently; meanings and feelings associated with space in one culture often have different associations in another culture (Hall 1973, 168). Nowhere is this more apparent than when we come across newly arrived immigrants. Often we get angry because we are presented with a well-meaning spatial cue that has a different interpretation in our culture. From a western perspective, Chinese people from overseas are often seen as being pushy and rude. But in a country of over 1.3 billion people, that is merely the result of a lot of people in not a lot of space.

## How Space Communicates

Notions of space, though not univer-

sal, are generalizable. Our physicality and the spatial relationships between people set the stage for social engagement. Information about the location (direction and distance), physical stance (or pose), movement and identity of humans is used to regulate the initiation, maintenance and termination of social interactions. This is illustrated very simply in the conversation flow between two people. If one person gets too close, the other re-establishes some distance by moving backwards. “The flow and shift of distance between people as they interact with each other is part and parcel of the communication process (Hall 1973, 180).”

“Spatial changes give a tone to a communication, accent it, and at times even override the spoken word. (Hall 1973, 180)” In the first place, the salience of sensorial cues is directly proportional to distance. Visibility of expressions and gestures, audibility of voice and intonation, olfactory and thermal sensations decrease with distance. And facial expressions and vocal intonation are fundamental regulators of face-to-face social interactions. Our level of engagement is shaped by our perception of attention; these sensorial cues give us that insight into the level of attention (Langton, Watt and Bruce 2000, 51). To compensate for increasing distance, sensorial cues must be amplified. This, in turn, affects the interaction in another way.

As distance increases, the content of the conversation becomes less intimate. Certain things are difficult or inappropriate to talk about unless one is in the right interaction zone. A couple having a discussion about their relationship would likely place themselves at a very close distance and in a space that is removed from other people. By contrast, a group discussion would place the participating individuals at a distance and location where everyone can see and hear each other. Sometimes, one individual in the group may speak too softly (either on purpose or not), forcing

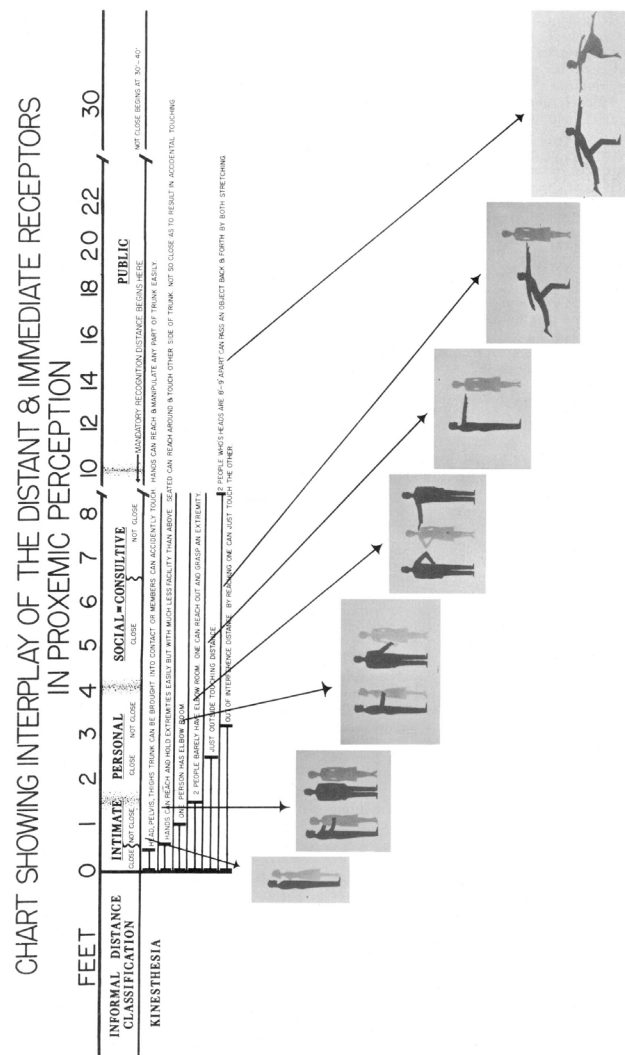
the rest of the group to move in, and rousing a frustrated and perhaps angry reaction (Patterson 1968, 353). When the space is not negotiated and handled appropriately, conversations and interactions become awkward and disjointed.

Noted anthropologist Edward T. Hall classified distances between individuals into interaction ranges (Hall 1968, 92-93), see **Figure 2.1, 2.2**:

|  |                   |
|--|-------------------|
| <b>Intimate</b>  | <i>(0-18in)</i>   |
| Unmistakable involvement between two people  |                   |
| <b>Personal</b>  | <i>(18in-4ft)</i> |
| Engagement at a comfortable distance; interactions among friends fall into this category |                   |
| <b>Social</b>  | <i>(4ft-10ft)</i> |
| Peripheral involvement, usually among non-friends  |                   |
| <b>Public</b>  | <i>(10ft+)</i>    |
| No meaningful involvement; public speaking   |                   |



TABLE II



In this chart the kinesthetic portion has been illustrated with sketches to indicate visually how these distances are set.

### Figure 2.2

Chart showing interplay of the distant & immediate receptors in proxemic perception.

### 3 Framework of Presence

People communicate and collaborate. Products signal and demand our attention. ‘Presence’ implies an engagement that provides and maintains focus and clarity through clear communication, effective collaboration, natural interactions, and continuous awareness. Movement is the most natural language we use; the communication is a part of our biological heritage. In this chapter, I present a framework, based on acting theory, for understanding ‘presence’ from an interaction perspective and present design variables for exploring and generating natural, conversation-like interactions through movement.

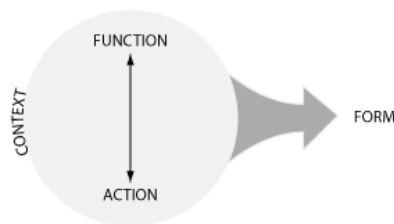
This framework takes an interaction-centered perspective on presence. It builds on themes drawn from acting theory, studies in nonverbal communication, and techniques from acting training and methodology. The focus is on the interactions between individuals and products within a context.

#### FUNCTION, ACTION, AND CONTEXT

This framework takes an interaction-centered perspective on presence. It builds on themes drawn from acting theory, studies in nonverbal communication, and techniques from acting training and methodology. The focus is on the interactions between individuals and products within a context.

An interaction can be thought as having three properties: function, action and context, see **Figure 3.1**. Function concerns what a product or user can do. Action addresses how a product or user carries out the function. Context is the circumstances in which the interaction is situated. When the function is a natural consequence of the action, and both function and action are appropriate in the given context, the interaction is fluid, resulting in a ‘present’ experience. Form emerges out of this function-action-context relationship. Prehistoric tools provide many examples where action and function are directly related; the tools are a natural, integrated part of the user’s physical action. In our everyday lives today, OXO good grips truly fit the physical actions carried about by the human body.

In most of our technological products, there is no meaningful relationship between function and action. Rather, action is usually a consequence of function and form. Further, actions are fixed for a particular function; little consideration is given for the different contexts in which the interaction might occur. The result is interactions that are unnatural and unintuitive; learning and remembering is required to use these products. Form, though communicative, may not lead to natural actions. One doesn't have to look hard for examples — just look at the mobile phone.

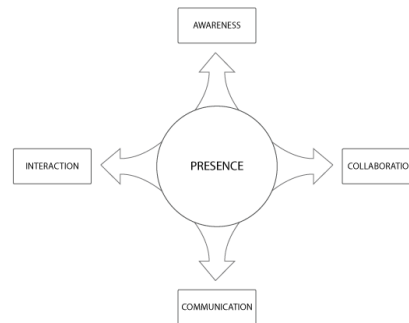


**Figure 3.1**

Function-Action-Context relationship and the emergent Form.

## FRAMEWORK OF 'PRESENCE'

'Presence' is achieved when there is coherence between function, action and context. This relationship can be considered through four themes: interactions, communication, awareness, and collaboration, see **Figure 3.2**.



**Figure 3.2**

'Presence' considered through the four themes: Interactions, Awareness, Communication, Collaboration.

### Interactions

#### *Objective, Expressive, Regulative*

Interactions can be described in three ways. Objective interactions are performed to accomplish a task. They are directed and bounded in space and should be straightforward to learn and easy to execute. Turning on a device or retrieving an email are examples of objective actions.

Expressive interactions convey emotional state. This type of action can be assigned multiple meanings; correct interpretation requires a consideration of the context in which it occurs. Such actions are important in deciding on the manner in which one should respond.

Regulative actions inform and guide the progression of an interaction. In shaping the flow of an interaction, users may change their spatial relationship, attentional focus, or physical orientation. For example, when a user looks

away repeatedly, they are signaling a loss of engagement and interest in the interaction.

### **Communication**

#### *Implicit, Suggestive, Aggressive*

By communication, we are referring to the communication of product state and behavior. Communication between user and product happens continuously and has implications for action. Implicit communication happens as “natural side effects [of behavior] that can be easily interpreted by others.” It “does not require a specific learning or training, or transmission (Norman 2007, 62).” Furthermore, implicit communication is informative without being annoying, disruptive or requiring conscious attention. The whistle of a teakettle when the water is boiling is one such example.

Suggestive communication politely but explicitly engages our attention. This type of communication is characterized by a subtle interruption that, in time, will fade if it is not responded to. It happens in the periphery and does not disrupt current user activity. Consider the power indicator for any digital product. When there is only 10% battery remaining, a pop up dialog box appears in the foreground and demands attention. If the communication had been suggestive, a subtler, yet equally clear signal would be used.

Aggressive communication interrupts violently and demands conscious and immediate attention. Though aggressive communication is normally associated with a loss of ‘presence’ as it removes the user from the current engagement, there are situations in which this form of communication is necessary for ‘presence.’ In matters of safety, for example, the aim is to bring the user out of their current activity and into a heightened state of attention; that is, making them present with the danger or problem. The added visual signals of road cones and construction barricades interrupt the

context in ways that draw extreme focus and attention.

### **Awareness**

#### *Informational, Physical, Social*

Awareness concerns the different types of information that can describe the context of interaction. Information awareness can be described as the (digital) data that profile an individual and their life. Appointments, GPS location, Foursquare (Foursquare is a web and mobile application that allows registered users to connect with friends and update their location) check-ins, contacts are all examples. Consider the following scenario: Through your Foursquare check-in and GPS location data, the mobile phone is able to determine that you are currently at dinner. When a phone call from an unknown number is received, the mobile phone holds the call instead of interrupting.

The sights and sounds of the surrounding environment equip products with a physical awareness. Determining the correct modality of engagement is a tough challenge for products. But by being aware of the physical characteristics of their surrounding environment, products can select a behavior that mimics.

Social awareness allows a product to understand the social context of interaction. This includes being sensitive to the intentions and emotions of an individual as well as whether the current activity involves one person or a group of people. In the example of a mobile phone, people receive text messages from family, friends and colleagues. One might not want a text message from a friend pop up when their mobile phone is used in a group activity with coworkers.

### **Collaboration**

#### *Anticipative, Responsive, Transitive*

Collaboration defines how products engage with users. The nature of col-

laboration in user-product interactions can either be anticipative, responsive or transitive. Anticipative collaboration happens when, based on an understanding of context or behavior patterns, products initiate an interaction or take an action without user prompts. In so doing, users can move seamlessly between activities and contexts in a flow that is consistent with higher user goals.

