Touching a Stranger:
Designing for Engaging Experience in Embodied Interaction

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We present Mediated Body, an exploration into designing for engaging experience in embodied interaction. Mediated Body entails a Suit worn by a Performer engaging in social play with a Participant. The Performer and the Participant each wear a pair of headphones, and when they touch each other's bare skin, they both hear a complex sound pattern. Our approach, which we call *research-through-explorative-design*, is a combination of experimental design in the lab and explorative design in the field, where qualitative assessments are used to elicit transferable knowledge contributions. This paper represents a case study of this somewhat innovative research approach in action. On the topical level, our results include three *artifact-level elements* that contribute to engaging experience: connecting touch and audio with the right balance between direct and emergent responsivity, justifying bare-skin touch between strangers, and providing open-ended action props with non-trivial internal complexity. Moreover, we suggest three *experiential qualities* as analytical tools pertaining to engaging experience in embodied interaction: the duality of performative immersion, the "magic circle" of transformative social play, and the explorative nature of emergent meaning-making.

Keywords – Embodied Interaction, Engaging Experience, Research Through Explorative Design.

Relevance to Design Practice – Interest is growing in the kind of embodied-interaction design concepts that Mediated Body represents, not only in explorative design research and digital arts but increasingly also in mainstream applications within mobile, public and location-based services as well as in the media and entertainment industries.

Introduction: Embodied Interaction as a Design Genre

Within interaction design, several forces have coincided in the last few years to fuel the emergence of a new field of inquiry, which we summarize under the label of *embodied interaction*. The term was introduced to the HCI community by Dourish (2001) as a way to combine the then-distinct perspectives of tangible interaction (Ullmer & Ishii, 2001) and social computing. Briefly, his point was that computing must be approached as twice embodied: in the physical/material sense and in the sense of social fabrics and practices. Dourish's work has been highly influential in the academic interaction design field and has to be considered a seminal contribution at the conceptual level. Still, we find that more needs to be done to create a body of contemporary design-oriented knowledge on embodied interaction.

Several recent developments within academia combine to inform and advance the emerging field of embodied interaction. For example, the field of wearable computing (see Mann, 1997, for an introduction to early and influential work), which can be considered a close cousin of tangible interaction, puts particular emphasis on physical bodiness and full-body interaction. The established discipline of human-computer interaction (HCI) has increasingly turned towards considering the whole body in interaction, often drawing on recent advances in cognitive science (e.g., Johnson, 2007) and philosophy (e.g., Shusterman, 2008). Some characteristic examples are the work of Twenebowa

Larssen et al. (2007) on conceptualization of haptic and kinaesthetic sensations in tangible interaction and Schiphorst's (2009) design work on the somaesthetics of interaction. Höök (2009) provides an interesting view of the "bodily turn" in HCI through the progression of four successive design cases. In more technical terms, the growing acceptance of the Internet of Things vision (which according to Dodson [2003] traces its origins to MIT around 1999) serves as a driver and enabler for realizations of embodied interaction. Finally, it should be mentioned that analytical perspectives on interaction in media studies are increasingly moving from interactivity to performativity, a concept of long standing in, for example, performance studies which turns out to have strong implications also for how interaction is seen as socially embodied (see Bardzell, Bolter, & Löwgren, 2010, for an example).

The picture that emerges is one of a large and somewhat fuzzy design space, that has been predicted for quite a few years within academia but is only now becoming increasingly amenable

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to interaction-design exploration as the underlying technologies, conceptual structures and theoretical foundations fall into place.

Within the extensive and largely unexplored design space of embodied interaction, we identify a particular area for design investigation in which the Dourishian challenge of combining physical and social embodiment is manifest. Specifically, we are interested in designing and assessing *ensembles* for engaging experience, consisting of human and technical actants (Latour, 1987). In such ensembles, communication takes place between the human actants, with the technology to some extent serving as a medium. Importantly, though, we recognize the significance of considering the agency and mediation of the medium rather than treating it as a passive transmission channel. Our work is similar in spirit to that of Dalsgaard and Hansen (2008) in that it is inspired by performance studies, even though they choose to combine the analytical roles of "operator, performer and spectator" into the single person involved in a traditional human-computer interaction.

This paper addresses a particular ensemble experiment, which we call the *Mediated Body*. Briefly, the Mediated Body entails a Suit worn by a Performer engaging in social play with a Participant. The Performer and the Participant each wear a pair of headphones, and when they touch each other's bare skin, they both hear a complex sound pattern. The experience arising from the integration of touch and sound is immersive for the Participant as well as the Performer, implying that there is a primary constellation of actants at play involving Performer, Participant and Suit. However, it must be noted that the embodied interaction takes place in a public place in full view of bystanders and spectators, who play the socially significant role of the Audience in the ensemble.

The work has novelty value in the sense that it explores a relatively uncharted region of the design space of embodied interaction. However, it is not entirely without precedent. For example, the Skinput work by Harrison et al. (2010) represents a fairly well-known exploration of how bare skin can be used as an input device by means of acoustic detection. Their work, however, is mostly focused on the interaction technology as such. The Skintimacy concept (Müller, Fuchs, & Röpke, 2011) represents a more experiential approach to connecting bare-skin touch with

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audio in a social setting, but this work appears to be in preliminary stages and there is scarce information on actual experiential qualities. In critical design and conceptual digital art, the topic of the body and its relations to mediation has been explored for quite some time, with representative examples ranging from the early and influential work by Stelarc (Art and Electronic Media, 2009) to more recent experiments such as the Critical Corset (Illutron, 2008) and the Hug-Shirt (CuteCircuit, n.d.). However, in relation to this body of work, we find that our direction and results are more relevant to mainstream interaction design and to the goal of creating engaging experience in embodied interaction.

Method: Research through Explorative Design

As indicated above, embodied interaction is an emerging field, drawing on several established bodies of knowledge but fusing them into a new and relatively uncharted design space. As researchers, our general mission is to construct new, relevant, criticizable and transferable knowledge within our chosen field of inquiry. For embodied interaction, it seems sensible to adopt a design research approach in which the design work is performed as part of the knowledge construction process. The outcome of such research can be expected to be threefold.

The first – and most obvious – expected outcome is the production of *artifacts* that will occupy previously unexplored points in the design space of embodied interaction. To be precise, even though artifacts represent knowledge in the sense of answering the question, "What could an X be like (that does Y)?" (Cross, 2007), they rarely represent transferable knowledge in an academic sense. The transferable knowledge typically resides in parts, elements, or aspects of the concepts underlying the concrete instantiations (the artifacts). Other designers (or, in our case, researchers using design as a mode of knowledge production) can appropriate such elements and use them generatively in new design situations. This notion of generative knowledge in artifacts has been advanced in many guises throughout the history of design studies and design research methodology, including notions such as patterns (Alexander et al., 1977), primary generators (Darke, 1979), and repertoires of solution elements (Schön, 1987).

A second expected outcome of this type of design research is a characterization of the *qualities* of the suggested solutions, abstracted to a level at which it can be reasonably claimed that these qualities inform the understanding of a whole class or genre of possible artifacts. In a design context, such understandings serve to guide upstream design work in desirable directions, as well as to guide assessment of proposed design ideas. Thus, the generative and artifact-oriented knowledge mentioned earlier works in tandem with the assessment-oriented knowledge expressed as design qualities. Being interaction designers, we are primarily concerned with use experiences, and thus the qualities we can expect to elicit from a design-research inquiry into embodied interaction are mainly experiential qualities (Löwgren, 2009).

Finally, we can expect outcomes on the level of *design strategies and directions:* useful conceptualizations, indications of gained insights, identification of crucial issues and outstanding questions, etc. This kind of knowledge has the general character of trade talk among professionals; it is found in many design-oriented research publications under the heading of Lessons Learnt, or something to that effect. It is notable that it is generally seen as a valuable contribution to the academic community, even though it is rarely as well-grounded as, say, conventional empirical research results.

