A Touch of Affect: Mediated Social Touch and Affect

Gijs Huisman
University of Twente, Human Media Interaction Group
Drienerlolaan 5, PO Box 217, 7500 AE, Enschede, The Netherlands
gijs.huisman@utwente.nl

ABSTRACT

This position paper outlines the first stages in an ongoing PhD project on mediated social touch, and the effects mediated touch can have on someone's affective state. It is argued that touch is a profound communication channel for humans, and that communication through touch can, to some extent, occur through mediation. Furthermore, touch can be used to communicate emotions, as well as have immediate affective consequences. The design of an input device, consisting of twelve force-sensitive resistors, to study the communication of emotions through mediated touch is presented. A pilot study indicated that participants used duration of touch and force applied as ways to distinguish between different emotions. This paper will conclude by discussing possible improvements for the input device, how the pilot study fits with the overall PhD project, as well as future directions for the PhD project in general.

Categories and Subject Descriptors

H.5.2 [**User Interfaces:**]: Haptic I/O; Theory and Methods.

Keywords

Mediated social touch; haptic interfaces; affect; emotion.

1. INTRODUCTION

Look around your office and ask a random colleague to hold hands with you. If said person complies, close your eyes for ten seconds and try to determine what you feel. Most likely, you will feel the warm, soft, perhaps slightly sweaty hand of your colleague. But more importantly, you are feeling the hand of a *person*.

Touch pertains not only to tactile sensations through which we can determine the shape, size, texture, and temperature of an object (i.e. discriminative touch), but also has a very strong social, and emotional component too [10, 23]. Most likely your request was met with puzzled looks from your colleague, and a sense of unease upon first contact. Such feelings do not only depend on the tactile sensation itself, but are strongly influenced by your relationship with your colleague, as well as your gender, and culture [10].

HCI research investigating touch focusses mostly on discriminative touch, for instance in interaction with touch screens [19], tangible interfaces [20], and haptic feedback [28]. However, recent efforts have recognized the importance of social touch [12, 30], and have investigated how mediated social touch (i.e. communicative touch between at least two people through input and output devices) is perceived, and can influence someone's affective state [31]. The ongoing PhD work outlined in this position paper builds on this last line of research. Two main research questions guide the PhD project, namely: to what extent can interpersonal touch occur through mediation? And, to what extent does mediated touch influence people's affective state?

2. RELATED WORK

2.1 What is touch?

The touch sense can be divided into two separate systems, namely: the cutaneous and kinesthetic systems. Haptic perception refers to touch sensations involving both the cutaneous and the kinesthetic system [12]. One's awareness of the position of one's limbs in time and space is made possible by the kinesthetic system, which draws on information from mechanoreceptors in the muscles, skin, and joints, as well as from motor-commands executed in the brain [12]. The kinesthetic system can, for instance, provide information about the size and weight of an object. The cutaneous system pertains to sensations that are a result of stimulation of different receptors in the skin. The human skin contains thermoreceptors that sense temperature, nociceptors that sense pain, and mechanoreceptors that sense deformations of the skin [12, 21]. Recent evidence suggests that the hairy skin contains a type of receptive afferent (i.e. nerve carrying information to the central nervous system), called CT afferent, which is not found in the glabrous (i.e. hairless) skin. These CT afferents respond particularly strongly to slow stroking motions, for example when applied to the forearm, while being insensitive to stimulations typically associated with discriminative touch [25]. This has lead researchers to propose the social touch hypothesis, which states that CT afferents have a potential to elicit pleasant subjective experiences, which are highly relevant for interpersonal social touch [25]. Considering mediated social touch, this finding is important in that it

ICMI'12, October 22–26, 2012, Santa Monica, California, USA.

highlights the social nature of touch, as well as that it provides insights into which actuators might best be used to produce tactile sensations reminiscent of social touch.