Responsive collaboration requires that products respond in a timely manner and clearly communicate its understanding. Products that do not acknowledge a user action and indicate its current state confuse and confound. Responsive collaboration ensures that user and product are mutually connected to each other in activity.

Transitive collaboration concerns the means in which the user and product remain connected despite lulls in activity. This can take the form of natural signals and cues that keep both updated on the progression of an interaction.



## DESIGN VARIABLES

As user-product interactions are dynamic, one necessarily must consider notions of space and time. To design product behavior and user-product interactions that lend themselves to 'present' experiences then, I draw from to the vocabulary of Laban Movement Analysis and Viewpoints.

| Design Variable             | Interactions   | Communication  | Awareness   | Collaboration   |
|-----------------------------|--|--|---|---|
| <b>Spatial Relationship</b> | How might changes in the spatial relationship between user and product have implications for the intention and intimacy of an interaction? | How might changes in the spatial relationship between user and product affect how the product might communicate with the user? | How might changes in the spatial relationship signal a change in the social dynamic of the interaction? | How might changes in the spatial relationship affect product behavior?                              |
| <b>Orientation/Pose</b>     | How might changes in the orientation or pose of a user relative to product have implications for user attention?                           | How might changes in the orientation or pose of a user relative to product change communication?                               | n/a   | How might changes in the orientation or pose of a user relative to product affect product behavior? |
| <b>Gesture</b>              | What are free and natural user actions?  | What natural 'gestures' can products use to communicate?   | n/a   | How might gestures be used in collaboration between product and user?                               |
| <b>Tempo</b>                | What does the tempo of an action suggest about user intent?  | How does tempo affect the expressive quality of product communication?   | What does the tempo of a user action suggest about emotional state?                                     | How does tempo affect smooth collaboration between product and user?                                |
| <b>Duration</b>             | How can duration be used in an user action to signify function?  | How long or short should a product communication last?   | n/a   | n/a   |
| <b>Rhythm</b>               | n/a  | n/a  | n/a   | What implications does the rhythm of user actions have for collaboration?                           |
| <b>Repetition</b>           | What patterns of behavior can be inferred from repeated user actions?  | How can repetition be used for emphasis in communication?  | n/a   | How can product behavior change based on repeated user actions to facilitate collaboration?         |
| <b>Response</b>             | What is the quality of the user response and what does this suggest about intention and emotional state?                                   | How fast or slow should a product communicate?   | n/a   | How should products respond to facilitate collaboration?  |
| <b>Information</b>          | n/a  | n/a  | What sources of information can be used to understand user context?                                     | n/a   |

**AWARENESS**

- >Attentional demand of device must be context sensitive
  - >Users should not be distracted from their current activity
  - >Background interactions should be primary means of engagement
  - >Foreground interactions must be used in critical situations
  - >Foreground interactions can be present only when the user is not engaged with another group or individual.
- >Device should be able to infer user intent
  - >Device should be senstive to action qualities:
    - >weight
    - >space
    - >time
    - >accuracy
  - >Device should be able to detect implicit cues including:
    - >movement flows
    - >gestures
    - >spatial relationships
    - >repetition
- >Device should respond appropriately to user actions based on inferred user intent.

**LANGUAGE** (intuitive, understantable, useable, inferrable)

- >Visual information must be clear and understandable for each user
  - >There must be only one ‘area’ in focus
  - >The area of focus must be quickly identifiable at-a-glance
  - >Form factor must contrast sufficiently to allow users to distinguish the area of attention:
    - >contrast
    - >color
    - >texture
    - >size
    - >sound
    - >movement
    - >architecture (arrangement of elements)
  - >Content should be consumable at-a-glance
- >Device actions must be clear and understandable for each user
  - >Visual form expresses action
  - >User action should clearly indicate resultant device action
  - >User actions should be natural
  - >Input control mechanisms should not have multiple meanings
  - >Output control mechanisms should not have multiple meanings
- >Physical and visual form of device should clearly communicate function
  - >Information can be communicated through multiple means simultaneously

**ACTIONS**

- >Actions must be performable by all age groups
- >Actions must be natural, intuitive and repeatable
- >Sensorial cues must be clear without being intrusive or painful

**ENGAGEMENT**

- >Device must respond in a natural timeframe
  - >Users must sense perceivable feedback either instantaneously or immediately following
- >Interactions must take full account of a device’s physicality
- >Interactions should take advantage of the user’s physicality
- >Interfaces must be a natural extension of the device
  - >Information should appear at the location of action
  - >Information must be understandable at a glance
  - >Affordances should not be limited to the virtual
- >Device interruptions should be “socially” appropriate
  - >Device should invite instead of demand interaction
- >Device feedback should be multi-sensorial
  - >Feedback must not be limited to visual and audio
- >Actions should be expressive
  - >Device form can be dynamic
- >User actions should be simple without being nondescript
  - >Users should not have to perform unnecessary steps
- >Functionality can unfold in inquiry
  - >Action possibilities should be discoverable in interaction

**FLOW**

- >Content navigation must be simple and efficient
  - >User task flows should be clear and efficient
  - >User action possibilities should be obvious
- >Device should maintain a peripheral presence
  - >Users should be confident and implicitly aware of the device’s state without detracting from their current activity
- >Device should be able to detect rhythmic properties in the environment
- >Device should be engaged in rhythmic synchronicity with the user

**ADAPTABILITY**

- >Device must recognize patterns of behavior for each user
  - >Device should recognize repeated user responses to the same device action
  - >Device should change device action upon detecting repeated patters of user response
- >Device should be context aware to include:
  - >location
  - >time
  - >user activity
  - >social relationships
  - >physical environment

After a literature review of existing research was conducted, the idea of physicality and engagement was brainstormed upon. This line of inquiry lead to a focus on presence in interaction and how devices/systems can be present within human-human interactions in a meaningful way. A list of design criteria was developed to guide the design of such devices/systems.

This list consist of six themes: awareness, language, actions, engagement, flow and adaptability. In each area, I am interested in how they play out physically, cognitively and emotionally. Primary criteria are expressed as MUST; secondary criteria are expressed as SHOULD.

## 4 Concept Exploration

As a design exemplar the mobile phone was chosen as the product for which the user-product interactions would be considered. The framework was used to understand and generate interactions and experiences that would contribute to a more 'present' experience. The design variables presented in the previous section entitled Design Variables provided concrete points of exploration and ideation. The concepts were validated through user testing with foam-core prototypes. In the second phase, a digital prototype of the most resonant concepts was constructed as a proof-of-concept of the technical feasibility of such designs. This chapter will focus on the concept exploration and user testing. The implemented prototype will be described in Chapter 5.

### THE MOBILE PHONE

Mobile technology is deeply intertwined into our lives and enables us with tremendous ability. Our mobile phones are always on and always on us; they are product, friend and talisman all at the same time. Though intelligent, they are a socially awkward part of our lives. With the multiple tasks that take place, the mobile phone provides a constant stream of interruptions that removes us from our current context. Furthermore, the nature of mobility makes interactions variable and complex. Different contexts call for different product behaviors and different user-product interactions. Accordingly, the mobile phone is almost the ideal product for re-design around the notion of 'presence'.

Specifically, four scenarios are explored:

- Scenario 1: Receiving & Responding to Calls
- Scenario 2: Clock Alarm Function
- Scenario 3: Camera Function
- Scenario 4: Information Signaling

## Scenario 1

### *Receiving & Responding to Calls*

Josh had been looking forward to his date with Sarah all week. It took him three weeks to finally summon the courage to ask her out. As they are having lunch, though, they are suddenly interrupted by the Glee Cast rendition of “Sweet Caroline.” Josh’s mom is calling. He frantically reaches into his backpack for his phone; in his nervousness, he fumbles to find the button to silence it. Suffice it to say, Josh is embarrassed and Sarah does not appreciate the fact that Josh had forgotten to silence or turn it off before their lunch date. See **Figure 4.1**.

### Analysis

Despite the seemingly simple activity of receiving and responding to a phone call, people still find themselves in embarrassing situations. With the power of mobile connectivity, the variety of circumstances one might find oneself in when a phone call comes through is unimaginable. Then, there’s the matter of responding to the call. We have to push buttons to silence the ring, push buttons to ignore a call, push buttons to answer a call. Surely, there is a more natural and fluid way of interacting.

**Actions:** The user action of pressing buttons is arbitrary, unexpressive and requires conscious user attention. It does not communicate the intention of the user with response to future interruptions.

**Communication:** By ringing aloud, product behavior is fixed and aggressive (unless the user explicitly indicates otherwise).

**Awareness:** Product does not sense the context of the user, which can include time of day, user’s appointments, physical environment characteristics, and social dynamic (individual or group setting).

**Collaboration:** In requiring the user to press a button for each decision point



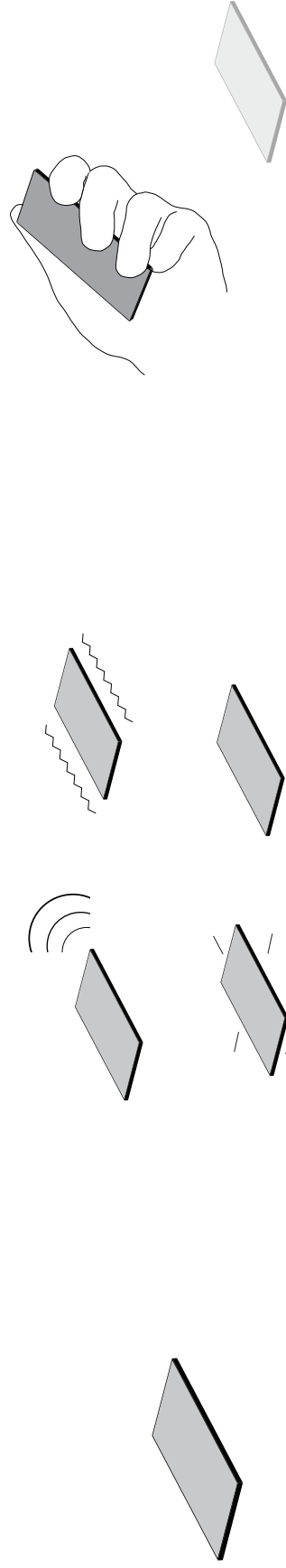
**Figure 4.1**

Receiving & Responding to Calls

(silence ringer, answer call, etc.), the collaboration lacks mutual responsiveness between user and product.