Within academic interaction design, there is a general trend towards what is called research-through-design (see, e.g., Zimmerman, Forlizzi, & Evenson, 2007). This trend can largely be seen as an attempt to introduce design-research approaches and design-related types of knowledge like the ones listed above into the academic field of HCI, and as such it represents a valuable effort towards broadening the methodological base of HCI research. We find, however, that the nature of the embodied interaction field and our specific direction of designing an ensemble requires a bit of methodological elaboration beyond what are today considered established interaction-design research methods.

First, since embodied interaction is an emerging field, there is no comprehensive body of available knowledge on existing design concepts and interaction idioms, nor is there a common understanding of desirable experiential qualities of embodied interaction and its materials to start from. What this means, on the level of craft activities, is that lo-fi prototyping and other forms of indicative envisionments may be of limited value in our design-research process since they generally rely on the participants' ability to "fill in the blanks" using previous knowledge of how, for example, a conventional interaction technique feels and behaves. Field studies of existing practices to inform the design of new concepts and artifacts are also less likely to be useful, for similar reasons.

Second, our decision to explore the possibilities for designing an ensemble, involving Performer, Participant, Suit and Audience, entails even further complications from a methodological point of view. The design work involves planning the behaviors and properties of Performer and Suit (which are the elements of the ensemble that we have control over), but it should be apparent that what actually takes place in the ensemble will be emergent and improvised to some extent, rendering it impossible to predict and plan a "best" course of action in advance. Instead, it seems necessary to design in a way similar to how improvisational theatre is directed: The designer can establish plots, characters, settings and props – but when the play is performed, she can only sit back and watch how the collective improvisation unfolds. The set-up can then be changed before the next performance, and the process continues in a close experimental loop.

Due to these two specific characteristics of the task at hand, we propose a research process that might be called *research-through-explorative-design*, which is distinguished by the following traits.

- A focus on "sketching with technology" (Buxton, 2007), aimed at creating functional or partially functional prototypes, is used to explore issues of behavior and enactment (as opposed to envisionment). The reason for this focus is that the kind of behaviors we are seeking emerge in use over time and are virtually impossible to sketch using less functional modes of representation.
- Experimentation in the sense of making and trying out prototypes or partial prototypes is the primary mode of working, and experiments are distributed between the lab and the "wild" according to the properties they are devised to study.
- The goal of the experiments is to develop an understanding and a sensibility for the experiential qualities of embodied interaction's design materials (cf. Hallnäs, Melin, & Redström, 2002) and ensembles.

What all this means for our purposes is that our study comprises an explorative design experiment that includes data collection, followed by systematic analysis of the data collected during the experiment.

The experiment starts in the lab, but the main context is a performance art festival at which the Mediated Body concept is refined and assessed in a tight iterative process. As mentioned earlier, the two elements of the ensemble that we have control over are the Performer and the Suit, and correspondingly, the experimental design process comprises performance strategies as well as technical functionality. A development diary (including different hardware and software versions) is kept to trace the design process. Consecutive versions of the ensemble are tested in use and experiential data are collected in the forms of videos, interviews – with Performer as well as with Participants – and field notes.

The analysis is mainly focused on identifying experiential qualities of the ensemble. The key method is a phenomenographical mode of qualitative analysis and presentation (Marton, 1986), using the videos, interviews and field notes as raw data. Moreover, in order to create a rich picture of experiences and understandings, a collaborative writing exercise is performed in which the Performer and the Observer (the researcher collecting the data during the experiment; see below) start by simultaneously writing their individual accounts of the experiment in a shared document, then elaborating on each others' texts and finally collaborating on merging them into one fairly coherent text. The resulting document occupies an interesting middle ground between data and analysis and represents an explicit articulation of embodied experience, thereby complementing the video and other conventional data sources.

System Description: The Symbiotic Mediated Body System

In order to understand the interaction that takes place using the Mediated Body suit, this section introduces the concept of the system and the technology behind it.

The System Concept

Mediated Body is a symbiotic system consisting of a human (the Performer) wearing custom-built technology (the Suit). The system offers a play session to a single Participant at a time. The role of the technology is to sense physical bare-skin connection between the Performer and the Participant, where the sensing yields analogue values in a range starting from a few centimeters from actual touch, to light touch, to full contact. The values are converted into a relatively complex soundscape, which is played back in the headphones that both the Performer and the Participant wear (Figure 1). Thus, from the Participant's point of view, the Performer is akin to a human theremin (Wikipedia, n.d.), a musical instrument that she can play by touching it. However, due to the design of the system, the instrument can also play its player:

When the Performer touches the Participant, the soundscape is affected in the same way.

The headphones make the interactive soundscape a shared experience between Performer and Participant, and they also serve to limit surrounding sounds and thus make the experience more intimate and private for the two players.

Further, the suit includes bright lights on the Performer's chest (Figure 2). These lights serve two purposes: First, they enhance the interactive properties of touch by changing color and pulse when a touch is sensed, and secondly, they broadcast some of the interaction dynamics of the ongoing session to the surrounding area. This has the added effect of attracting the attention of new potential Participants.

The analogue nature of touch sensing, and the relatively complex functional relations between input (touch) and output

Figure 1. Mediated Body in action: Participant and Performer touch each other's bare skin to shape the shared soundscape.
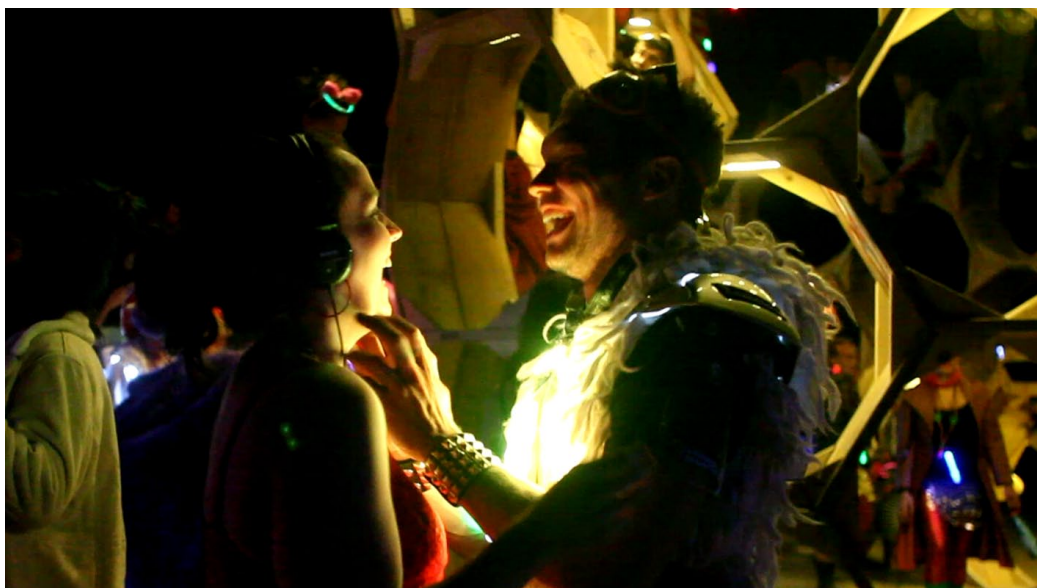

