DESIGNING FOR INTERPERSONAL TACTILE INTERACTION OVER DISTANCE

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Abstract. Our main goal is to design an interpersonal interaction device involving the tactile perception. Starting from observations on subjects manipulating tangible mock-ups we observed to main strategies in the way they act to establish the contact with their partner: either they adopted an 'engaged' or a 'receptive' attitude. Using a minimalist approach and a very simplified 1D interaction space we conducted user experiments to try to design tactile avatars that would fit with these observed strategies.

1. Introduction

As underlined by Paul Watzlawick, "one cannot not communicate" (Watzlawick, 1984). Hence, numerous communication technologies have been developed over the last decades, and socializing with others has become one of the most popular uses of the Internet. However, to convey non verbal signs, computer mediated communications can be frustrating. Those phatic signals (shaking hands, smiling or other appropriated facial expressions, doing expressive gestures, etc.) are necessary for the mutual recognition and attesting mutual interest. To share the cues needed to gracefully manage this contact negotiation (i.e. starting end ending a conversation), prototypes using text, video, and graphic indicators have been developed (Tang, 2007). An alternative of audio and visual channel, which are often overloaded, would be to use the tactile modality in distal communication. Since touch is a very private sense and does not interfere with environmental perturbations, it could be of a great interest in all such situations of non-verbal interactions.

2. Related work

Many researches have been done on products involving the tactile sense for interpersonal interactions. InTouch (Brave and Dahley, 1994) and ComTouch (Chang et. al., 2002) are popular prototypes supporting emotional or phatic aspects of communication by involving haptics and vibrotactile feedbacks. Tactile stimulators have also been implemented on 'perceptual supplementation devices' or 'sensory substitution systems'. Those were initially developed as an aid for persons with sensory handicaps. An example is the Tactile Vision Sensory Substitution (TVSS) invented by Bach-y-Rita which transforms the images captured by a digital camera into tactile stimulation on a square matrix of 400 dynamic pins. Early trials with this system rapidly showed that spectacular capacities for recognizing objects and even faces in the environment could be developed by users on the condition that they were active (translating and rotating the camera) (Bach-Y-Rita and Kaczmarek, 2003). This 'active perception' theoretical framework has been variously developed in the ecological approach to perception (Gibson, 1966) and in sensory-motor or enactive approaches (Varela, 1979).

This literature review confirms that, even if tactile technologies do not provide yet realistic stimuli, this can be compensated by a richness of action to develop a product engaging the user in a pleasurable and emotionally rich experience of distal contact with her/his partner.

3. Users' attitudes observations

Our attempt of designing a product for interpersonal mediated interactions involving the tactile sense is based on a process which largely mobilized participative design theories and tangible interaction [8]. Indeed, making interfaces elements tangible is inspiring for subjects and allows to reveal some of their latent needs. Through the observation of subjects simulating the usage of an interpersonal interaction device with mock-ups on which the contact list had been made tangible (each contact being embodied in an interface element) we enlightened different attitudes regarding the way one person contacts another. Those could be ranked on a continuum, going from a 'receptive' attitude to an 'engaged' attitude.

The attitude has been qualified as 'receptive' when the subject moves the tangible parts embodying the persons she or he wants to communicate with toward him: *«I do not move myself but I change the location of my friend to make the contact with me»*. On the contrary, her or his behaviour was qualified as being 'engaged' when he or she user moves the elements of the tangible interface embodying her or him toward parts embodying the others: *«I engage myself and move toward my friend »*.

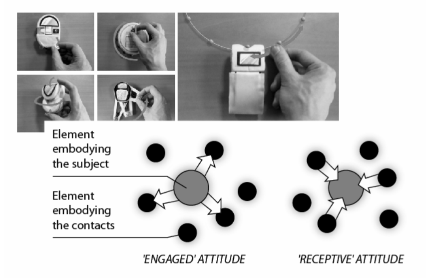

Figure 1. Observations of rough mock-ups manipulations.

In this context, our challenge is to design a shared tactile interaction space where users could express and perceive ‘engaged’ and ‘receptive’ communicational attitudes. To achieve this goal, we chose a minimalist experimental approach. This has the advantages of facilitating the collection user’s activity traces and their interpretation according to the observed behaviours or strategies. Furthermore, thanks to the simplicity of the system, the results can have a general value and find a wide range of applications.