# Redesigned Interaction Concepts

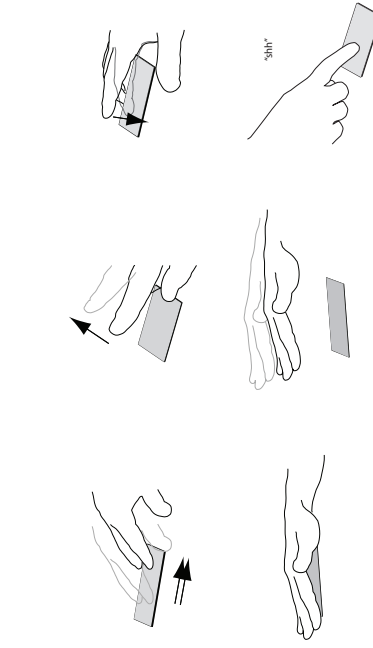
## Receiving & Responding to Calls



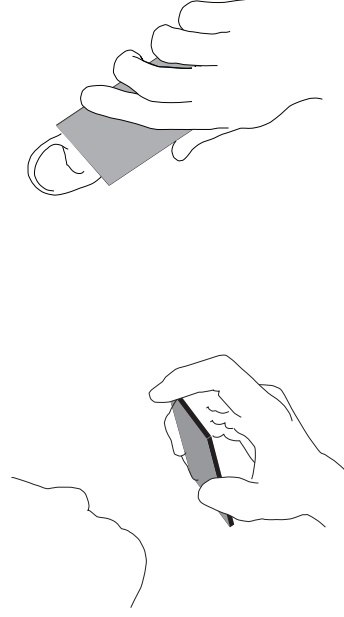
Call incoming...

Based on an sensed awareness of the environment, it can communicate through ringing, vibrating, glowing or even silently sending the call to voicemail

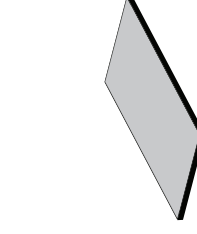
Picking up the phone automatically silences the notification of an incoming call



User can silence the phone through a number of natural gestures



By changing the spatial relationship between the user and phone, the user indicates whether they want to take the call...



...Or reject it.

## Scenario 2

### Alarm Clock Function

It's 7am and Josh's alarm goes off as programmed. He isn't looking forward to the day though as he was out late last night celebrating his buddy's birthday. He reaches over and fidgets with his phone to find the buttons to snooze the beeping. He can definitely use an extra hour this morning. Ten minutes later, his phone alarm goes off again as expected. Again, Josh silences it. Two snoozes later, he begrudging gets up.

On his way to work, he checks his schedule for the day and learns his 9am meeting was canceled. If only he knew, he could totally have had that extra hour of sleep. See **Figure 4.2**.

### Analysis

The alarm clock function is surprisingly rigid in its behavior despite the abundance of information and sensory data available to help it adapt its behavior. Though it is true that this is one situation in which one may not want too much variability, there is potential for a more satisfying experience.

*Actions:* The user action of pressing a button to silence the alarm takes away from the potential for rich expression. The manner in which a user snoozes the alarm can be indicative of physical and emotional state.

*Communication:* Alarm behavior is fixed and tends to be consistently aggressive.

*Awareness:* By tapping into readily available sources of information, such as the user's calendar, the alarm can adjust its behavior. Other sources can include local news feeds (inclement weather, school and work closures), weather, etc.

*Collaboration:* By not being adaptive and anticipative, there is no collaboration.



**Figure 4.2**

Alarm Clock Function

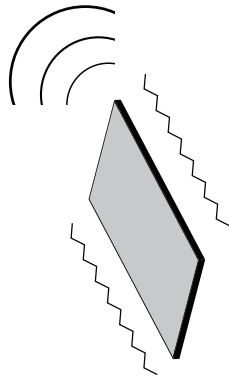


**Figure 4.2 (cont'd)**

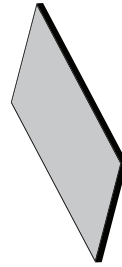
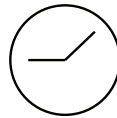
Alarm Clock Function

# Redesigned Interaction Concepts

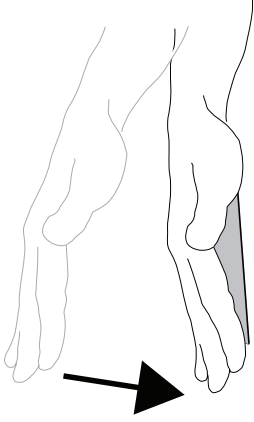
## Alarm Clock Function



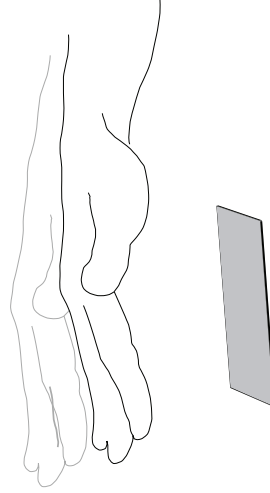
Alarm goes off...



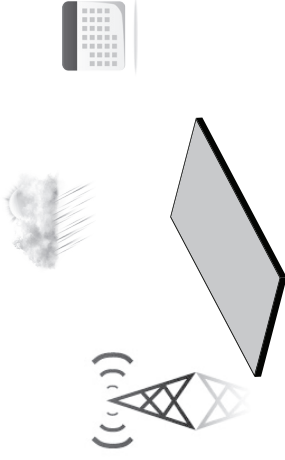
The phone can adjust its snooze behavior based on its understanding of user context.



Based on the quality of the action (tempo, duration, response, etc.), the phone can infer the emotional and intentional state of the user.



Users can interact with the alarm through a number of different ways; this allows for free, natural and expressive movements



The phone can draw from a number of sources to gain an awareness of the user context.



### Scenario 3

#### Camera Function

With spring comes the cherry blossoms and on his walk back to work from lunch, Josh catches sight of the first ones to bloom. He takes out his mobile phone with its 5 megapixel camera to snap a few pictures for his mom. He launches the camera function and gingerly holds the phone, careful not to cover the lens. To get a close-up shot, Josh taps down on the screen to reveal the zoom feature. While continually balancing the phone between his fingers, he uses his index finger to adjust the on-screen slider that controls the zoom level. Finally, he presses a button on the front of the phone (facing him) to snap the picture. See **Figure 4.3**.

#### Analysis

Most camera phones today can take some pretty good pictures and are equipped with a good array of on-the-fly photography settings. Yet the interactions are not conducive to taking quality pictures. Instead of focusing on the characteristics that make for good photography, such as composition and framing, the user is concentrating on operating the device. The result is a cumbersome product - highly powerful, but rarely used to its potential.

*Actions:* The user actions are highly indicative of his/her objectives. Yet the device requires an explicit input of commands.

*Collaboration:* Instead of working in tandem with the user to capture a good picture, the device waits for user input and furthermore, requires it through clumsy screen-based controls.

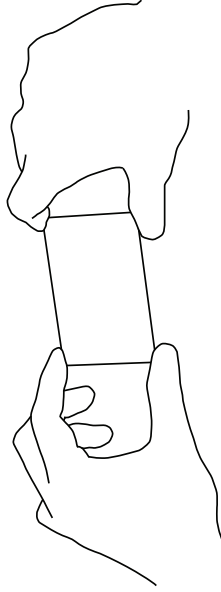


**Figure 4.3**

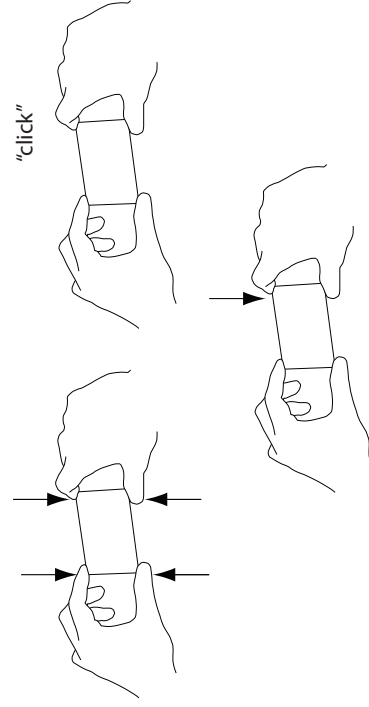
Camera Function

# Redesigned Interaction Concepts

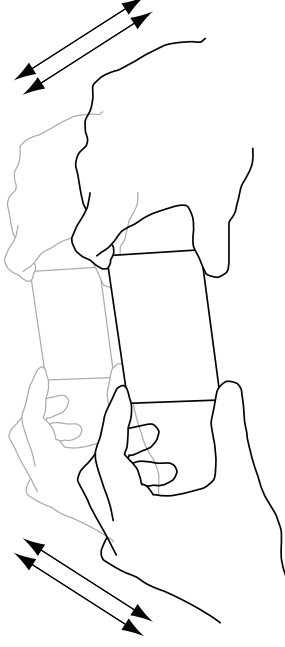
## Camera Function



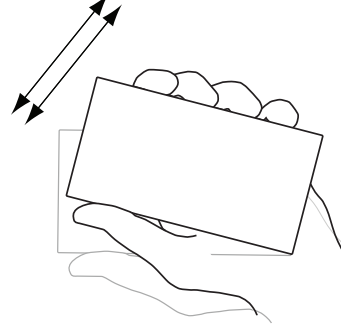
The positioning of the fingers is unique to taking pictures and can be used to indicate user intent to access camera functionality.



Taking a picture can be accomplished in a number of ways - pressure, voice, button.



In changing the spatial relationship, by moving the phone towards and away from the body, a user can naturally change the zoom factor.



Deleting a picture can be accomplished by shaking the mobile phone like an etch-n-sketch toy.

## Scenario 4

### Information Signaling

On his way to work, Josh pulls up the Washington State Department of Transportation mobile app to check on the traffic conditions. He sees that SR-520 is clogged at the bridge as usual, but as he looks up from his app, he realizes he is already too far into the turnoff to possibly take an alternate route. It'll be another long work commute. Pulling out his phone to call into work and let his boss know he'll be late, he realizes there is only 5% battery left. He should have checked before leaving the condominium this morning.

Later on that day, as Josh is leaving work, he finds himself drenched in a rainstorm. Being indoors all afternoon, he had no idea the weather had turned for the worse. There is the weather app, but who remembers to check that anyways. See **Figure 4.4**.

### Analysis

We depend on bits and pieces of information concerning a wide range of contexts to smoothly get through the day. This information is readily available and our devices can readily access it. Yet, unless we explicitly query for it, the information is unavailable.

*Communication:* Through implicit means, the mobile device can provide us with just-in-time information to help us move seamlessly through the day.

*Awareness:* With the computing power available and the instant and continuous connectivity, mobile devices can track data and information that is relevant to us.

*Collaboration:* Mobile devices can learn our patterns of behavior and over time anticipate our informational needs.



**Figure 4.4**

Information Signaling

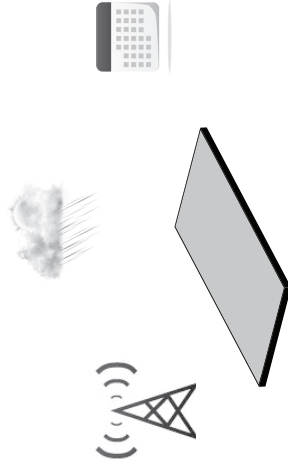


**Figure 4.4 (cont'd)**

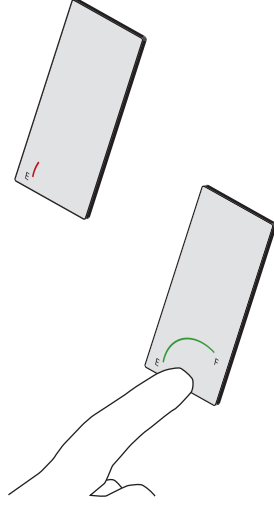
Information Signaling

# Redesigned Interaction Concepts

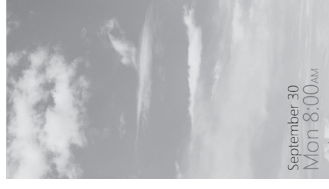
## Information Signaling



The phone can draw from a number of sources and correlate it with patterns of user behavior to deliver the necessary information at the right time.