Figure 2. Mediated Body in action: Lights that change in color and pulse add to the experience.
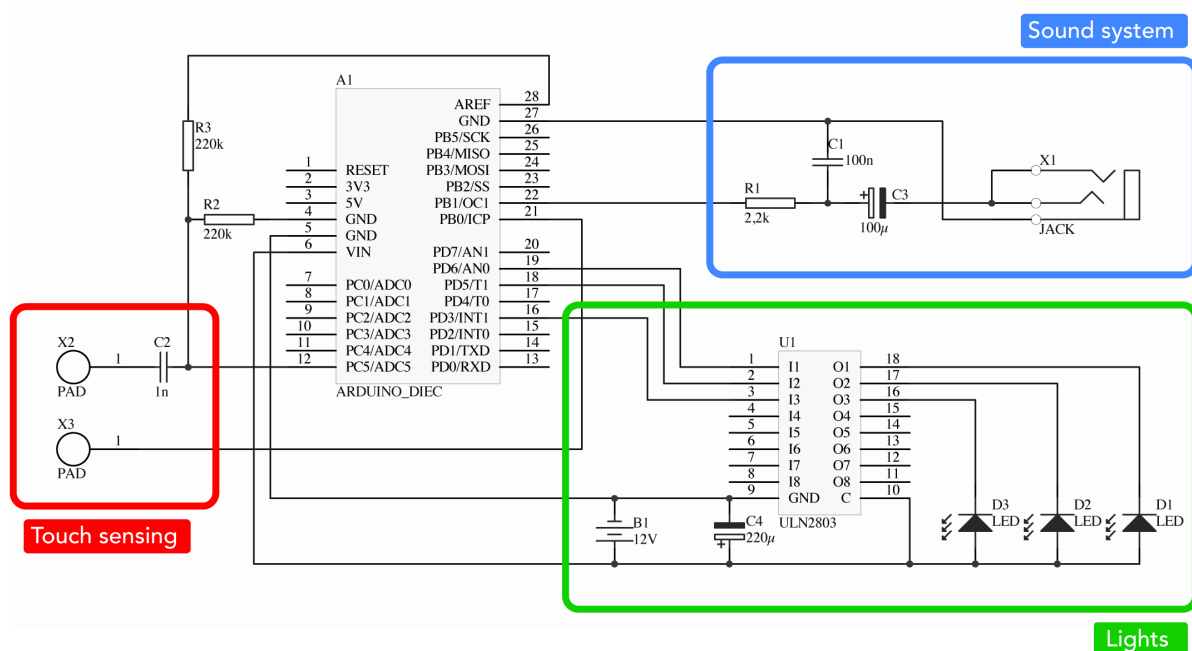
Figure 3. Overall schematic of the Mediated Body system, with connections.
(The different subsystems indicated by the color frames correspond to the ones shown in Figure 4.)

(sound and light) as detailed in the next section, together form an open and ambiguous interaction surface for the Participant. This enables the Performer to enhance the experience with various performative techniques, inspired by and tailored to the situation and context of the play session. Moreover, the Performer can employ costumes and props (a megaphone, plastic sword, space gun, etc.) to project a playful mindset to other potential Participants and bystanders. The complexity of the performance combined with the interactive soundscape aims to create an intimate and immersive experience for the Participant to explore and engage in, together with the Performer.

Its Construction

The technology making up the Mediated Body suit consists primarily of the following elements (Figure 3).

Main processor: Arduino board. An Arduino (n.d.) board serves as the real-time processor, which senses touch and converts it into sound and light patterns. A 12 V pack of AA batteries serves as the power source for the Arduino board, which distributes the power to the rest of the system. The software is written in C++ and consists of 1920 lines of code.

Lights: RGB light strip. For the lights we use an LED light strip with red, green and blue channels. By controlling the amount of light on each channel, it is possible to work with the whole color spectrum. LED strips are flexible enough to embed in clothing, yet robust enough to withstand virtually any kind of weather.

Sound system: Wave table synthesizer. The limited processing power of the Arduino board presents a bit of a challenge in creating engaging real-time sounds. Our approach is to embed

a home-made 8 bit,16 kHz, 4 voice wave-table synthesizer in the Arduino board. This allows for six types of wave tables: sin, cos, square, triangle, noise and saw. The sound quality of this setup is rough by contemporary standards, but it allows us to implement portable real-time manipulation of the individual wave forms, frequencies and modulations of four separate voices based on the input from the touch sensor.

Touch sensor: Signal-based sensing. Touch is measured as a signal-to-noise ratio (SNR) between two points, as follows: A square wave is sent through the Performer's body and listened for on the Participant's body. The "trick" here is to mount the listening wire on the foam of the Participant's headphones so that it contacts the conductive skin of the body when the headphones are put on, forming a circuit (Figure 4). The listening wire returns the SNR of the square wave as an analogue value indicating the quality of the connection between sender and listener. This value is roughly proportional to the amount of touch taking place between the Performer's and the Participant's bodies. The parameters of the circuit are tuned such that the SNR value starts rising when the two bodies are a few centimeters apart, creating the impression of there being an aura surrounding the bodies that reacts to touch.

A previous prototype used capacitive touch sensing, obviating the need to connect a listening wire to the Participant's body. However, we were unable to make the system stable without electrical grounding, obviously an impractical requirement for a portable system. In terms of sensing capabilities, we found the two approaches to be quite similar, with two notable exceptions: Capacitive touch sensing has more aura-like qualities and is capable of sensing large touch areas, such as full body hugs, through clothing. In contrast, the SNR method proved more precise in sensing direct touch.
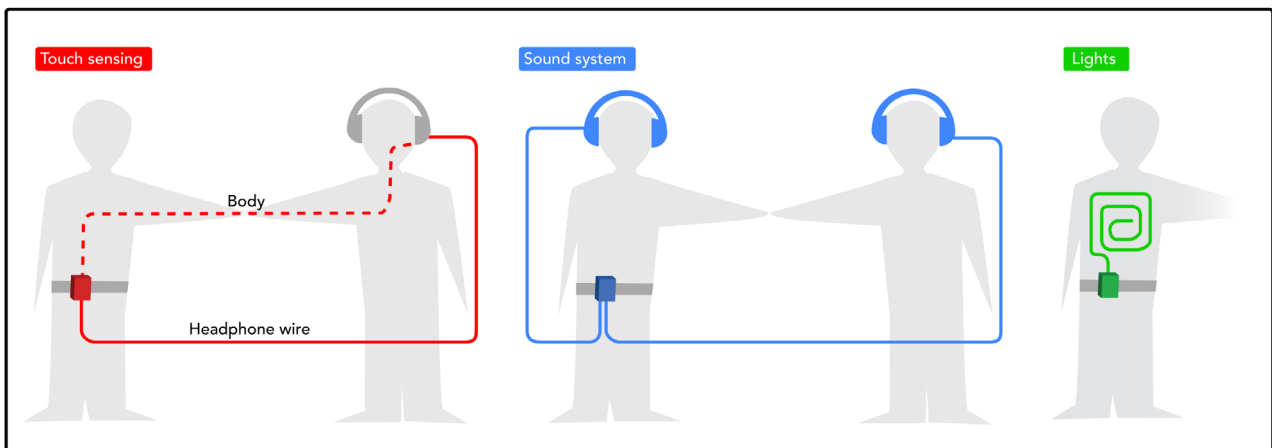
Figure 4. The different subsystems. Left: Touch sensing operates on the circuit formed by bodies touching and a separate listening wire running along the Participant's headphone cord. Middle: The sound system involves two pairs of headphones with cords, controlled by the embedded synthesizer. Right: The lights on the Performer's body are controlled by the Arduino board.

Behavioral Design: Converting Simple Input into Complex Output Patterns

Much of the effort in designing the Mediated Body technology has gone into its interactive behavior, since we assume that a straightforward coupling between touch sensor and sound+light output would allow the Participant to "figure out" the causality too fast and leave little room for play. The aim of our technical work is to create a platform for a rich and complex interactive experience, and to this end we compensate the simplicity of the sensor by working with time and variance.

We compute the amount of what we call "energy" as a way to capture the temporal aspect of the interaction: More touch and longer touch increases the energy slowly, whereas the energy falls off at a faster rate when no touch is sensed. This simple transformation opens possibilities to, for example, modulate output by changing touch over time or to sustain a certain level of "energy" by tapping at an appropriate rhythm. The two parameters of energy over time and real-time touch are used to mix and match the different voices of the synthesizer into a dynamic soundscape. Table 1 illustrates a simplified setup.

Setups such as this one are the products of an explorative effort in the lab in which multiple experiments were made to create complex and diversified sound patterns while still maintaining an intuitive connection between touch and sound. The process was a highly experimental one of changing and combining different parameter values while listening to the resulting sounds. We found that due to the nature of sound synthesis, even small changes in parameter values could result in constructive and destructive interference phenomena, leading to different sound patterns based on the amount of touch over time.

Even though there is certainly room for further development towards more complex couplings of input and output, the approach described here has proven adequate for our needs to test different soundscapes and to tune the balance between direct response and time-dependent changes.