2.2 Interpersonal touch

Touch is considered as one of the earliest types of communication for humans [22], and it is a powerful mode of communication too: studies have shown that interpersonal physical contact is essential in the development of cognitive and socio-emotional skills in infants [1], can increase compliance to requests (i.e. the 'Midas touch' effect) [10], and can have stress-reducing effects [9]. Touch can have strong immediate affective consequences [30, 31]. For example in romantic couples, being touched by one's partner is typically considered pleasant, whereas being touched by a coworker can be considered unpleasant [10]. In these examples touch is either positively, or negatively valenced. Moreover, touch is considered to be an intensifier of emotional displays from other modalities. However, recent evidence suggests that touch can also be used to communicate specific emotions [16, 18]. In a series of experiments, Hertenstein et al. [18] found that three basic emotions, and three pro-social emotions were recognized at above chance levels when they were communicated solely through touching of the arm and hand of the decoder. Accuracy ratings of the decoded emotions were very similar to accuracy ratings obtained from studies into facial, and vocal expressions of emotion. Moreover, in a follow-up study, Hertenstein et al. [16] found that when participants were allowed to touch each other on the whole body, two additional emotions were decoded at above chance level. However, many of the effects of social touch depend on the interpersonal relationship [5, 29], and the gender of the individuals applying, and receiving the touch [6, 17] as well as their cultural background [9], and the body location to which the touch is applied [16]. Such factors need to be taken into consideration when designing devices and experiments for mediated social touch (see for instance [11]).

2.3 Mediated touch

Numerous devices have been designed and built that allow people to communicate a touch over a distance. For example devices that communicate a sense of presence of another person through a shared object [4], devices that add tactile input and output as an additional communication channel [8], and devices that aim to provide more intimate communication over a distance through touch [15, 24]. While this work provides valuable insights into, for instance, possible designs for mediated touch devices, some argue [12, 30, 31], that there is a lack of empirical research into the underlying mechanisms of mediated touch. Some studies that are a noticeable exception to this, have for instance found that the Midas touch effect occurs to some extent after mediated touch [13], that body location effects are similar between real and mediated touch conditions [11], that mediated touch can, to some extent, affect a person's emotional experience of a story when combined with the auditory channel [31], and that touch can help communicate empathy during interaction with a virtual agent [3]. Similar to Hertenstein et al.'s [16, 18] approach, some studies have also found indications that people can successfully communicate emotions through mediated touch. In one study, participants were asked to encode seven basic emotions using a force-feedback joystick. The encoded emotions were played back to different participants, who were tasked with decoding the emotions from the joysticks movements. Results showed that all emotions were recognized at above chance level [2]. In another study, participants used a turning-knob in two metaphorical tasks (i.e. a Ping Pong game, and stroking each other's hand), during which they communicated four different emotions. Overall the four emotions were decoded at above chance level [27].

Wang et al. [30, 31] state that most studies into mediated touch use some form of symbolic tactile communication. The authors argue that touch is a much richer communication channel and that in using touch for symbolic communication, it is reduced to a low bit rate tool [31]. However, the immediate affective consequences of remote touch are a result of a sense of presence [14, 26] (i.e. the feeling of being touched by another person). Therefore symbolic tactile communication can also have immediate affective consequences when a strong sense of presence is present in the communication. One way to study the level of presence is to compare emotional responses between 'real' and mediated conditions [26]. Similar emotional responses can be considered an indication of a felt sense of presence. This approach is considered an important element of the research outlined in this position paper.

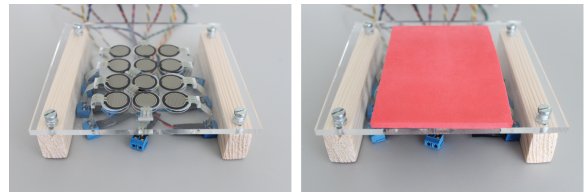

Figure 1: Prototype of the input device containing twelve force sensitive resistors.

3. MEDIATED TOUCH AND AFFECT

The aim of the current ongoing PhD work is to build on experimental studies into mediated touch. In the first stages of the PhD project, devices, such as depicted in Figure 1, will be used as tools to simulate human touch. Through the design of these devices, specific manipulations can be introduced in the experiments (e.g. cutaneous or kinesthetic stimulation). The main interest of the PhD project described here is perception and elicitation of affect in mediated touch [3, 18, 30]. In later stages of the project, psychophysiological measurements of emotion, such as facial electromyography, electrodermal activity, and heart rate [7] will be applied to assess similarities between real and mediated touch, as well as the extent to which a sense of presence is elicited by the mediated touch [26]. The next section will outline the design of a mediated touch device (Figure 1), and describe a first pilot study as an initial investigation of the communication of emotions through mediated touch.