Users constantly activate the screens on their phone just to check the battery power. With an implicit display, the power meter lights up when users touch and hold anywhere on the screen; when the power is low, the power meter will automatically show.



The background of the interface acts as a window into the outside, keeping weather conditions on the periphery of a user's attention.

## USER RESEARCH

Semi-structured interviews involving elements of participatory design were conducted to validate conceptual interaction frameworks. For the study, 14 functionalities of the mobile phone were selected. Participants were asked to invent their own interactions with the mobile phone for the specified tasks. In analysis, their responses were compared against the redesigned interaction concepts. In some cases, there was agreement on what constituted a more natural interaction; in other cases, participants generated new ideas; in still other cases, participants defaulted to conventional interactions found in mobile phones today.

Low fidelity foam-core prototypes of a mobile phone, each with different physical action possibilities, were created. No screens were necessary as the study focused on interactions that were (physically) movement-based. By using movement without any graphical or textual guidance, the activity forced users to act in the most intuitive, logical and/or natural way.

### Research Protocol

Ten participants, of which 5 were males and 5 were females, were recruited for the study. Their ages ranged from 22 to 35 and all are up-to-date with current mobile phone technologies and product offerings. As such, they can easily navigate the potential mobile phone interactions. This group of participants easily learns user-product interactions, however contrived and illogical. However, they all do acknowledge that, in certain situations, product behavior is annoying and even obnoxious.

The study consisted of 14 tasks:

Power On/Off

Phone Functions

- Answer Call
- Silence Call
- Do Not Disturb

Connectivity

- Navigate Contacts
- Compose Text
- Send Text
- Discard Text
- Camera Mode
- Zoom
- Snap Picture
- Delete Picture

State

- Weather aware
- Power aware

At the onset of the study, participants were asked to familiarize themselves with the foam-core prototypes by playing with them in order to discover the possible actions and movements. The prototypes included:

- twister (See **Figure 4.6**)
- folder (aka “moleskin”) (See **Figure 4.8**)
- separating (pulling apart) (see **Figure 4.9**)
- slider
- switchblade
- clam shell
- divets (See **Figure 4.7**)
- pressure-surface
- gesture-based
- block (no touchscreen, no buttons, no manipulable physical characteristics)

The participants were then asked to carry out 14 tasks (listed above) using any number of the prototypes and to describe aloud their thoughts and actions as they were enacting them. They were also free to invent their own gestures or movements. Participants were encouraged to improvise in their exploration and consider multiple ways of accomplishing the same task. The aim was not to find the most popular or ‘right’ interaction for each task. Instead, participants were told that they were designing the mobile phones; this ensured that the most natural user-product interactions would surface.

## Questionnaire

I am developing a new mobile phone. In front of you is a collection of mock-ups of mobile phones that you can hold and play with. I will be asking you to play with the mock-ups and then, asked to complete a series of tasks using one or multiple mock-ups. Please describe aloud your thoughts and actions. If you find none of the mock-ups suitable for the task at hand, you are free to invent your own mock-up or interaction.

1. Power on the mobile phone

2a. Imagine your mobile phone is ringing, answer the call.

2b. Imagine your mobile phone is ringing, silence the call.

2c. Change the settings of the mobile phone so that it does not interrupt you with any sort of notifications (incoming calls, text messages, etc.)

3. Imagine you are looking up a contact, how do you want this contact information present? Now, navigate through the contacts information.

4a. Imagine you've found the contact you were looking for and want to send them a text message. How would you start to compose a text message?

4b. Discard the text message you've composed (but not yet sent).

4c. Send the text message.

5a. Imagine you want to take a picture, go into camera mode.

5b. Zoom in on the object you want to take a picture of.

5c. Take the picture.

5d. Delete the picture.

6a. Describe how you check the weather



Figure 4.5

The complete suite of foam-core prototypes

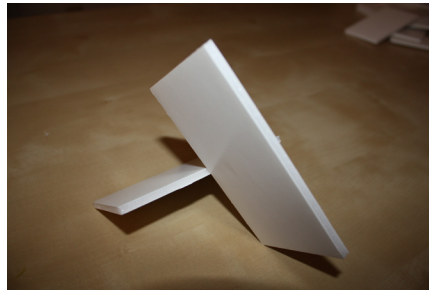


Figure 4.6

The twister foam-core prototype

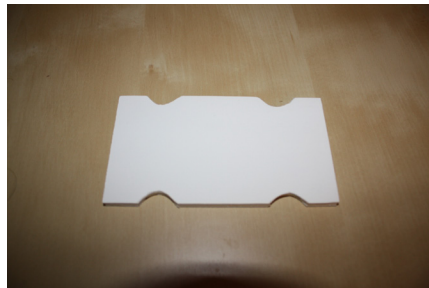


Figure 4.7

The diverts mobile phone.

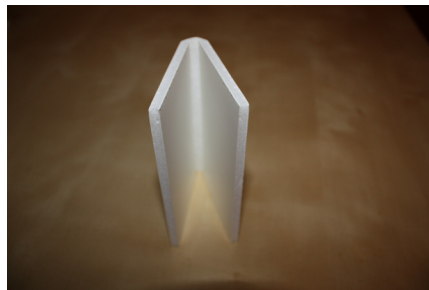


Figure 4.8

Moleskin mobile phone



Figure 4.9

The pull-apart phone.



today on your mobile phone.

6b. How else might you learn about the weather?

7a. Describe how you check the battery power on your mobile phone.

7b. How else might you be aware of the batter power on your mobile phone?

8. Are you male or female?

9. What is your age?

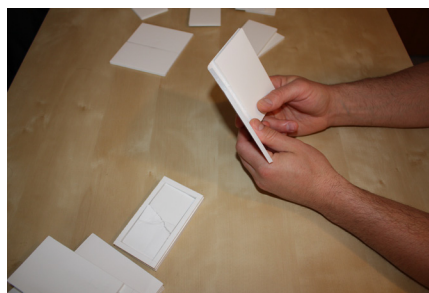
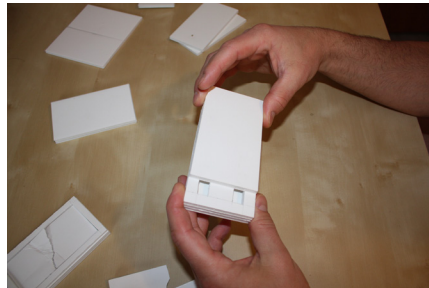
### Research Results

Through the structured questioning and the use of physical prototypes to allow participants to think by doing, the experiments aim to find intuitive reactions and responses to different phone behaviors. This was achieved by asking users to generate interactions for each task. The responses of the participants were recorded and upon completion of the experiments, all responses were analyzed collectively to understand what actions participants generally considered intuitive and natural. Only results relevant to the scenarios described in the previous section are discussed in this section.

**Answering a Call:** All participants intuitively slide open the slider phone, flipped up the switchblade phone and opened up the clamshell phone to answer a call. They also mentioned pressing a button on the screen as a way of answering a call — the common interaction found in most touch screen mobile phones today.

When presented with the block phone, users were at a loss with how to interact with it. They did not see the possibility of using changes in spatial relationship between user and device to cue interaction.

**Silencing a Call:** To accomplish this task, participants suggested a number



**Figure 4.10**

User Testing



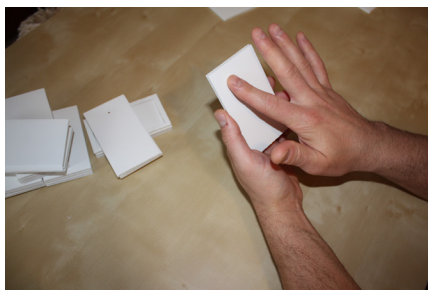
of different gestures. Eight participants chose to silence a call by turning over the phone. Five participants used a voice command such as “shh.” In terms of gestures, four participants used a finger wave as if to imply “naughty” and one participant used a two-finger sliding motion (as if to close someone’s eyelids) as another option. Two participants asked aloud if they could glare angrily at the phone to silence it.

**Do Not Disturb:** When presented with this task, the eight participants who previously suggested the action of turning over a phone to silence a call retracted their answer. They saw the action of turning over a phone as a more appropriate to this task. Six participants suggested covering up the phone with one’s hands. One participant used the prototype that allowed one to separate the phone into two parts by pulling. This participant reasoned that by physically separating the phone into two parts, one is physically disabling the phone.

**Camera Mode:** All users defaulted to using a button on the screen or on the phone itself to enter camera mode. Two participants used the switchblade as a possible interaction — that by flipping out a second plate, the lens is revealed. The same two participants also used the slider to slide out the camera lens and enter camera mode. One participant used the divets mock-up and reasoned that the positioning of one’s fingers can signal the intent to use the mobile phone as a camera.

**Zoom:** Every participant used some sort of dial or button to zoom in and out.

**Snap Picture:** Every participant used a physical button to snap a picture instead of the touchscreen-based buttons that are becoming increasingly common in smartphones today. Three participants used voice commands such as “1..2..3..”, “cheese”, “click.” One participant remarked that “by using a voice command, I don’t have to disrupt the stabil-



**Figure 4.10 (cont’d)**

User Testing

ity I need to take a clear picture.” Contrary to this opinion, two participants used finger pressure to take a picture.

**Delete Picture:** The responses here were evenly split between using a physical gesture with the phone and using a screen-based gesture. Five participants used a shaking motion, as if the phone was an etch-n-sketch toy, to delete the picture. Four participants gestured a ‘X’ on the screen to delete the picture while two participants used a downward swipe gesture to “swipe the picture off the table so to speak.”

**Weather Aware:** All participants resorted to an icon on the screen to indicate weather. experiences.

**Power Aware:** Seven participants recommended using an analog LED display where the amount lit up reflects how much battery is left. Two participants suggested using sound cues to signal when the battery power is low. Three participants remarked specifically the difficulty in finding an indicator that, in the process of signaling, did not contribute to draining more power.

## Analysis of Research Results

Generally, in asking the participants to generate new ways of accomplishing common mobile phone –related tasks, most participants referred back to experiences and interactions that 1) they were familiar with but 2) still considered better than screen-based menus and buttons. In the process of thinking aloud and improvising with the prototypes though, many of the participants started to invent more unconventional methods. Primarily, participants devised gestures as a more natural way of accomplishing the task.

Reflecting on the choices of the participants, it is clear that the choice of actions were constrained by the affordances of the mock-ups. Very few of the interaction concepts I came up with appeared in the responses of the participants. One reason could be the lack of interactivity of the foam-core prototypes. Without this autonomous feedback, participants could not figure out that a mobile device could be sensitive to our implicit, natural movements. Another reason could be our acceptance and expectation that devices are inherently ‘dumb’ in interaction and need to be told what to do. However, participants did agree that such implicit understanding would lead to more natural interactions and unobstructed user

## 5 Digital & Experience Prototyping

In this chapter, I discuss the prototype scenarios and present the digital prototype implementation and experience prototype (video sketch) for the four mobile phone scenarios described in Chapter 4. The digital prototype is a proof-of-concept of the interaction concept demonstrating its technical feasibility. Furthermore, as explained in the above analysis of research results, an interactive prototype will allow for a better evaluation of the concepts.