As mentioned earlier, the system also includes light output produced through an LED strip. The interactive behavior of the light is relatively simple and basically depends on when touch is sensed. In an idle state, the light glows green and pulsates at a relaxed breathing pace. When touch is detected, the light turns red and the pulse increases. The intensity of the red light is proportional to the strength of the touch signal.

Field Study: Iterative Collaborative Design Process

The key activity in developing the Mediated Body concept was a week-long experiment taking place at the Burning Man festival in Black Rock Desert, Nevada, in early September 2010. It is important to reiterate at this point that our research methodology entailed design as a means of knowledge construction; moreover, it must be pointed out that the Mediated Body concept entails technology as well as performance. Hence, the key roles in the experiment were the following.

- **Participants:** People at the festival who took part in play sessions with the Mediated Body.

Table 1. A simplified example of how output is modulated by mixing and matching synthesizer voices based on input parameters.

Voice #	Volume	Frequency	Waveform	Resulting property
Voice 1	Energy	Real-time touch	Sine	Fast rising / low volume
Voice 2	Energy x 2	Energy x 2	Square	High pitch slow rising.
Voice 3	Real-time touch	Energy / 2 * -1	Sine	Fast rising lowering pitch
Voice 4	Real-time touch	Real-time touch	Triangle	Tight coupling

- **Performer:** The person who wore the suit during performance and who took part in continuously refining his performing strategies and the technical functionality of the Suit.
- **Designer:** The person who designed and continuously refined the functionality and interactive qualities of the Suit, in collaboration with the Performer.
- **Observer:** The person who observed and collected qualitative data—through video recordings, interviews and field notes—while Participants and Performer were involved in play sessions using the Mediated Body suit.

Before going into the details of the experiment, it is necessary to characterize the Burning Man festival as an experimental context.

Radical Self-Expression and Social Play at Burning Man

The art festival Burning Man started as an annual bonfire ritual on the beach of San Francisco in 1986, and was moved in 1990 to the Nevada desert, where organizers felt they could create a more uninhibited performance art event (Figure 5). Since then, it has become a major event attracting some 50,000 participants

interested in what is called "radical self-expression" and a social structure built on a gift economy. The festival area is divided into a temporary city where participants live (called Black Rock City) and the playa, which is a desert space serving as an open art exhibition for the participants. The playa is also the location of the festival's traditional Temple and the Man statue, which are burned on the last two days of the festival under ceremonial conditions.

In order to assess the results of the Mediated Body experiment, we need to elaborate on the values shaping the culture at the Burning Man festival. Most importantly, as already noted, the festival runs on the notion of *radical self-expression* (Burning Man, n.d.). This means that participants expect to express themselves in large and small ways, for example: to present full-scale art projects, to build and drive mutant vehicles and art cars, to shoot light and fire effects into the air, to wear experimental clothes, to engage in improvised games and quests, to drink with and talk to strangers, to play music and to dance. A recurring sentiment at the festival is that you can be whatever you want to be, and you can do whatever you want to do. This creates a ubiquitous sense of *social play*, where people might dress up as police officers and start controlling traffic, or build a makeshift mobile prison to drive around and catch stray "furries" (people dressed up as cats, dogs, etc.) to bring them to the "furry camp."

Figure 5. Burning Man participant on the playa.

The following quote from the festival's own principles (ibid.) summarizes the Burning Man ethos for the purposes of this study.

> Our community is committed to a radically participatory ethic. We believe that transformative change, whether in the individual or in society, can occur only through the medium of deeply personal participation. We achieve being through doing. Everyone is invited to work. Everyone is invited to play. We make the world real through actions that open the heart.
>
> [...]
>
> Immediate experience is, in many ways, the most important touchstone of value in our culture. We seek to overcome barriers that stand between us and a recognition of our inner selves, the reality of those around us, participation in society, and contact with a natural world exceeding human powers. No idea can substitute for this experience.

"The Week at Burning Man"

This section details in roughly chronological order how the Mediated Body experiment was conducted at Burning Man.

Under the chosen research strategy, the week at the festival was seen as an opportunity to engage in intensive development of the Mediated Body concept through iterative prototyping. Thus, preparing for the experiment involved creating a wide collection of tools and props in order to be able to improvise during the week. Ultimately, the researchers arrived at Black Rock City with three prototype Suits, a diverse set of costumes and props for social play, and all necessary tools for modifying the hardware and software of the Suits.

The Performer had been to Burning Man before and knew that his normal mode of social play worked only in daylight. He saw the Mediated Body concept as a way to extend his activities to the night-time as well, and his initial activity within the scope of this study was to put together a night-time persona by combining the Suit components with a robot costume.

The first night of experimentation was remarkable for the Performer, who had never tried the Suit before and didn't know what to expect. Initially, however, he had misgivings about performing in the dark and he was generally cold and miserable. But all that changed when he walked up to a Participant and asked her to put on the headphones. The instant connection that they shared immediately put him in a playful mood. The lights and the captivating nature of the experience attracted bystanders, and eventually he had people standing in line waiting to take part.

Even though the first experiment was an undisputed success in terms of public appeal, it must be noted that the Participants enjoyed the experience more wholeheartedly than the Performer, who was still to some extent distracted because he was self-conscious about the Suit. For the Performer, the new technology had not yet become completely ready-to-hand (Heidegger, 1927/1962) for social play.

The next few days were characterized by appropriation and experimentation. The Performer quickly became comfortable with the Suit and started developing interaction strategies to enrich the playing experience for himself and the Participant. In terms of interaction design, the version of the Suit that was used on the first night was felt to be lacking in a few respects: The light response was based on the analogy of a pulse increasing over time, meaning that there was too little perceivable immediate light feedback upon touch. This was addressed in a second version of the Suit that used the red channel of the RGB light strip as a direct touch indication, with light strength made proportional to the amount of touch.

Moreover, the sounds used in the first version turned out to actually encourage the Participants to slap or punch the Performer, an experience that proved to be quite painful. In the second version, softer, stroking types of sounds were implemented and the gain on direct feedback was increased by some 10 percent to provide a tighter coupling between touch and sound.

The experiment had now reached a kind of "steady state," in which the Performer would engage in countless play sessions with different Participants, while the Observer struggled to keep pace while collecting video data and field notes. In fact, it was clear that the Performer now felt empowered to engage in social play also at night, and he chose to wear the Suit even when the Observer was not collecting data. At this point, a typical session would play out along the following lines.

1. First contact is initiated, either by the Performer making a playful comment to someone, or by someone making a comment to the Performer (often concerning the lights on his chest). The Performer then says something like, "You wanna try something cool?" or "Are you in a playful mood?" or simply "You wanna play?" These questions are not intended to be answered, but rather aim at suggesting a playful tone and energy in the interaction.

2. The Performer then pulls out the spare headphones and says something like, "Let me just put these on you." At that moment, the person in front of the Performer becomes a Participant in the Mediated Body experience.

3. The Performer's first step is to give the Participant a gentle touch to communicate the connection between touch and sound (Figure 6). This usually brings an expression of joyful discovery to the Participant's eyes. Verbal communication stops at this point, since both the Participant and the Performer are wearing headphones.

4. When the Participant understands the fundamental principle of the concept, they start exploring it together (Figure 7). The Participant concentrates on discovering the possibilities for creating sounds, trying different ways of touching and touching in different places.

5. After half a minute to one minute of highly immersed "touch-play" exploration, the Participant grasps the possibilities of the concept. If the session continues beyond this point, it suggests that the Performer and the Participant are playing and enjoying the moment.