4. EXPERIMENTAL SET-UP

4.1. DESCRIPTION OF THE APPARATUS

As the architecture and control modalities of the product we are designing are not yet fixed, we chose to conduct our interpersonal interactions experiments using standard computers. The system is described in the next figure (figure 2). The system is made of two web linked computers. On each computer is plugged a mouse and a dynamic tactile stimulator made of two Braille cells (a 4x4 pins matrix). The software “TACTOS”, developed at the University of Technology Compiègne, carries out a coupling between the displacements of the mouse and the position of an avatar along a shared line (with the ends joined to form a circle and avoid bounds effects at each extremity of the line). The length of the shared line has been fixed to 400 pixels. Each time a participant encounters her/his partner’s avatar, she/he received an all-or-none tactile stimulation. Thus, this experimental device allows tactile encounters between blind people or blindfolded participants.

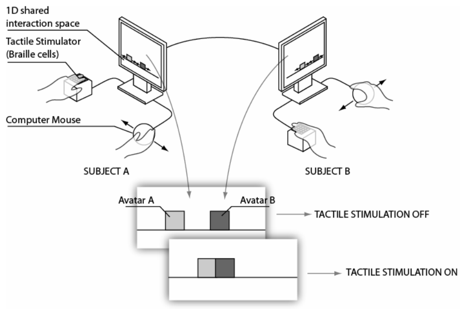

Figure 2. Illustration of the TACTOS system.

4.2. TACTILE AVATARS DESIGN

In real and natural conditions, there is a coincidence between the touching subject and the touched subject: I can not touch someone or something without being touched. However, when a technical mediation is used for distal touch, the perceiving-field (what is used to touch the environment) can be separated from the image-body (what is given to be touched by others): touching without being touched and being touched without touching become possible situations (figure 3).

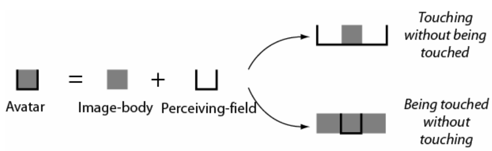

Figure 3. Tactile avatar decomposition and offered possibilities.

Our assumption is that we build tactile avatars which can take advantage of different sizes of forms of perceiving-field and image-body to express ‘engaged’ and ‘receptive’ communicational stances.

Thus, 4 avatars were designed by the combination of 2 different sizes of perceptive-field and 2 different sizes of image-body (

TABLE 1).

TABLE 1: Experimented tactile avatars.

		Perceptive-field	
		4 pixels	**20 pixels**
Image-body	**4 pixels**	 **S-S**	 **L-S**
	20 pixels	 **S-L**	 **L-L**

We can notice that on a perceptive point of view (in other words: considering what the subjects feel) the S-S/S-S, L-S/L-S, S-L/S-L and L-L/L-L combinations are equivalent. Indeed when both subjects have identical avatars, they are perceived by their partner as soon as they perceive her/him. By this way we can reduce to 7 the number of avatars' combinations to be studied. These 7 combinations should allow us to exhaustively experiment the effects on the dyadic interaction dynamics of a difference of image-body only; of perceptive-field only; and of both in coupled conditions and crossed conditions

4.3. HYPOTHESIS AND EXPERIMENTAL PROTOCOL DESCRIPTION

We expect that the L-S avatar would be appropriated to an 'engaged' attitude, while the S-L avatar would be better for a 'receptive' attitude. Indeed, to match an 'engaged' attitude, the avatar of the subject in the interaction space has to facilitate an active exploration of the interaction space. By enabling the perception of a large area, the probability to meet someone else is increased. On the other hand, a 'receptive' communicational stance corresponds to a more passive behaviour: the subjects does not move, but tries to make the contacts come to him/her. In this situation, attracting others is the main point: perceiving a large area becomes less important than being perceived by others over a large area.

To put to the test our hypothesis we imagined a task eliciting 'engaged' or 'receptive' attitudes. A guiding task appeared us as being relevant. Indeed, to be successful in this collaborative kind of task the guide has to be 'receptive' since he has to attract her/his partner to be able to show him the way, while the other subject has to be 'engaged' and actively explore the space to be able to follow the guide in the correct direction.

20 participants aged between 19 and 27 took part to this study (10 pairs, 6 males pairs, 2 females pairs, and 2 mixed). They were placed in two separated rooms and can only interact though the TACTOS system. They

were blindfolded to not see the position of their partner on the computer screen and had a few minutes to accommodate to the TACTOS system and to the tactile perception. The experiment was divided into 7 sessions. During each session the subjects had to do 2 guiding tasks, being alternatively guiding and guided. For each pair of participants, the order of the sessions was randomized to avoid learning effects.