### PROTOTYPE SCENARIOS

In the following subsections, the interaction concept for the scenarios will be described. Note that the alarm clock function was not prototyped.

## Scenario 1

### *Receiving & Responding to Calls*

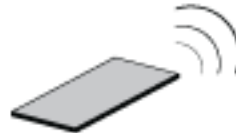
In this scenario, two interaction flows were prototyped: answering a call, and rejecting a call. See **Figure 5.1**.

Through an awareness of the physical environment, the device communicates the incoming call in a manner that is contextually appropriate (for example, in a restaurant setting where the ambience is generally quiet, the mobile phone lows or vibrates gently in mimicry). In picking up the phone, the user implicitly acknowledges the call. Sensing this regulative action, the mobile device silences the incoming call alert. Then, by exploiting the communicative function of changes in spatial relationships and gestures, the mobile phone can collaborate more responsively with the user to realize the task of answering or ignoring the call. Specifically, in bringing the phone towards one's ears or mouth, the decreasing distance between the user and device signals an intention to answer the call. Conversely, by putting the phone down or covering the phone up, the user is implicitly ignoring the call.

#### Answering a Call



Call incoming...



Device rings.



Touch sensors sense the user picking up the phone and silence the ring.



Proximity sensors detect the user bringing in the phone.

#### Rejecting a Call



Photoresistors detect the user covering up the device and silence the ring.

**Figure 5.1**

Prototype Scenario 1

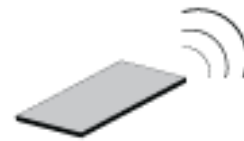
## Scenario 2

### *Alarm Clock Function*

In this scenario, the force of the users response is detected. See **Figure 5.2**. This scenario was not implemented.

The user action in this scenario is both an objective and an expressive one. While silencing the alarm is the objective, the manner in which it is enacted give hints to the intentions and emotions of the user. In the Viewpoints vocabulary, tempo and duration of response are attributes that distinguish different ways of silencing the alarm; in the language of Laban Movement Analysis, the action can be characterized by time, space, weight, and flow. A wave gesture is very different than a slam, which is very different than a button press. The differences are manifested in the physicality of the action but point to the psychology of the user. A wave may suggest the user is calm and ready to rise, while a slam of the hand may suggests a tired, grouchy user who could really use more sleep. The mobile phone alarm can then adjust its behavior based on the inferred psychological state of the user and informational awareness (of user's appointments for example).

### Responding to Alarm



Alarm rings.



Pressure sensors detect the force of the user action.

**Figure 5.2**

Prototype Scenario 2

### Scenario 3

#### Camera Function

In this scenario, the transition to camera mode and the zoom functionality are demonstrated. See **Figure 5.3**.

By recognizing the pose/orientation and gesture of the user action, the mobile device can collaborate responsively in a synchronized manner with the user to realize the activity of taking a picture. In so doing, the user is kept engaged and focused on the actual activity instead of trying to operate the mobile phone camera.

#### Camera Mode



Touch sensors detect finger positioning.



Proximity sensors detect device motion away from or towards the user.

**Figure 5.3**

Prototype Scenario 3

#### Scenario 4

##### *Device Power Level Indicator*

In this scenario, a LED indicator (representing power level) is activated by touch. See **Figure 5.4**.

In today's mobile devices, a user has to unlock the screen to access the power indicator icon on the home screen. Such explicit interaction is poor product communication. Instead, this power indicator automatically reveals itself when it reaches a low power state. This implicit signaling improves product communication by being nonintrusive and keeping users constantly informed through peripheral awareness. If a user wants to check the power status, a simple touch gesture on the location of the batter reveals its state.

#### LED Power Indicator



**Figure 5.4**

Prototype Scenario 4

## DIGITAL PROTOTYPE

The prototype was built using the Arduino microcontroller and an array of sensors, which include:

- IR proximity sensor
- capacitive touch sensors (4)
- accelerometer
- photoresistor
- pressure sensor

As device feedback of user activity is visual, parts of a user interface (those relevant to the scenarios) were built out. This user interface was implemented in Flash. USB-to-serial communication was employed between the hardware prototype and software user interface. **Figure 5.5** shows the system diagram for the prototype.

The interaction concepts presented could be implemented in any number of ways using different sensing technologies. As a proof-of-concept though, the exact implementation is of lesser importance. Rather, the goal is to demonstrate the technical feasibility of such ideas and communicate its experience through an interactive prototype.

## THEORY OF OPERATION

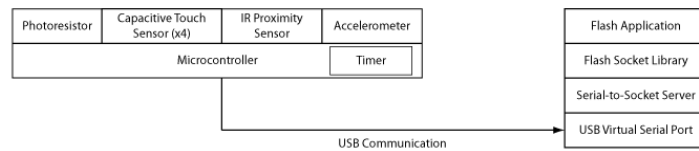
The following diagrams capture the different states as well as the transitions and associated triggers.

### Home Screen

This diagram describes the transitions from the main screen. The Device Power Level Indicator scenario is included in this diagram. See **Figure 5.6**.

### Receiving & Responding to Calls

This diagram describes the transitions involved in receiving and responding to calls. See **Figure 5.7**.



### Camera Function

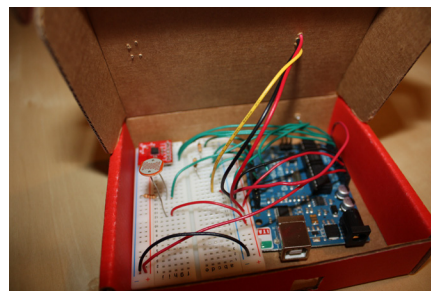
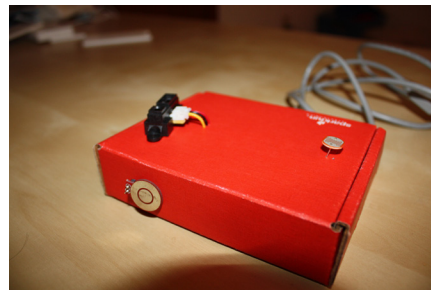
This diagram describes the transitions involved in operating the mobile phone in camera mode. See **Figure 5.8**.

**Figure 5.5**

Prototype System Diagram

## EXPERIENCE PROTOTYPE

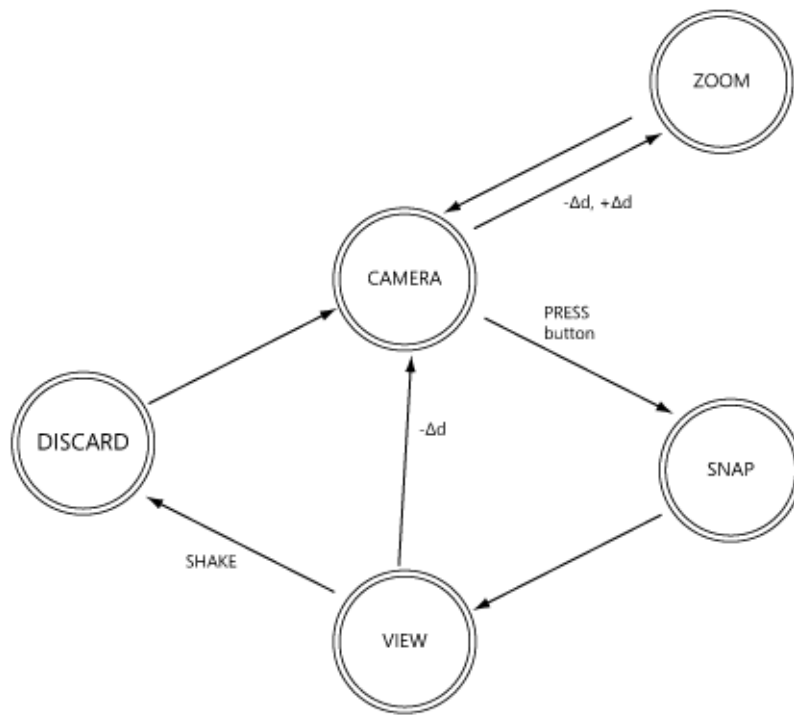
A video sketch was created to communicate the experience of these new interaction concepts in the context of a day-in-the-life. See accompanying DVD.



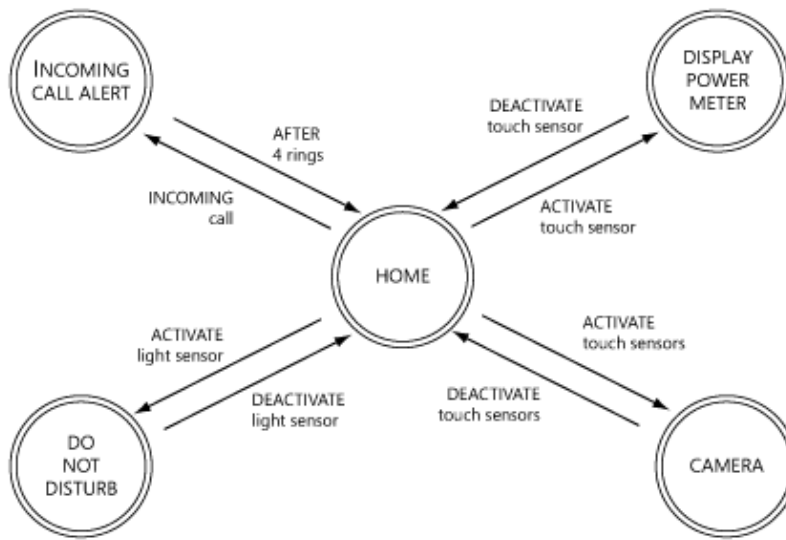
**Figure 5.6**

Digital Prototype



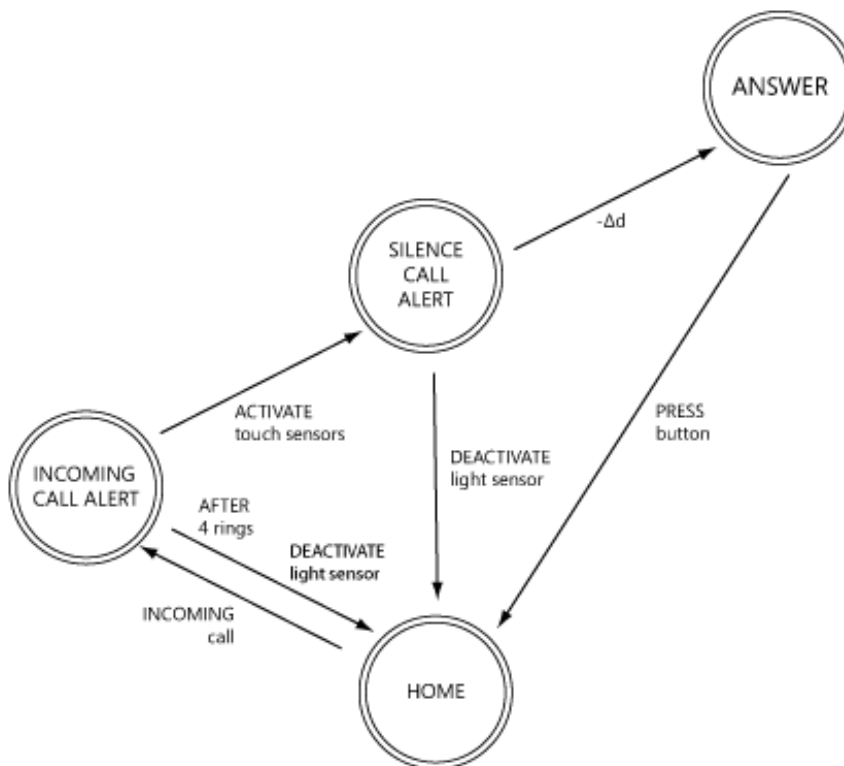
**Figure 5.8**

User Interaction &  
Transitions for Camera  
Functionality



**Figure 5.6**

User Interactions & Transitions from Home Screen.