3.1 Communicating emotions

An I/O device was conceived in order to partially replicate Hertenstein et al.'s [18] experiments. The output side consists of a grid of 4x3 eccentric-mass vibration motors

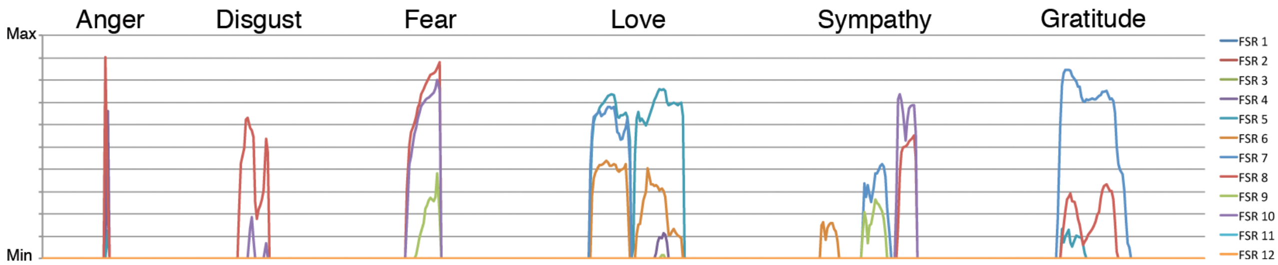

Figure 2: All six emotions as encoded by one participant. For each emotions the colored lines indicate activation of individual FSRs.

inside a sleeve that is worn on the forearm. The intensity of vibration of the motors will be controlled by the input device, which consists of a grid of 4x3 force-sensitive resistors (FSR) mounted on a plain surface, and covered by a foam sheet (Figure 1). Data from the FSRs will be logged in order to identify patterns in the expression of emotion using the device (Figure 2). Compared to other studies that investigated the communication of emotions through mediated touch using force-feedback devices [2, 27], the experiment proposed here focusses on cutaneous perception (i.e. vibrations applied to the skin surface) instead of kinesthetic perception.

3.2 Pilot study

The goal of the pilot study was to see if participants could encode a number of emotions using the input device. It was hypothesized that participants would use force, duration, and location of touch as ways to encode emotions using the device. Five participants (four male, one female), all graduate students, were asked to encode six emotions (anger, disgust, fear, love, sympathy, and gratitude) that have been found to be recognizable through touch of the forearm [18]. In addition to video recordings, data from all twelve FSRs was recorded.

It was explained to participants that it was their task to communicate six different emotions by touching the foam sheet, which they were told, represented the forearm of another person. Participants were told that the data from the sensors would be recorded and played back to another person through a grid of vibration motors, after which the other person would have to decode the emotion from the vibrations.

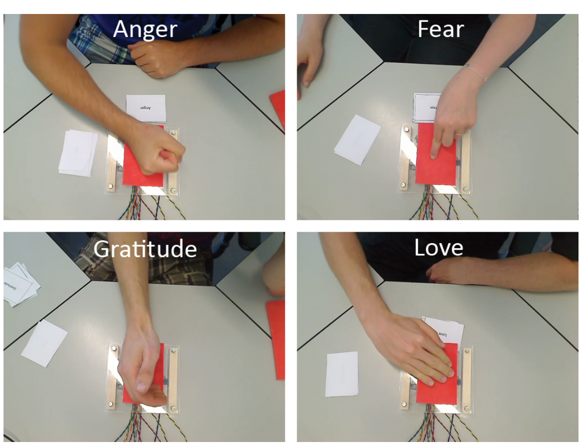

Figure 3: Examples of participants encoding emotions using the input device.