4.4. EXPERIMENT DESCRIPTION

The above figure (Figure 4) helps to understand the guiding process.

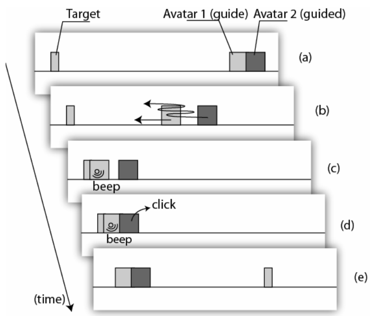

Figure 4. Guiding task illustration.

Subjects started the session in contact of each other (Figure 4 (a)). Then, the guide goes to one direction. As the shared line along which the subjects move is joined at its ends the guide will necessarily meet the target whatever the direction she or he chooses. The guided person then explores the interaction space to try to find where is going her or his guide and has to try to keep in touch with her or him (Figure 4 (b)). When the guide meets the target a sound is played. This sound can only be perceived by her or him and it indicates the direction in which he or she has to go the meet the next target (Figure 4 (c)). However, there are two necessary conditions to make the further target appear: (1) both avatars are in contact with the current target and (2) the guided subject has to click on the current target (Figure 4 (d) and (e)). This enforces the subjects to stabilize a perceptive crossing, which is the only way for the guided person to understand that the guide has found the target. The objective is to reach the maximum amount of targets in 90 seconds.

4.5. SCORES ANALYSIS

For each one of the 7 tested avatars' combinations and each one of the two possible statuses (either guide or guided) the mean and standard deviations of the scores (amount of target reached) was calculated and plotted (Figure 5). We can notice that the standard deviation is quite important. This reflects important differences in inter-individual abilities which were observed during the experiment. Indeed, although all participants had never used the Tactos system before the experiment, some appeared very at ease and very enthusiastic by discovering a new mediated interaction modality, while others felt a bit uncomfortable with the apparatus.

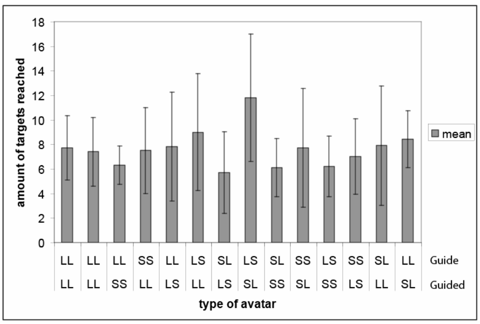

Figure 5: mean of the scores reached for all the tested avatars' combinations

Considering these calculated means we notice in 5 cases out of 14, the performances have been lower than in our reference situation (L-L guiding L-L with corresponds to a kind of 'natural touch' - since the subject is touched as soon as he touches her or his partner – with same avatars' sizes for both partners). An interesting case is the crossed conditions (S-L guiding L-S and L-S guiding S-L) since it provided either the best or the worst measured performances. This tends to confirm our hypothesis, i.e. the possibility to couple an attitudinal behaviour with a particular avatar:

- a large perceiving-field and a small image-body matches an 'engaged' attitude;
- a small perceiving-field and a large image-body matches an 'receptive' attitude;

The fact that anti-symmetrical avatars' configuration gave the higher performances also shows that in such kind of collaborative task, to maximize the efficiency, each partner has not only to chose an avatar which matches her or his own attitude or intentionality, but she or he should also consider the avatar of her or his partner in her or his choice. To confirm the significance of these results, variance analyses were done. A first between-couples ANOVA was run across the 14 avatars combinations. A significant difference was found in the scores across avatars configurations variations. $F(12,129)=1,86$, $p=0.047<0.05$. Then, a second ANOVA was run, to enhance the effect of both avatars' combinations and subjects' statuses (either guide or guided). A significant difference was found ($F(6,54)=4,95$; $p=.0004<0.05$), which allows us to conclude that an avatar has not the same effect if it is used to guide or to be guided.

5. Conclusions and Discussions

Our main goal is to design an interpersonal interaction device involving the tactile perception and matching users' attitudes we observe on subjects manipulating tangible mock-ups. Using a minimalist approached and a guiding task in a very simplified 1D interaction space we managed to design and evaluate avatars which seem to fit with the 'engaged' and 'receptive' communicational attitudes. However, this attitude was inherent of the task, since guiding implies a 'receptive' attitude and following implies an 'engaged' attitude. To complete this study and being able to provide rules for such tactile avatars design we should conduct other experiment with other tasks (such as competitive task) where the attitude would not be imposed and see if subjects better perform with an avatar that corresponds to their attitude.

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