**Figure 5.7**

User Interaction & Transitions for Responding to a Call

## 6 Reflections & Future Work

So what is the end result of this thesis exploration? In this chapter, I present a future scenario describing what life might be like with user-product interactions that are designed with a focus on enabling and maintaining ‘presence.’ I revisit the function-action-context relationship and the framework of presence in the context of the interaction concepts developed and this future scenario, showing its applicability in understanding and generating natural user-product interactions. Finally, I will point to future directions in this exploration.

### FUTURE SCENARIO

It’s 7:00am and Josh’s alarm goes off as programmed. He isn’t looking forward to the day though as he was out late last night celebrating his buddy’s birthday. He reaches over and slams down on his mobile phone. Synced up to his calendar, his phone is aware that Josh’s 9am meeting was canceled. So, sensing his reluctance, his phone adjusts its snooze interval to give him a little more sleep. At 7:45am, the alarm goes off again. Though Josh would like to sleep some more, the extra time definitely helped make the day a little more tolerable. Grabbing his mobile phone on the way out the door, Josh notices a red indicator on his phone. The battery is just about dead again so Josh reaches for his charger as well.

On the drive to work, the GPS on his mobile phone recognizes he is taking his usual route. But this morning, SR-520 has slowed to a crawl due to a broken-down car. The phone alerts Josh and suggests an alternate route. He definitely didn’t want to be stuck in that mess; it would have added an extra 45 minutes to his commute.

Josh has been looking forward to his lunch date with Sarah all week. It took him 3 weeks to finally summon the courage to ask her out. As they are having lunch, though, the phone receives an incoming call. Sensing that they are in a rather quiet setting, the phone glows dimly. Josh notices and apologizes for the interruption. Upon picking up the phone, the phone stops glowing. Seeing that it is only his mom calling, Josh sets the phone back face down.

With spring comes the cherry blossoms and on his walk home from work, Josh catches sight of the first ones to bloom. He takes out his mobile phone with its 5 megapixel camera to snap a few pictures for his mom. After all, he ignored her call earlier. Placing his fingers on the four corners of the phone automatically transitions the phone into camera mode. He adjusts the zoom level by moving the phone towards and away from him. Finally, he presses a button on the top of the phone to snap the picture.

Later on in the day, as Josh is about to leave work, he sees his phone has water all over it. Not real water, just a visualization layer to indicate the current weather conditions. He reaches for an umbrella on the way out the door.

## TO BE OR NOT TO BE...

'Presence' allows for meaningful engagement in the activities we partake in and with the people involved. In our increasingly technology-mediated existence, we often find ourselves lost in the product rather than lost in the experience. We spend more time tending to and taming technology than living life. User-product interactions need to be made more natural — one that is clear, implicit, effortless and part of a dialogue.

Action is the basis of how we come to experience the world and find it meaningful. We do, emote, communicate and regulate naturally through our bodies. It is through our actions and movements that we navigate the physical and social landscapes of the world. Accordingly, to arrive at 'present' experiences, the design of interactions should focus on the actions themselves, as opposed to the outcome of those actions.

In designing user-product interactions, action must be synonymous with function, and appropriate within the

context. When the action, function and context are addressed, the form emerges as a natural consequence. This ensures the actions and interactions are natural, resulting in 'presence.' When the focus centers on designing form to communicate action, the action, though apparent, may not be natural.

But how?

Laban Movement Analysis and Viewpoints, distilled into the Design Variables, provide a language for thinking about and exploring movement. The Framework of Presence I invented breaks down the notion of 'presence' into the four themes of interactions, communication, awareness and collaboration. For a truly 'present' experience, one in which the user and product are harmonized in activity, all four must be considered when designing user-product interactions. Their roots in acting theory are directly traceable: interactions speak to the theme of psycho-physical unity; communication and collaboration speak to the theme of mutual awareness and collaboration; awareness addresses the theme of context. Together, the framework and the design variables give the designer concrete tools design around action to arrive at natural interactions and hence, a 'present' experience.

The interaction concepts around the mobile phone were considered using the Framework of Presence and generated through a methodical exploration using the Design Variables. Comparing the interaction concepts generated with our current way of accomplishing the same task, one can clearly note a distinct change in the user-product interaction. In the interaction concepts, there is now an implicit, effortless coordination between the user and the product.

Applying the framework and design variables further, I present the future scenario above — one in which the product, through its behavior, allows the user

to remain present in the here and now and transition seamlessly between the different activities and contexts.

## FUTURE WORK

This thesis brought together ideas from drama, nonverbal communication, and phenomenology to inform the development of a framework of ‘presence.’ With this framework, designers have a practical tool to approach the design of user-product interactions with action as its central focus. By starting with action, the interactions are made more natural and intuitive, resulting in more ‘present’ experiences. In the design exemplar, a subset of mobile phone interactions was redesigned with this framework. The resulting interaction concepts demonstrated an improved fluidity in user-product interactions.

Moving forward, the next step would be to continue to develop this framework through application of the framework to different design exemplars. Interactive prototypes would also need to be built to allow for more comprehensive user research as the use of foam-core prototypes require user imagination of product responses. Finally, this problem of designing for ‘presence’ was approached with the goal of making products socially smarter through a heightened awareness of user behavior. The next step is to look to research in artificial intelligence, robotics and biological systems to further understand how human and machines could engage in what J.R. Licklider termed, a “symbiotic relationship.”

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## Appendix

**APPLICATION FOR IRB REVIEW OF RESEARCH INVOLVING HUMAN SUBJECTS**

(Not for exempt research)

Please complete this application as thoroughly as possible. Your application should include the following:

1. A consent form using the current CMU template that the participants and/or parent/guardian will be required to sign.
2. A copy of any questionnaires, surveys, images, de-briefings that will be used.
3. A copy of any recruitment documents (including advertisements, flyers, letters, invitations, email) to be used;
4. A copy of the training certificates for all individuals working on the research unless they are on file with the CMU IRB. Training is available at: <http://www.citiprogram.org>. See the [IRB website](#) for details.
5. If the PI is a student, the faculty advisor must submit a Faculty Advisor Assurance Form.

Please email all documents to [irb-review@andrew.cmu.edu](mailto:irb-review@andrew.cmu.edu). For assistance call CMU Research Compliance @ 412-268-5460 or email [irb-review@andrew.cmu.edu](mailto:irb-review@andrew.cmu.edu). Additional information and templates are available at <http://www.cmu.edu/osp/regulatory-compliance/human-subjects.html>

|   |  |  |
|---|--|--|
| <b>1. Protocol</b>  |  |  |
| Title: Designing for Presence: How can human-device interactions be made more natural?                                  |  |  |
| <input type="checkbox"/> This is a previously approved study that has lapsed.   | Previous IRB No: HS11-154  |  |
| <b>2. Principal Investigator (PI)</b>   |  |  |
| Name: Bryan Cheung  |  | Department: Design   |
| Telephone: 206.484.2470   | E-mail: <a href="mailto:bccheung@andrew.cmu.edu">bccheung@andrew.cmu.edu</a> | Training Cert. <input type="checkbox"/> Attached <input checked="" type="checkbox"/> On File |
| <input checked="" type="checkbox"/> I am a student. If so, please provide information about your faculty advisor below. |  |  |
| Faculty Advisor Name: Mark Baskinger  | E-mail: <a href="mailto:baskinger@cmu.edu">baskinger@cmu.edu</a>             | Training Cert. <input type="checkbox"/> Attached <input checked="" type="checkbox"/> On File |
| <i>If a student is the PI, the faculty advisor must complete and submit a Faculty Advisor Assurance Form.</i>           |  |  |
| If there is someone other than PI to correspond with regarding this protocol, please list below.                        |  |  |
| Contact Person Name:  | Telephone:   | E-mail:  |
| Business Manager for your department:   |  | E-mail:  |
| <b>3. Co-investigators</b>  |  |  |
| Name:   | E-mail:  | Training Cert. <input type="checkbox"/> Attached <input type="checkbox"/> On File            |
| Name:   | E-mail:  | Training Cert. <input type="checkbox"/> Attached <input type="checkbox"/> On File            |
| Name:   | E-mail:  | Training Cert. <input type="checkbox"/> Attached <input type="checkbox"/> On File            |
| Name:   | E-mail:  | Training Cert. <input type="checkbox"/> Attached <input type="checkbox"/> On File            |
| Name:   | E-mail:  | Training Cert. <input type="checkbox"/> Attached <input type="checkbox"/> On File            |
| Name:   | E-mail:  | Training Cert. <input type="checkbox"/> Attached <input type="checkbox"/> On File            |
| Name:   | E-mail:  | Training Cert. <input type="checkbox"/> Attached <input type="checkbox"/> On File            |
| <b>4. Funding</b>   |  |  |
| <input checked="" type="checkbox"/> Unfunded research   |  | Sponsor/Source:  |
| <input type="checkbox"/> External Funding   |  | SPEX Proposal #:   |
| <input type="checkbox"/> Internal Funding   |  | Oracle String:   |
| Grant Title:  |  |  |
| <i>If you don't know the funding/grant information, please get it from your department's business manager.</i>          |  |  |

**5. Protocol Description**

Provide, in lay terms, a summary of your proposed study as outlined below. You may attach the protocol to this form if you like.

**Purpose of the study.**

The purpose of this study is 1) to understand implicit human-human interactions, 2) to apply this understanding to the design of novel human-device interactions, and 3) to demonstrate these human-device interactions in a design exemplar.

By implicit human-human interactions, we are interested primarily in how people communicate through non-verbal means including space, time, physical cues and movement.

Concerning human-device interactions, tangible and gestural interactions will be the primary focus. The goal is to make technology become a natural extension of our activities and environments.

To demonstrate some of the novel human-device interactions, the design exemplar to be explored is a mobile device.

Describe the research procedures (include the activity, location and time required of the participant).

For the first research activity, recruited participants (via email) will be asked to engage in a generative modeling activity on campus. Participants will first be given a number of paper prototypes that mock up the physical characteristics of a mobile phone and asked to play with them to discover the possible interactions. With the consent of the participant, photographs of their interactions with the prototypes will be taken. Participants will then be asked what task/interaction each prototype is demonstrating (for example: answering a call, sending a text message, etc.). Finally, participants will be given a task/interaction and asked which prototype(s) could be used for the task/interaction. The activity should take 30 minutes to complete.