The scenario above represents a sequence of play moves that could be found in virtually every session. In addition, it was

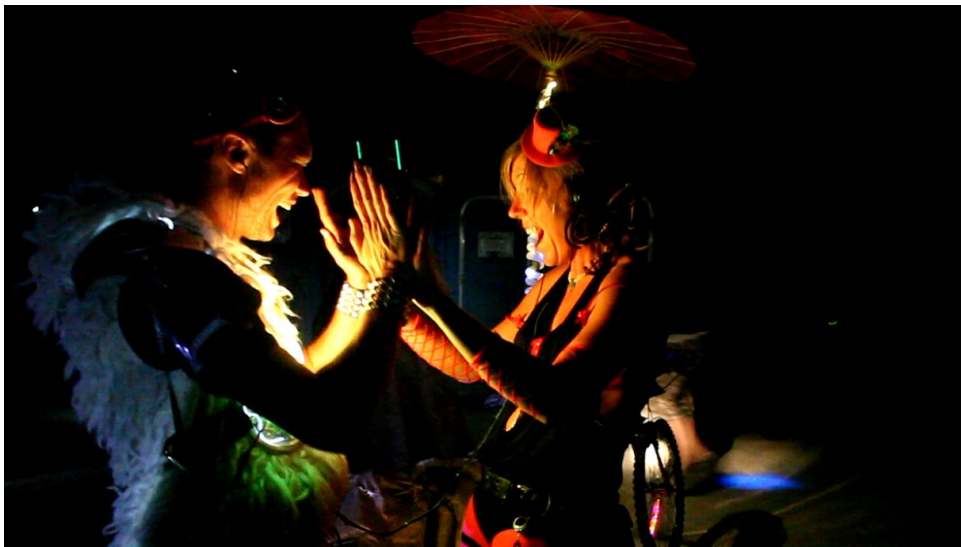Figure 6. The session starts with a first touch.

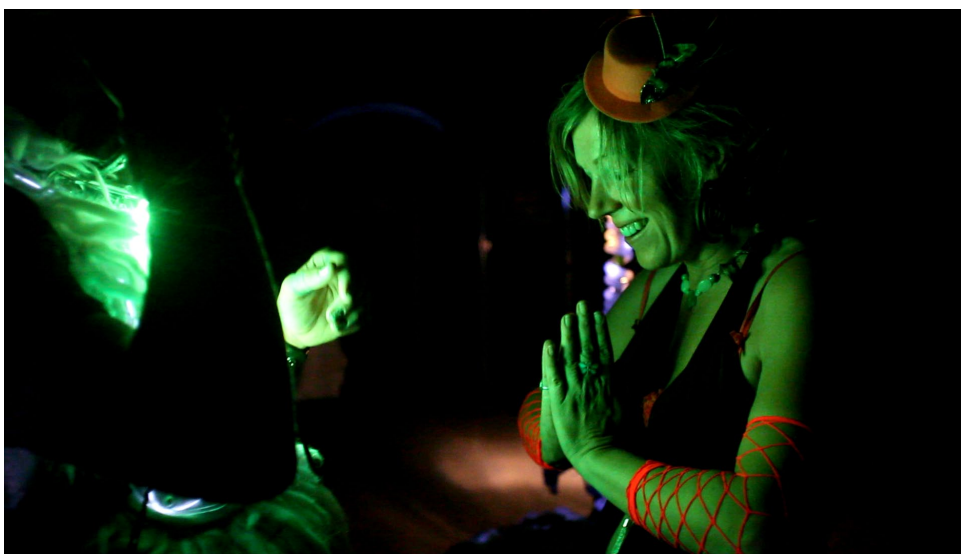Figure 7. Performer and Participant immersed in sharing the experience.

Figure 8. Decompression.

quite common for the Performer to enact different interaction strategies that added depth and complexity to the Participant's experience and prolonged the session. These strategies will be detailed in the section below.

In some cases, the Performer and the Participant formed such a genuine connection that the session would turn into a prolonged exchange in which the technology of the Suit became secondary.

Ultimately, the Participant and the Performer would take off their headphones, indicating the end of the session (Figure 8). At this point, comments such as "That is so cool – How do you do that?" were quite common. There was also a clear need for "decompression," a period of time in which the Participant and the Performer would have to re-contextualize into the everyday world the intense and intimate experience they had just shared.

Findings: Participant Experience, Performer Strategies

As pointed out earlier, the core of the Mediated Body concept is a tripartite ensemble involving a Participant, a Performer and a Suit. Even though the experience of taking part in play sessions with the Mediated Body is in many ways holistic, there is still a sense in which the Performer is "part of the system" and the Participant corresponds to the "user." Hence, we analyzed the data from the week-long Burning Man experiment – videos, interviews, field notes and the collaboratively written document – according to two main categories of findings, one pertaining to the Participant's experience and the other covering the Performer's strategies to enhance and play with the experience.

Characterizing the Experience of the Participant

When a Participant was engaged in a play session with the Mediated Body, the experience was generally characterized by two intertwined themes: immersed experience and behavioral exploration. The session typically started with a distinct moment of first touch that we have singled out analytically and ended with a period of what we call decompression.

First Touch

When the Participant had put on the headphones and touched the Performer for the first time, there was often an observable sparkle in their eyes and a change in posture and demeanor, indicating that they "got it." The connection between touching a stranger's skin and "hearing" that touch, so to speak, was a new experience, yet immediately graspable and enticing further exploration.

Immersed Experience

As the session unfolded, a dialectic would take shape between being immersed in the play and getting comfortable with the intimacy of the situation. The jumping between these two modes of interaction was performed by touching and moving, thus making it a non-verbal experience. However, to capture the

essence of what went on in the play session between Participant and Performer, consider the following illustrative questions: "Do you touch me?", "Do I touch you?", "How much can I touch?" and "Am I allowed to touch here?" Each of these questions represents a higher level of intimacy. As they grew more comfortable and understood each others' boundaries, the tentative dialectic phase would turn into an increasingly more immersed full-body experience. The Performer characterized the tentative play and the experience of the Participant thus (this quote and the following ones are verbatim from the collaborative data collected during the experiment, including grammatical errors):

> How I set the scene really influences whether people consider themselves as either active or passive. It often depends how I start the interaction. Sometimes I approach people by putting on their headphones and then touching them to let people understand that touch is a part of the experience. People will often catch on, and start exploring what happens if they touch me back. However, very often people think that they are not supposed to move, and just stand completely still waiting for me to keep touching. I don't like telling people what to do, and instead try and suggest that they can be active, e.g. by holding out my hands and waiting for their reaction. Sometimes, quite often, this doesn't help, people are like paralyzed, and only if I ask them to touch me they realize they can be active. It happens quite often, I find it really interesting and apparent. For this reason, what I often do is that I start out by saying (after putting on headphones) "try touching me" as the opening - they will then automatically be the active and exploring part, and only after a while when they have caught onto what it is about, I start being active and touch back. It works really well empowering people like this.

It is obvious that close, prolonged physical contact of a caressing nature between two strangers violates a whole range of social norms, and specifically suggests a behavior so strongly sexually explicit as to be offensive in most social contexts. The Performer was very well aware of this and concerned himself with the impact the sexual connotations might have on the Participant's experience:

> When I approach people I always - mostly as a natural state of being - am without intentions of any kind, especially sexual. I might of cause be attracted to the person in front of me, but I am very aware of not introducing a sexual element into the interaction. I have the feeling that being neutral and signaling no agenda is extremely important for people to feel safe. It's not always like this, sometimes very seldom I've actively used it to flirt, but 9 out of 10 times any initiative to flirt comes from the other part, and as I interpret it, as a result of feeling safe, no expectations and allowed to withdraw.

There were several instances of uninhibited and immersive acts on behalf of Participants that even surprised the Performer, including full body hugging or taking a jacket off to expose more skin to interact with. In situations like this, the Performer usually had to take a literal step back and assess the situation before re-immersing in the joint play.

One thing that is amazing is how all norms about how/where/when to touch strangers completely disappears! I tried girls throwing their clothes after 10 seconds and jumping on me (literally) and guys starting to punch me in excitement having to make them stop because it hurts. The rules of touch gets radically changed by the technology. It can also be used as an intended excuse for intimate touch, that happens as well. Just saying the rules are changed!

It should be noted that from a technological point of view, hugging is actually not of much benefit, as it creates too large an area of contact and degrades the delicate quality of the connection between touch and sound. Consequentially, the Performer rarely initiated hugging, as his efforts were focused on orchestrating and innovating on the shared play experience (see below).

It should be clear from the account so far that the immersion in touch and sound, and in bodies and movement, created a strong dyadic and somewhat exclusive relationship between Participant and Performer: a bubble of shared play, as we have chosen to view it. It was clear that when the Participant and the Performer were in this bubble, they were significantly less than normally aware of their surroundings, not reacting to light and movement around them. It was quite common for an immersive session to take place in an extremely crowded and noisy environment, such as close to a stage or a dance floor, yet the metaphorical bubble would observably wrap itself around the players.