It was observed (Figure 3) that participants mostly used brief, and forceful touches for the negative emotions (two participants used more prolonged touches for disgust), whereas for the positive emotions they used more prolonged touches covering more sensors. To some extent these observations were corroborated by data from the FSRs. Figure 2 shows the sensor data for all six emotions encoded by a single participant. For both positive and negative emotions, participants mostly used expressive touch (e.g. hitting in the case of anger). One participant used more symbolic touches, for example in the case of gratitude in which this participant simulated a handshake (Figure 3). Participants made a number of comments in regard to the input device. First, it was mentioned that considerable force was required to activate the sensors. This was mainly due to the thickness of the foam covering the FSRs. It is plausible that the expressions of some emotions may only differ in the force applied during touch (e.g. love and sympathy). These subtleties were not captured in the pilot study. Replacing the foam with a thinner material may improve on this issue. Second, one participant mentioned that the active area was a rather small, flat surface, not representative of a human arm. Indeed, expanding the active surface as well as using a curved surface might make for a more realistic input device and allow participants to more accurately encode emotions as if they were making contact with the forearm of another person.

4. CONCLUSIONS

The goal of the PhD project outlined in this position paper is to provide insights into how people experience mediated touch. Paradigms from psychology research (e.g. [18]) can guide the design of experiments using mediated touch. This approach should provide insights into the underlying elements of mediated touch, such as the influence of other modalities, cultural factors, interpersonal relationships, gender, and effects of body site [11, 17, 16, 29]. It has to be noted here that mediated touch is in itself somewhat of a paradox, since touching someone requires two people to be in each others personal space. Therefore, investigating the felt sense of presence of another person [14, 26] as well as emotional responses to this sense of presence will be of vital importance to the current PhD project. Furthermore, experiments, such as the pilot study, can inform the design of new mediated touch devices to be used in other experiments during the PhD project. Moreover, results can guide implementation of tactile communication into existing devices. The results from the pilot study could for instance be translated to vibration patterns of a mobile phone. While such an approach is a strong simplification of human touch, and even of mediated touch, it might be a viable starting point for introducing mediated social touch into our daily mediated communication with others.

5. ACKNOWLEDGMENTS

This publication was supported by the Dutch national program COMMIT. Special thanks to Dirk Heylen and Betsy van Dijk for their contribution to this work.

6. REFERENCES

[1] P. A. Andersen and L. K. Guerrero. Haptic behavior in social interaction. In M. Grunwald, editor, *Human Haptic Perception: Basics and Applications*, pages 155–163. Birkhäuser Basel, 2008.

[2] J. Bailenson, N. Yee, S. Brave, D. Merget, and D. Koslow. Virtual interpersonal touch: Expressing and recognizing emotions through haptic devices. *Human-Computer Interaction*, 22(3):325–353, 2007.

[3] T. W. Bickmore, R. Fernando, L. Ring, and D. Schulman. Empathic Touch by Relational Agents. *IEEE Transactions on Affective Computing*, 1(1):60–71, 2010.

[4] S. Brave and A. Dahley. inTouch: a medium for haptic interpersonal communication. In *Proceedings of CHI '97*, pages 363–364. ACM, 1997.

[5] J. K. Burgoon. Relational message interpretations of touch, conversational distance, and posture. *Journal of Nonverbal Behavior*, 15(4):233–259, 1991.

[6] J. K. Burgoon, J. B. Walther, and E. J. Baesler. Interpretations, Evaluations, and Consequences of Interpersonal Touch. *Human Communication Research*, 19(2):237–263, 1992.

[7] J. Cacioppo, G. Bernston, J. Larsen, K. Poehlman, and T. Ito. The psychophysiology of emotion. In M. Lewis and J. Haviland-Jones, editors, *Handbook of Emotions*, pages 173–191. The Guilford Press, 2000.

[8] A. Chang, S. O'Modhrain, R. Jacob, E. Gunther, and H. Ishii. Comtouch: design of a vibrotactile communication device. In *Proceedings of DIS '02*, pages 312–320. ACM, 2002.

[9] T. Field. Touch for socioemotional and physical well-being: A review. *Developmental Review*, 30(4):367–383, 2010.