For the second research activity, a digital prototype of a mobile phone that includes some of the concepts generated from the first activity will be built. Recruited participants (via email) will be asked to complete a number of tasks using this prototype. With the consent of the participant, photographs of their interactions as they complete the tasks will be taken. Their general feedback and comments about the perceived intuitiveness of the prototype will be solicited immediately after the tasks. The activity should take 30 minutes to complete

Who will be asked to participate? Adults 18 years and older

Will questionnaires or surveys be used? ☐ Yes ☒ No

Will tasks be done on a computer? ☐ Yes ☒ No If yes, how will the tasks be accessed? ☐ Remotely via the internet? ☐ In the research lab? ☐ Other, please explain:

Will deception be used? ☐ Yes ☒ No If yes, describe how participants will be debriefed. Please include the debriefing material and/or script.

Will the research be conducted on the CMU campus? ☒ Yes ☐ No If no, please indicate the location(s).

*If applicable, please attach documentation of permission to conduct research in private, non-CMU space.*

**6. Participants**

Will any of the following classes of vulnerable subjects be involved in the proposed study? (check all that apply)

| Class   | Comments |
|---|----------|
| Pregnant women, human fetuses <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Pregnant women will not be specifically included or excluded. (See |          |

|   |   |                                    |
|---|---|------------------------------------|
| <a href="http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.htm">http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.htm</a> , research that is incidental to pregnancy and has no risk to the fetus can only include pregnant women if ALL aspects of Subpart B are met.)   |   |                                    |
| Neonates <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  |   |                                    |
| Prisoners <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No   |   |                                    |
| Children <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  |   |                                    |
| Individuals with compromised mental status <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, indicate how this will be determined.  |   |                                    |
| Will the participants be capable of understanding the nature of the study and the consent process? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No<br>If no, explain.   |   |                                    |
| What is the age range of participants in the proposed study? 18+  |   |                                    |
| How many participants are needed for the study? 10 - 20   | How was that number determined? 5 - 10 participants per study are needed to generate and validate design concepts |                                    |
| What do you estimate the ratio of males to females be? 1:1 Will this be reflective of the local population? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No<br>Will you target a certain population? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Please explain   |   |                                    |
| What do you estimate the percentage of minorities will be? The percentage of minorities at CMU  |   |                                    |
| Please list inclusion and exclusion criteria.<br>Inclusion Criteria: over 18; speak english; possess the physical dexterity to manipulate cellphone-size foamcore models; able to comment on viability of design features.<br>Exclusion Criteria: those not meeting the above criteria will not be considered.  |   |                                    |
| <b>7. Participant Recruitment</b>   |   |                                    |
| Describe how participant recruitment will be performed. Include how and by whom potential participants are introduced to the study. Participants will be recruited via email.   |   |                                    |
| Check all boxes below that apply.   |   |                                    |
| <input type="checkbox"/> CMU directory  | <input type="checkbox"/> Postings, Flyers   | <input type="checkbox"/> Radio, TV |
| <input checked="" type="checkbox"/> E-mail solicitation Indicate how the email addresses are obtained: There are mailing lists that students use to reach each other for the purpose of soliciting opinions and sharing information that I am already on.   |   |                                    |
| <input checked="" type="checkbox"/> Web-based solicitation. Specify sites: Facebook, Twitter  |   |                                    |
| <input type="checkbox"/> Participant Pool. Specify what pool:   |   |                                    |
| <input type="checkbox"/> Other, please specify:   |   |                                    |
| Please attach any recruiting materials you plan to use and the text of e-mail or web-based solicitations you will use.  |   |                                    |
| <b>8. Consent</b>   |   |                                    |
| Do you plan to use consent forms? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No<br>If no, you must complete the section below on waiver of informed consent.<br>If yes, describe how consent will be obtained and by whom.  |   |                                    |
| If participants are minors will assent forms be used? <input type="checkbox"/> Yes <input type="checkbox"/> No If No, please explain.   |   |                                    |
| Will the consent form be presented on paper or online? <input checked="" type="checkbox"/> Paper <input type="checkbox"/> Online  |   |                                    |
| Are you requesting to use a consent format that is different from the CMU model consent? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No<br>If yes, please explain.   |   |                                    |
| Are you requesting a waiver of informed consent? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No<br>If yes, please explain how each of the elements listed apply to your study:<br>1. The research involves no more than minimal risk to the subjects;<br>2. The waiver will not adversely affect the rights and welfare of the subjects; |   |                                    |

3. The research could not practicably be carried out without the waiver and ;

4. Whenever appropriate, the subjects will be provided with additional pertinent information after participation.

Are you requesting a waiver of written documentation (signed) of informed consent? ☐ Yes ☒ No

If yes, please answer the following questions.

1. Will the only record linking the participant and the research be the consent document and the principal risk to the participant harm would be from breach of confidentiality? ☐ Yes ☐ No

2. Do you consider this a minimal risk study that involves no procedures for which written consent is normally required outside of research? ☐ Yes ☐ No

### 9. Risks and Benefits

Will participants receive intangible benefit from the study? ☐ Yes ☒ No

Discuss the direct and indirect benefits to participants. There may be no personal benefit to users from their participation in the study but the knowledge received may be of value to humanity.

Discuss the risks to participants. There are no anticipated or known physical, psychological, or emotional risks in participating in this study.

Discuss how any risks will be managed and/or minimized. n/a

If deception is involved, please explain. n/a

Indicate the degree of physical or psychological risk you believe the research poses to human subjects (*check which one applies*).

☒ Minimal Risk: A risk is minimal where the probability and magnitude of harm or discomfort anticipated in the proposed research are not greater, in and of themselves, than those ordinarily encountered in daily life of during the performance o routine physical or psychological examinations or tests.

☐ Greater than Minimal Risk: A risk is greater than minimal where the probability and magnitude of harm or discomfort anticipated in the proposed research are greater than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.

Describe how the study fits in this risk level.

### 10. Participant Compensation and Costs

Are participants to be compensated for the study? ☐ Yes ☒ No If yes, what is the amount, type and source of funds?

|         |         |                         |
|---------|---------|-------------------------|
| Amount: | Source: | Type (gift card, cash): |
|---------|---------|-------------------------|

Will participants who are students be offered class credit? ☐ Yes ☒ No

Are other inducements planned to recruit participants? ☐ Yes ☒ No If yes, please describe.

Are there any costs to participants? ☐ Yes ☒ No If yes, please explain.

Will you compensate participants for injury resulting from participation? ☐ Yes ☐ No ☒ NA If yes, please describe.

### 11. Confidentiality and Data Security

Will personal identifiers be collected? ☒ Yes ☐ No Will identifiers be translated to a code? ☒ Yes ☐ No

Will recordings be made (audio, video)? ☒ Yes ☐ No If yes, please describe. Photographs may be recorded with the participant's consent. Faces will not be recorded, but arms and hands may appear in captured images.

Is the information so sensitive that you will obtain a certificate of confidentiality from NIH? ☐ Yes ☒ No

Who will have access to data (surveys, questionnaires, recordings, interview records, etc.)? Only the study researchers

Describe how you will protect participant confidentiality and secure research records (Will they be stored on a secure computer, locked cabinet, etc?). Paper consent forms will be stored in a locked location on the Carnegie Mellon

|                    |
|--------------------|
| For IRB Office Use |
| IRB No: _____      |
| Rec'd: _____       |

|   |
|---|
| University campus and will not be disclosed to third parties. Photographs and data files will be stored in a secured location accessed only by authorized researchers, and those in digital form will be password protected.  |
| Describe your process for monitoring data to ensure that study goals are met. (Review of lab notebooks, meetings to review data, etc.) The principal investigator will meet weekly with the faculty advisor during the study.   |
| <b>12. Conflict of Interest</b>   |
| Do you or any individual who is associated with or responsible for the design, the conduct of or the reporting of this research have an economic or financial interest in, or act as an officer or director for any outside entity whose interests could reasonably appear to be affected by this research project: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No<br>If yes, please provide detailed information to permit the IRB to determine if such involvement should be disclosed to potential research subjects. |
| <b>13. Cooperating Institutions</b>   |
| Is this research being done in cooperation with any institutions, individuals or organizations not affiliated with CMU?<br><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, please list and describe their role.   |
| Have you received IRB approval from another IRB for this study? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Pending<br>If yes, please attach a copy of the IRB approval.   |
| If applicable, please provide the name(s) and address(es) of all officials authorizing to access human subjects in cooperating institutions not affiliated with CMU.<br><br><i>Please attach documentation of approval.</i>   |

|  |
|--|
| <b>Principal Investigator's Assurance Statement for Using Human Subjects in Research</b> |
|--|

I certify that the information provided in this IRB application is complete and accurate.

I understand that as Principal Investigator, I have ultimate responsibility for the conduct of IRB approved studies, the ethical performance of protocols, the protection of the rights and welfare of human participants, and strict adherence to the studies protocol and any stipulations imposed by Carnegie Mellon University Institutional Review Board.

I understand that it is my responsibility to ensure that the human participants' involvement as described in the funding proposal(s) is consistent in principle, to that contained in the IRB application. I will submit modifications and/or changes to the IRB as necessary.

I agree to comply with all Carnegie Mellon University policies and procedures, as well as with all applicable federal, state, and local laws, regarding the protection of human participants in research, including, but not limited to:

- Ensuring all investigators and key study personnel have completed human subjects training program;
- Ensuring protocols are conducted by qualified personnel following the approved IRB application;
- Implementing no changes in approved IRB applications or informed consent documents without prior IRB approval in accordance with CMU IRB policy (except in an emergency, if necessary to safeguard the well-being of a human participant, and will report to the IRB within 1 day of such change);
- Obtaining the legally effective informed consent from human participants or their representative, using only the currently approved date-stamped informed consent documents, and providing a copy to the participant.
- Ensuring that only IRB-approved investigators for this study obtain informed consent from potential subjects.
- Informing participants of any relevant new information regarding their participation in the research that becomes available.
- Promptly reporting to the IRB any new information involving risks to research participants, including reporting to the IRB, Data Safety and Monitoring Boards, sponsors and appropriate federal agencies any adverse experiences and all unanticipated problems involving risks to human subjects or others that occur in the course of the research.

## Carnegie Mellon University

For IRB Office Use

IRB No: \_\_\_\_\_

Rec'd: \_\_\_\_\_

- If unavailable to conduct research personally, as when on sabbatical leave or vacation, arrangements for another investigator to assume direct responsibility for studies will be made through modification requests to the IRB;
- Promptly providing the IRB with any information requested relative to protocols;
- Promptly and completely complying with IRB decisions to suspend or withdraw approval for projects;
- Obtaining Continuing Review approval prior to the date the approval for a study expires (approval for the study will automatically expire);
- Maintaining accurate and complete research records, including, but not limited to, all informed consent documents for 3 years from the date of study completion;
- Informing the CMU IRB of all locations in which human participants will be recruited for protocols and being responsible for obtaining and maintaining current IRB approvals/letters of cooperation when applicable;
- Complying with federal, state and local laws and regulations and sponsor terms and conditions; and
- Complying with CMU policies on the responsible conduct of research.