What happens is that sometimes people get aware after a while, pull a little away, smile at me, and then throw themselves into the play again. These moments are really beautiful – I feel I completely emerge myself into that other person, as they are not aware of me, I lose my self awareness also and for a moment I only exist to

enhance their experience. I lose myself as they lose themselves. It's fantastic how strong an emotional connection is build in a state of not being aware of each other. Even after trying the suit hundreds of times, I still have really intense experiences of what I could call complete presence. It is beautiful taking the headphones of a person after such an experience, look each others in the eyes as humans (almost like blushing after making love), get a big hug, and separate. Isn't it beautiful: meet a stranger, have 3 minutes of the most intense experience of intimacy and exploration, and then leave as strangers but connected [by virtue of] a common experience. It's like one night stands when it is best – just better.

Now, I'm glad there was no speaker. [*Before the experiment, the Performer had thought that a speaker would be better than headphones.*] A lot of the magic from creating this bubble came from the intimacy of headphones. People are not judged by spectators as no one else can hear.

However, it was clear from our observations that the bubble was not opaque, so to speak. There was an interesting duality at play for the Participant (and the Performer) of being immersed in the dyadic experience, yet at the same time performing for the bystanders watching the couple play (Figure 9). The Performer could sense occasionally that the Participant would turn up the smiles and the exploration an extra notch for the Audience.

[S]ome people also perform a bit when there are spectators, and the headphones allow them to exaggerate the experience they are having. I especially noted this with "competing girls" – quite funny – who competed with each other in having the most intimate and amazing experience with me. Did I like? yes, i like :)

Figure 9. Participant and Performer acknowledging the audience.

The smiles and sparkling eyes of Participant and Performer immersed in play, and the energy they radiated through their actions and motions, made it quite apparent to others that there was something fascinating going on. On occasion, there would be whole crowds of people gravitating towards the play, watching and perhaps waiting their turn to have a go.

> [S]ometimes I attract a lot of attention, and other people are waiting to try once I'm done. That is often fine, and there is a great interaction between people […] However, sometimes I tried people simply lining up (yes, 10 people got in a damn line) and simply treating me like an art sculpture. I feel it loses a lot of the magic – I much better like surprising people with something they don't expect at all.

Exploring the Possibilities

Apart from the immersed experience, the findings suggested a strong element of explorative interaction, in which the Participant would set out to discover the possibilities of the interactive Mediated Body experience and of the technology involved. We interpreted this element as a combination of natural curiosity and a way to excuse some of the norm-violation and defuse some of the intimacy of the situation. Our data suggested that a more explorative approach to the whole experience was found predominantly with male Participants.

> Thinking about this, I think that this is really the core of why MB is so successful. It hits it right on the head – on the one hand it is different and just a game with sound and light, and on the other hand it creates such an isolated sphere around you and facilitate

touch in the most intimate way, yet still keeping it a fun innocent game.

One of our main findings on exploration was how the nature of interaction changed with the sound designs of the two main versions of the Mediated Body technology. Version 1 of the sound design encouraged hard hitting, simply because of the roughness of the sounds (Figure 10). Participants reacted to the quality of the sounds and felt that hitting influenced the sounds, even though in actuality they were merely following the rhythm already coded into the sounds. The resulting exploration could be quite painful for the Performer, who requested more "stroke-like" sounds. In the second version, the sounds were designed to have a softer and smoother quality. Moreover, the technical connection between touch and sound was made more direct so as to create a tighter coupling and to discourage the Participant from resorting to force to influence the quality of the sounds resulting from touching. The differences between the first and second versions were quite subtle, though, pointing to the inherent complexity in how small differences can change the whole nature of the interaction.

From the Participant's point of view, one of the main forces behind the explorative interaction seemed to be the urge to understand the causal mechanisms connecting touch and sound. As described above, the actual causal connection was fairly simple and it did not take long for a Participant to "figure out" the mechanism and exhaust the interactive possibilities. The Performer took it upon himself to create a more sustained and varied experience for the Participant by developing and employing a multitude of performance strategies. These strategies will be detailed in the next section; however, the phenomenon should

Figure 10. Participant slapping the Performer's palms forcefully.

be mentioned here as it had a strong bearing on the Participant's resulting experience of the Mediated Body ensemble as a whole.

Leaving the Playing Field

Occasionally, there would be a very long session in which Participant and Performer would move repeatedly together into and out of the bubble, taking off their headphones for a short conversation before putting them back on and returning to the immersed experience. In these instances, the technology became secondary and a more genuine and deep-reaching connection formed between Participant and Performer. They were attracted to each other in a way that went beyond the admissible moves on the playing field offered by the Mediated Body concept, and a mutual non-verbal agreement would be made to step over the formal boundary and do things such as holding each other (and sometimes more) without wearing the headphones and using the technology as a prop for social play.

Decompression, Afterglow

The typical way for a session to end was for Participant and Performer to take off their headphones. At this point, there was an obvious need for what we have called "decompression" – a shared state of afterglow in which the two had to come back to the everyday world outside the mediated bubble, and to negotiate a more everyday relationship to each other. It seemed this was a necessary step after having shared such an intimate experience with a stranger using such a powerful social play facilitator. The longer the session, the greater was the need for decompression.

Besides re-establishing an everyday relationship, the decompression period also served as a time for the Participant to develop a better understanding of the technology and how it worked. Questions such as "How does it work?" were quite common during decompression. Depending on the situation, the Performer would sometimes choose to explain the workings of the technology, whereas other times he would deliberately tell a fairy-tale-like story to keep the Participant in a playful mood.

The Performer's Strategies for Creating Engaging Experiences

As the Performer shared the Mediated Body experience with hundreds of people, it is quite understandable that he sought novelty and variation. This manifested itself in his developing and employing a wide range of strategies to create new experiences for himself and new ways to entice a Participant to engage in explorative interaction, to stay in the bubble for a longer time, and to come out with a richer experience. It turned out that the technology itself was open-ended enough for an inventive and resourceful person like the Performer to improvise and create a surprisingly wide array of strategies.

> I quickly learned the dynamics of the game, and developed all kinds of tricks to enhance the experience. The software in both ver. 1 and 2 was too simply. The problem being that people get it quite

fast. They figure out how it reacts, and after a minute or so they loose a bit of excitement. Some people keep showing excitement, but that is often because they wanna play with me instead.

More specifically, the Performer developed the following strategies to enhance the experience for the Participant (and certainly also for himself).

Narrative frame

The Performer would sometimes create an interpretive framing to serve as a narrative backdrop for the Participant's experience. Some of these backdrops were patently false, such as one on the connection between light color and mood:

> Just for the fun, and because I cant help it, I tell all kinds of crap about what the suit is and does. I wanna see how people react different depending on the story I give them. I tell all kind of stuff: that it converts their aura to sound, that it feels your love energy, that the light shows your inner mood (even though it's always red when you touch).

Other examples included improvising on how the technology actually worked but explaining it in more mystical terms, using for example words like "aura":

> Aura is the best description, and one that really facilitate a great interaction. Once people hear it is about aura, they intuitively become really slow and start working in the area of almost touching. MB has a background noise that is there all the time and changes slightly, so even without doing *anything* people already then have the impression that they hear their aura. Starting from such a sensitive state of mind, even the smallest touch is really a great experience. How can I formulate this – telling the aura-story makes the sound effects last a lot longer and have a much higher impact. Its amazing how important the story or frame of mind is! I cannot stress this enough.

As indicated in this quote, the Performer felt that the aura concept worked quite well to set the right kind of mood for the interaction.

Dramatizing Causality

In order to give the Participant a more challenging and sustained task in understanding the causality of the technology, the Performer developed a range of strategies. Some involved bodily actions designed specifically to avoid repetition, in order not to give the Participant enough "data" to reach a conclusion on how simplistic the touch-sound connection really was:

> Some of the tricks I have learned to do, helps me hide how simply the input-output causality actually is. With a thousand tricks I create a [smoke screen] so people don't completely know what actions lead to what outputs. I keep them suspended longer. Here are some of my tricks: I try to make sure that every touch is different (different duration, different place on the body, one hand or both at the same time etc etc), in that way the person doesn't really try the same thing twice and never get confirmation that a

specific action leads to a predictable outcome. It works surprisingly well, I can keep it going for quite long.