[10] A. Gallace and C. Spence. The science of interpersonal touch: an overview. *Neuroscience and Biobehavioral Reviews*, 34(2):246–59, 2010.

[11] A. Haans, C. de Nood, and W. A. IJsselsteijn. Investigating response similarities between real and mediated social touch: a first test. In *Proceedings of CHI '07*, pages 2405–2410. ACM, 2007.

[12] A. Haans and W. IJsselsteijn. Mediated social touch: a review of current research and future directions. *Virtual Reality*, 9(2-3):149–159, 2006.

[13] A. Haans and W. A. IJsselsteijn. The Virtual Midas Touch: Helping Behavior After a Mediated Social Touch. *IEEE Transactions on Haptics*, 2(3):136–140, 2009.

[14] A. Haans and W. A. IJsselsteijn. Embodiment and Telepresence: Toward a Comprehensive Theoretical Framework. *Interacting with Computers*, In Press.

[15] R. Hansson and T. Skog. The lovebomb: encouraging the communication of emotions in public spaces. In *Proceedings of CHI '01*, pages 433–434. ACM, 2001.

[16] M. J. Hertenstein, R. Holmes, M. McCullough, and D. Keltner. The communication of emotion via touch. *Emotion*, 9(4):566–573, 2009.

[17] M. J. Hertenstein and D. Keltner. Gender and the Communication of Emotion Via Touch. *Sex roles*, 64(1-2):70–80, 2011.

[18] M. J. Hertenstein, D. Keltner, B. App, B. a. Bulleit, and A. R. Jaskolka. Touch communicates distinct emotions. *Emotion*, 6(3):528–33, 2006.

[19] C. Holz and P. Baudisch. Understanding touch. In *Proceedings of CHI '11*, pages 2501–2510. ACM, 2011.

[20] H. Ishii. Tangible Bits: Beyond Pixels. In *Proceedings of TEI '08*, pages 15–25. ACM, 2008.

[21] K. O. Johnson. The roles and functions of cutaneous mechanoreceptors. *Current Opinion in Neurobiology*, 11(4):455–61, 2001.

[22] E. McDaniel and P. A. Andersen. International patterns of interpersonal tactile communication: A field study. *Journal of Nonverbal Behavior*, 22:59–75, 1998.

[23] F. McGlone, A. B. Vallbo, H. Olausson, L. Loken, and J. Wessberg. Discriminative touch and emotional touch. *Canadian Journal of Experimental Psychology*, 61(3):173–183, 2007.

[24] F. F. Mueller, F. Vetere, M. R. Gibbs, J. Kjeldskov, S. Pedell, and S. Howard. Hug over a distance. In *Proceedings of CHI '05*, pages 1673–1676. ACM, 2005.

[25] H. k. Olausson, J. Wessberg, I. Morrison, F. McGlone, and A. Vallbo. The neurophysiology of unmyelinated tactile afferents. *Neuroscience and Biobehavioral Reviews*, 34(2):185–91, 2010.

[26] M. Slater. Presence and Emotions. *Cyberpsychology & Behavior*, 7(1):121–121, 2004.

[27] J. Smith and K. MacLean. Communicating emotion through a haptic link: Design space and methodology. *International Journal of Human-Computer Studies*, 65(4):376–387, 2007.

[28] R. Stone. Haptic feedback: a brief history from telepresence to virtual reality. In S. Brewster and R. Murray-Smith, editors, *Haptic Human-Computer Interaction*, volume 2058 of *Lecture Notes in Computer Science*, pages 1–16. Springer Berlin / Heidelberg, 2001.

[29] E. H. Thompson and J. a. Hampton. The effect of relationship status on communicating emotions through touch. *Cognition & Emotion*, 25(2):295–306, 2011.

[30] R. Wang and F. Quek. Touch & talk: contextualizing remote touch for affective interaction. In *Proceedings of TEI '10*, pages 13–20. ACM, 2010.

[31] R. Wang, F. Quek, D. Tatar, K. S. Teh, and A. Cheok. Keep in touch: channel, expectation and experience. In *Proceedings of CHI '12*, pages 139–148. ACM, 2012.