Bryan Cheung

March 8, 2011\_\_\_\_\_

Principal Investigator Name and Signature

Date

*Note: If e-mailed from the PI's CMU e-mail account a hand written signature is not needed. Please type in name and date. If the PI is a student, the faculty advisor must submit a Faculty Advisor Assurance Form.*

**Please email all documents to [irb-review@andrew.cmu.edu](mailto:irb-review@andrew.cmu.edu).**

Note: Links to the policies and Federal regulations for the protection of human research subjects (including the Code of Federal Regulations [CFR] Title 45 CFR Part 46 and Title 21 C.F.R. parts 50 and 56) are available on the IRB web page (<http://www.cmu.edu/provost/spon-res/compliance/hs.htm>).

Comments:

# Carnegie Mellon University

## Institutional Review Board

Federalwide Assurance No: FWA00004206

IRB Registration No: IRB00000603

## Research Regulatory Compliance

Warner Hall, Fourth Floor

Pittsburgh PA 15213

412-268-1901

[irb-review@andrew.cmu.edu](mailto:irb-review@andrew.cmu.edu)

### Certification of IRB Approval

**IRB Protocol Number:** HS11-154  
**Title:** Designing for Presence: How can Human-device Interactions be made more Natural?  
**Investigator(s):** Brian Cheung, Mark Baskinger  
**Department(s):** Design  
**Date:** **March 30, 2011**

Carnegie Mellon University Institutional Review Board (IRB) reviewed the above referenced research protocol in accordance with the requirements of Public Law 99-158 as implemented by 45 CFR 46 and CMU's Federalwide Assurance. The research protocol has been given **APPROVAL by Expedited Review on March 30, 2011 as authorized by 45 CFR 46.110 (7) and 21 CFR 56.110. This APPROVAL expires on March 29, 2012** unless suspended or terminated earlier by action of the IRB.

All untoward or adverse events occurring in the course of the protocol must be reported to the IRB within three (3) working days. Any additional modifications to this research protocol or advertising materials pertaining to the study must be submitted for review and granted IRB approval prior to implementation. Please refer to the above-referenced protocol number in all correspondence.

Federal regulations require that all records relating to this research protocol be maintained for **at least three (3) years after completion** of the research, and be accessible for inspection and copying by authorized representatives at reasonable times and in a reasonable manner.

The Investigator(s) listed above in conducting this protocol agree(s) to follow the recommendations of the IRB and the Office of the Provost of any conditions to or changes in procedure subsequent to this review. In undertaking the execution of the protocol, the investigator(s) further agree(s) to abide by all CMU research policies including, but not limited to the policies on responsible conduct research and conflict of interest.

The IRB maintains ongoing review of all projects involving humans or human materials, and at continuing intervals, projects will require update until completion. At the end of the current approval, a progress report and current consent form must be submitted to the IRB summarizing progress on the protocol during that period. Please be advised that the progress report requests information pertaining to women and minorities; therefore, this information should be tracked with your participants' data.

Please call the Research Regulatory Compliance Office at 412-268-1901 if you have any questions regarding this certification. Thank you.



David Danks, Ph.D., Chair, IRB



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## Consent Form for Participation in Research

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**Study Title:** Designing for Presence: Generative Modeling Activity

**Principal Investigator:**

Bryan Cheung  
School of Design, MMC 110  
Carnegie Mellon University, Pittsburgh PA 15213  
phone: 206.484.2470  
bccheung@cmu.edu

**Faculty Advisor:** Mark Baskinger, Associate Professor

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**Purpose of this Study**

The purpose of this study is twofold: 1) to understand people's intuitive way of interacting with devices, and in particular, a mobile phone, and 2) to generate novel interactions with a mobile phone.

**Procedures**

If you agree to be in this study, you will be asked to

- play with paper prototypes that mock up mobile device interactions
- name/describe the task/interaction the prototype is demonstrating
- match a list of tasks/interactions to a particular prototype

The activity will take about 30 minutes to complete and be conducted on the Carnegie Mellon University campus. With your permission, I would also like to take photographs throughout the activity.

**Participant Requirements**

Participation in this study is limited to individuals of ages 18 and older.

**Risks**

There are no anticipated or known physical, psychological, or emotional risks in participating in this study.

**Benefits**

There may be no personal benefit from your participation in the study but the knowledge received may be of value to humanity.

**Compensation & Costs**

There will be no compensation or cost to you if you participate in this study.

## Consent Form for Participation in Research

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### Confidentiality

By participating in the study, you understand and agree that Carnegie Mellon may be required to disclose your consent form, data and other personally identifiable information as required by law, regulation, subpoena or court order. Otherwise, your confidentiality will be maintained in the following manner:

Your data and consent form will be kept separate. Your consent form will be stored in a locked location on Carnegie Mellon property and will not be disclosed to third parties. By participating, you understand and agree that the data and information gathered during this study may be used by Carnegie Mellon and published and/or disclosed by Carnegie Mellon to others outside of Carnegie Mellon. However, your name, address, contact information and other direct personal identifiers in your consent form will not be mentioned in any such publication or dissemination of the research data and/or results by Carnegie Mellon.

The researchers will take the following steps to protect participants' identities during this study: (1) Each participant will be assigned a number; (2) The researchers will record any data collected during the study by number, not by name; (3) Any original recordings or data files will be stored in a secured location accessed only by authorized researchers.; (4) Any video and/or audio recordings and photographs will not reveal the names or faces of participants.

### Optional Permission

I understand that the researchers may want to use photographs of the activity and/or a short portion of any video or audio recording for illustrative reasons in presentations of this work for scientific or educational purposes. I give my permission to do so provided that my name and face will not appear.

☐ YES   ☐ NO   (Please initial here \_\_\_\_\_)

### Rights

Your participation is voluntary. You are free to stop your participation at any point. Refusal to participate or withdrawal of your consent or discontinued participation in the study will not result in any penalty or loss of benefits or rights to which you might otherwise be entitled. The Principal Investigator may at his/her discretion remove you from the study for any of a number of reasons. In such an event, you will not suffer any penalty or loss of benefits or rights which you might otherwise be entitled.

## Consent Form for Participation in Research

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### Right to Ask Questions & Contact Information

If you have any questions about this study, you should feel free to ask them now. If you have questions later, desire additional information, or wish to withdraw your participation please contact the Principal Investigator by mail, phone or e-mail in accordance with the contact information listed on the first page of this consent.

If you have questions pertaining to your rights as a research participant; or to report objections to this study, you should contact the Research Regulatory Compliance Office at Carnegie Mellon University. Email: [irb-review@andrew.cmu.edu](mailto:irb-review@andrew.cmu.edu) . Phone: 412-268-1901 or 412-268-5460.

### Voluntary Consent

By signing below, you agree that the above information has been explained to you and all your current questions have been answered. You understand that you may ask questions about any aspect of this research study during the course of the study and in the future. By signing this form, you agree to participate in this research study.

---

PARTICIPANT SIGNATURE

---

DATE

I certify that I have explained the nature and purpose of this research study to the above individual and I have discussed the potential benefits and possible risks of participation in the study. Any questions the individual has about this study have been answered and any future questions will be answered as they arise.

---

SIGNATURE OF PERSON OBTAINING CONSENT

---

DATE

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## Consent Form for Participation in Research

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**Study Title:** Designing for Presence: Prototype Evaluation Activity

**Principal Investigator:**

Bryan Cheung  
School of Design, MMC 110  
Carnegie Mellon University, Pittsburgh PA 15213  
phone: 206.484.2470  
bccheung@cmu.edu

**Faculty Advisor:** Mark Baskinger, Associate Professor

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**Purpose of this Study**

The purpose of this study is to gather general feedback and comments on digital prototypes of a mobile phone with novel interactions.

**Procedures**

If you agree to be in this study, you will be asked to complete a series of mobile phone related tasks using a digital prototype with novel interactions. Afterward, you will be asked to provide your general feedback and comments about the intuitiveness and naturalness of the interactions. The activity will take about 30 minutes to complete and be conducted on Carnegie Mellon's Pittsburgh. With your permission, I would also like to take photographs throughout the activity.

**Participant Requirements**

Participation in this study is limited to individuals of ages 18 and older.

**Risks**

There are no anticipated or known physical, psychological, or emotional risks in participating in this study.

**Benefits**

There may be no personal benefit from your participation in the study but the knowledge received may be of value to humanity.

**Compensation & Costs**

There will be no compensation or cost to you if you participate in this study.

**Confidentiality**

By participating in the study, you understand and agree that Carnegie Mellon may be required to disclose your consent form, data and other personally identifiable information as required by law,

## Consent Form for Participation in Research

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regulation, subpoena or court order. Otherwise, your confidentiality will be maintained in the following manner:

Your data and consent form will be kept separate. Your consent form will be stored in a locked location on Carnegie Mellon property and will not be disclosed to third parties. By participating, you understand and agree that the data and information gathered during this study may be used by Carnegie Mellon and published and/or disclosed by Carnegie Mellon to others outside of Carnegie Mellon. However, your name, address, contact information and other direct personal identifiers in your consent form will not be mentioned in any such publication or dissemination of the research data and/or results by Carnegie Mellon.

The researchers will take the following steps to protect participants' identities during this study: (1) Each participant will be assigned a number; (2) The researchers will record any data collected during the study by number, not by name; (3) Any original recordings or data files will be stored in a secured location accessed only by authorized researchers.; (4) Any video and/or audio recordings and photographs will not reveal the names or faces of participants.

### Optional Permission

I understand that the researchers may want to use photographs of the activity and/or a short portion of any video or audio recording for illustrative reasons in presentations of this work for scientific or educational purposes. I give my permission to do so provided that my name and face will not appear.

☐ YES ☐ NO (Please initial here \_\_\_\_\_)

### Rights

Your participation is voluntary. You are free to stop your participation at any point. Refusal to participate or withdrawal of your consent or discontinued participation in the study will not result in any penalty or loss of benefits or rights to which you might otherwise be entitled. The Principal Investigator may at his/her discretion remove you from the study for any of a number of reasons. In such an event, you will not suffer any penalty or loss of benefits or rights which you might otherwise be entitled.

### Right to Ask Questions & Contact Information

If you have any questions about this study, you should feel free to ask them now. If you have questions later, desire additional information, or wish to withdraw your participation please contact the Principal Investigator by mail, phone or e-mail in accordance with the contact information listed on the first page of this consent.

If you have questions pertaining to your rights as a research participant; or to report objections to this study, you should contact the Research Regulatory Compliance Office at Carnegie Mellon University. Email: [irb-review@andrew.cmu.edu](mailto:irb-review@andrew.cmu.edu) . Phone: 412-268-1901 or 412-268-5460.

## Consent Form for Participation in Research

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### Voluntary Consent

By signing below, you agree that the above information has been explained to you and all your current questions have been answered. You understand that you may ask questions about any aspect of this research study during the course of the study and in the future. By signing this form, you agree to participate in this research study.

---

PARTICIPANT SIGNATURE

---

DATE

I certify that I have explained the nature and purpose of this research study to the above individual and I have discussed the potential benefits and possible risks of participation in the study. Any questions the individual has about this study have been answered and any future questions will be answered as they arise.

---

SIGNATURE OF PERSON OBTAINING CONSENT

---

DATE