Another strategy was for the Performer to suggest alternative hypotheses of what triggered the sound effects that they could both hear:

> Another way is telling stories, like saying that the thing measures the energy of different bodyparts. People will then experiment with different parts of their bodies. The effect is the same - people automatically start doing a lot of different things and don't repeat the same action several times, which would quickly lead them to figure out the simplicity of the algorithm.

> Another way to introduce ambiguity is to suggest causalities that aren't there. If I stroke my fingers up along the veins on peoples arms, the sound will raise the further I get up the arm (in reality due to the duration of the touch), but people feel that it is due to the movement on the body. They will themselves start experience with movements, and as the duration is important they get the same effect. Once I lead them down that alley, they might never realize how simple it is. Its all about planting a seed - an intuitive hypothesis about what is going on. I can further facilitate the feeling of motion as important, by pulling my arms/body away at points in time that support the interpretation of motion as an important factor.

As a final example of how the Performer made the simple causality of the Mediated Body technology into a captivating drama, he developed his skills in playing the technology as an instrument. In this way, he could make different sounds in different places, giving the Participant the impression that different body parts sounded differently, and also to suggest that different ways of touching would cause different sounds:

> Do different repeated things, e.g. tap my fingers, stroke, keep hands close to face, and make sure they all give different effects. That gives the impression that there are at least 3 completely different modes of touching, and confuses people a lot.

It should be noted that the technology was in fact intentionally designed to be played like an instrument, in the sense that modulating touch parameters like distance and pressure as well as their values over time would create different sounds. What the Performer did during the experiment was to develop his ability to play the instrument (Figure 11), even though he tended to think of this in terms of faking or filling in to compensate for the shortcomings of the technology.

Gift from a Stranger: The Performer Becoming the Wingman

Towards the end of the experiment, the Performer developed an interesting variation on the key concept by handing over the experience to two previously uninitiated people, thus becoming a Mediator instead of the Performer:

> A new level of interaction when going from interacting with one other person, to when I tried facilitating the interaction between couples. "Flirting mediation". I had obviously flirting couples come really close, gave them an excuse to get closer, touch, connect. It was funny, from initially being a threat, I became the wingman emerging out of nothing.

The Performer's Overall Impressions

In general, it is safe to conclude that the Performer was exceptionally pleased with the Mediated Body concept and how it extended his ability to engage in social play and to impart an immersive, compelling experience to the Participant.

> All I had to do was walk up to someone and ask them to wear my headphone, and play would start. What really blew me away is how this suit is simply a play and interaction catalyst! It's a magnet for fun, or rather, a great excuse to start an interaction that is at the same time both intimate and [non-committal]…

Reflecting on the capabilities of the technology, he commented on what he found to be the inadequate level of complexity implemented in the prototypes and how it could be improved:

> Once people catch on to the connection between touch and sound, I often see the excitement in their face, and they rush on to explore
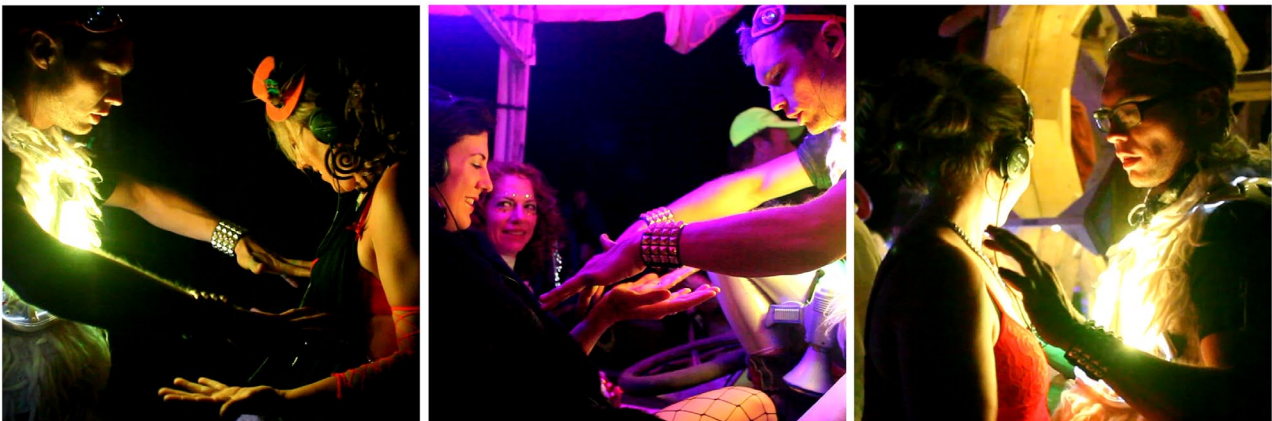

Figure 11. Examples of Performer strategies: Focusing on the concept of an aura, touching the veins, and touching with repeated taps.

the rest of my body for new sounds, new outputs, anything! But the excitement leaves them fast as there is simply nothing more to get – they figured it out, game is over. That's why I thought myself a thousand tricks to simulate more complex input-output patterns. This suit is amazing, but if you ask me for a wish, I would wish that some of my tricks were real and build into the suit.

Due to the difficulties with calibrating the equipment, the suit often reacts different to people. […] The interesting effect comes when several people try it right after each other, and it is obvious to them all that they had different experiences "what was it like to you?" – I love the dynamic when every person tries to tell the others how their experience was fantastic in a whole other way. People really don't like getting the same experience - and it is also a lot easier for me when it is very different interactions. I would love if this could be integrated and different sets would load automatically or something.

The issue of implemented versus perceived complexity is something we return to in the subsequent section as we discuss design implications.

To summarize our findings, the Mediated Body was very successful in the superficial sense that it turned out to be highly attractive and much appreciated. During the week of the Burning Man festival, the Performer chose to use the Suit more or less all the time (including the times when the Observer was not collecting data) and he interacted with several hundred Participants, many of whom clearly had an engaging experience. We feel that this outcome may justify considering the artifact as a source for other design researchers interested in engaging experience in embodied interaction. In the following section, we summarize the transferable results of the work through reflection on the design process and the findings.

Results: Artifacts, Qualities and Design Directions

As stated earlier, the study reported here was planned so as to result in three types of contributions toward the aim of designing embodied interaction for engaging experience: Artifacts, qualities, and design strategies and directions.

Artifacts: Key Aspects of the Mediated Body Concept

We identify three key aspects that we deem to be crucial to the engaging experience of the Mediated Body concept, as well as transferable to the academic community of design researchers in embodied interaction.

First, the idea of *connecting touch to audio* seems to make for an engaging experience, provided that the right balance is struck between direct feedback and more complex, emergent responsive behavior. This point will be explained further below. The light feedback that is included in the concept serves a relatively minor role in the immersed experience of Performer and

Participant, but appears quite important for attracting the attention of the Audience and for extending the scope of the concept to night-time use.

Secondly, it is a highly distinctive feature of the concept that touch detection requires *bare-skin connection*, and that it takes place *between strangers*. This is a somewhat novel and daring move, one which makes the experience considerably more intriguing and titillating. In some sense, it forms an excuse for questioning a whole range of established social norms by engaging in a polyvalent moment of social play (see below). However, it must be noted that the bare-skin aspect, with its norm-breaking potentials, is contingent on the context of use. It worked very well at Burning Man, and we suggest that it would work as well in other playful settings such as clubs or parties. A bus stop on a rainy Monday morning may not be as good a setting for playing with the Mediated Body. Still, it is conceivable to envision a stealth-oriented variation for more discrete use between people who like the sense of sharing a secretive interactive intimacy, by using inconspicuous headphones and by means of subtle touching, while seemingly abstaining from interaction. Such a variation would amount to a translation of the bare-skin aspect to a fundamentally different social context.

A final contribution on the artifact level concerns the possibility of designing *open-ended props with non-trivial internal complexity*. Intuitively, it would seem that the goal of creating open-ended props for the Performer would rule out the possibility of complex touch-audio transformations in the Suit. However, we find that there is no such inhibitory relationship. The best example in the present work is the design concept of "energy" accumulating over touch duration that we used as one of the factors modulating the sound output. This is a somewhat complex concept, yet we found it to be one of the most versatile and useful props available to the Performer for narrating the Mediated Body experience in a variety of ways. As Salen and Zimmerman (2004) remind us, the rules of the system and the rules of the interaction in playful settings are two different things, even though they overlap.

Qualities: Characterizing the Mediated Body Experience

Concerning experiential qualities, the findings section above aims at painting a rich picture of the experience of taking part in play sessions with the Mediated Body. Here, our intention is to summarize the most salient experiential themes of the ensemble as a whole, in a way that might inform the academic understanding of engaging experience in embodied interaction.

It is obvious from our findings that immersion is an important theme in understanding the Mediated Body experience. More specifically, our data indicate an experiential quality that we have chosen to call *performative immersion*, a state of duality in which Participant and Performer are on the one hand wrapped up in the bubble of exploring and playing with touch, audio and light together – and on the other hand, performing knowingly for an Audience. We would argue that this quality is

not peculiar to the Mediated Body concept but rather represents an increasingly important consideration in designing embodied interaction. The physical/material aspect of embodiment implies possibilities for designing more immersive and captivating use experiences, whereas the social embodiment aspect generally entails empowering the user to perform.

The ensemble, including the Suit as well as the Performer's appearance and strategies, was designed to set a playful mood. We characterize the resulting interaction experiences as examples of *transformative social play*, in which the Participant and Performer jointly sidestep inhibitions and question common norms for social behavior. What they essentially do is to skip over a whole series of steps normally required in social interaction between strangers. The reason for this, we argue, is that the experience is framed as a playful and explorative one in which the touch-audio-light sensations offer the participants the possibility of temporarily transforming social relationships. There is ample data to show how the duo often have to backtrack along the chain of social steps when taking the headphones off, reverting to asking for names and talking politely about the experience they have just shared. The experiential quality is similar to what game studies calls "forbidden play" (Salen & Zimmerman, 2004), seminal examples being games such as Spin the Bottle, in which a player has to kiss the person the bottle points to after it is spun on the ground. Entering the "magic circle" (ibid.) of such a game allows, and even requires, the player to behave in ways that are considered taboo outside of the game.

Finally, the open-ended design of Mediated Body and its quality of social play seem to create a significant experiential quality of *emergent meaning-making*, manifesting itself in how the Performer narrates the possibilities and functions of the ensemble as well as in how the Participant explores the effects of different actions. A particularly clear example here is the concept of an "aura," which was used already in the lab to guide the design of the touch sensor and which the Performer found to be a highly generative concept for inspiring Participants to take part in the experience and to enjoy a pleasurable interaction. Another example concerns the Performer's need for variation, illustrated in the many different stories he told in actions and words about, for example, how different kinds of touching influence the audio soundscape. More generally, when designing ensembles for embodied experience, we find it important to provide enough ambiguity to allow for multiple interpretations and narrations (cf. Gaver, Beaver, & Benford, 2003) in order to turn the experience into something more than a one-off walk-up-and-use attraction.

Design Strategies and Directions

The final section of our results concerns lessons learnt from designing the Mediated Body ensemble, as well as outstanding questions and issues that need to be addressed in order to advance the discipline of designing embodied interaction.

The approach of *designing an ensemble* has certain implications for design, which we will explain briefly. When we aim at including both technical and human actants into the scope of design, when we aim at designing the behavior and appearance of the Suit as well as the performative strategies of the Performer, and when we explicitly aim for ambiguity and improvisation and for creating an experience in-the-moment, it should be clear that the actual outcomes cannot be fully anticipated or planned. The best way to conceptualize the situation might be to think of it as an extended network of actants, including also the Designer. In this extended network, the Designer has certain intentions and certain means of trying to realize them: Suit functions, Performer props and Performer strategies. But there are also other forces at play, including the Participants' intentions and actions, the presence of the Audience, and the spontaneous improvisations of the Performer, none of which can be "designed." The Designer builds and combines different experiential building blocks to make certain courses of action more likely, while at the same time expecting surprising outcomes and interactions.

There is a trade-off in designing the behavior of the Suit between providing direct, predictable audible response to touch (similar to the concept of tight coupling [Ahlberg & Shneiderman, 1994] in early discussions of direct manipulation interfaces) and providing a more complex response in which the pattern of the causal touch-sound relationship is not directly apparent but rather reveals itself gradually as Performer and Participant explore the interaction possibilities. We suggest that it is important to consider how the Participant perceives and masters the complexity of the interaction. If the complexity appears much greater to the Participant than her mastery of it, the experience may be more confusing than anything else. Conversely, if it is perceived as mastered easily and not complex at all, boredom will rapidly set in. To us, there are a couple of *experiential sweet spots* to be sought (cf. Gaver et al., 2009): an intriguing one at which complexity is slightly higher than mastery; and one of pleasant comfort, at which mastery is slightly higher than complexity. It should be noted at this point that these sweet spots move as mastery grows, emphasizing the need for progressive revelation and emergent complexity to make the experience more engaging over time (cf. Khaslavsky & Shedroff [1999] on the dramaturgy of seductive experience).

Finally, what are the most promising directions for further work in embodied interaction based on the Mediated Body? As indicated in our data, the Performer felt that the concept should offer more possibilities, that more complex functions should be designed into the Suit, while still retaining the openness and ambiguity that it offers. From a technical point of view, an immediate response might be to propose functions such as different sounds for different parts of the body or improved touch-sensing techniques that would offer greater variety depending on, for example, if there is a blood vessel right under the skin at the point of contact. But before leaping to conclusions about how best to improve the Suit's complexity, we would like to unpack the notion of complexity itself a little further. In doing so, we find that there are actually two kinds of complexity involved in the Mediated Body concept. One is the interface complexity that relates to creating more elaborate patterns within the paradigm of direct response, such as making a leg sound different from an

arm when touched. This appears to be the kind of complexity that the Performer is talking about in our data. The other is the behavioral complexity that relates to the software that connects the touch input to the sound output. Recalling the discussion of direct response versus gradual revelation above, what we mean by behavioral complexity is typically time-based patterns in which constructs like touch duration, variation and rhythm are used to modulate the sound output. Our findings seem to suggest that behavioral complexity is harder for the Participant to perceive and master than interface complexity, and that it is open to multiple interpretations and thus multiple performance strategies on the part of the Performer. Thus, we would conclude tentatively that the strategy of designing powerful behavioral props has greater experiential potential than the strategy of hard-coding more varied interaction possibilities. Above all, it seems clear that there is more work to be done on developing notions of implemented and perceived complexity in designing ensembles for engaging experience.

Conclusion

The aim of this work was to contribute to the design of engaging experience in embodied interaction by exploring a relatively uncharted region of the design space through design experiments and assessment.

Our contributions include three key artifact-level elements that seem to have desirable effects on the interaction experience: connecting touch and audio with the right balance between direct and emergent responsivity, justifying bare-skin touch between strangers, and providing open-ended action props with non-trivial internal complexity.

Moreover, we suggest three experiential qualities that can be used to begin unpacking the notion of engaging experience in embodied interaction: the duality of performative immersion, the "magic circle" of transformative social play, and the explorative nature of emergent meaning-making.

To conclude, there is a question begging to be addressed: What is the scope of the results? Are any of these contributions relevant outside the context of performance art festivals? As we have argued above, there is a range of other socially playful settings where we believe the Mediated Body concept is immediately applicable, such as clubs and parties. Moreover, we indicated how the concept could be translated to different realizations, such as a stealth-mode experience in more sedate settings. Finally, we would like to point out that the level of engagement engendered by the concept indicates that it could have some potential to actually transform certain social settings by provoking the questioning of prevalent social norms. Such a deployment would be more akin to critical design, and we hope to be able to explore its implications in future work.

Acknowledgements

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