Tactile interaction in on-line communities

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ABSTRACT

To study the dynamics of on-line tactile interactions, we developed an original experimental device. It was conceived starting from sensory substitution systems that we develop for blind people. It allows an analysis of reciprocal perception (caresses) and of mutual recognition of the people in interaction. These observations show that it is possible to recognize the image which we present to others (our face) through the way in which they perceive us.

Author Keywords

Tactile interaction, Blind people, Mutual gaze, Sensory substitution systems.

ACM Classification Keywords

H.5.1 Multimedia Information Systems. *Artificial, augmented, and virtual realities;* H.5.2 User Interfaces. *Haptic I/O;* H.5.3 Group and Organization Interfaces. *Synchronous interaction*

INTRODUCTION

We currently develop devices of perceptual supplementation (sensory substitution systems [1,3]) to give to blind people an access to graphic information on computer screen. However, concerning the adoption of these devices by blind people we encounter the problem of the qualitative experience (qualia) and of the emotional value of the percepts[2,6]. Our principal hypothesis is that the constitution of emotional values must be carried out by creating a community of users sharing the same technical interfaces. That led us to the study of a kind of distal caress on the networks. It is also the occasion of an experimental research on some major psychosocial questions like the recognition of the other, or the perception of the image that each one presents to others [10]. Indeed, in this context it seems possible to study a purified and fundamental form of reciprocal perception, in this case a kind of mutual touching which is the tactile equivalent of catching each other's gaze in vision. First of all, we present our system of perceptual supplementation: the tactile stylus. Then, we will present our experimental device and the results of a preliminary experiment. Finally we will propose some conclusions and hypotheses for future research.

I. THE TACTILE STYLUS (TACTOS)

The aim of the "Tactile Stylus" (software "Tactos") is to give to blind people an access to graphic information on computer screen (Patent US-2004-0241623-A1). It carries out a coupling between the stylus of a graphics tablet and tactile sensory stimulators (figure 1)[7]. The tactile stimulation is produced by a dynamic control of 2 electronic Braille cells (2X8 points of stimulation). The movements of virtual receptive fields on the screen are driven by the stylus and command the stimulators. When a receptive field covers a black pixel, the corresponding tactile stimulator is activated. The mechanical components stimulate the pad of the left index fingertip while the movements of the receptive fields are driven by the right hand (all the subjects are right-handed). So, this system allows subjects to explore virtual pictures present on the screen.

For practical applications one can increase the number of receptor fields and tactile stimulators, but for fundamental research it is on the contrary more interesting to work in the

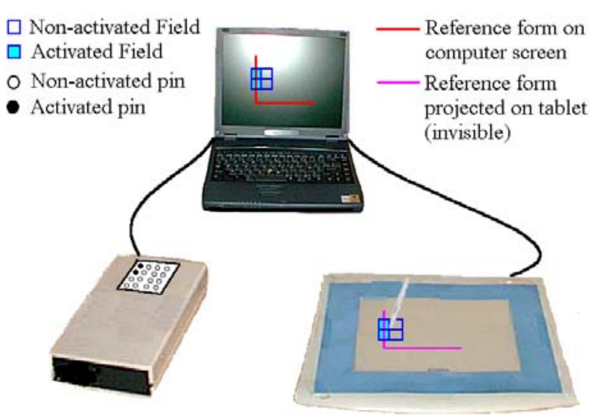


Figure 1

orderline case where sensory information is reduced to a single receptive field connected to a single tactile stimulator. However, even in this simplest version one observes a capacity to recognize forms. In such experimental conditions, our subjects can perceive forms only via an active exploration of the virtual image. So, this prosthetic device enforces a spatial and temporal deployment of the perceptive activity as a trajectory which can easily be observed and recorded (figures 2 et 3).

Figure 2

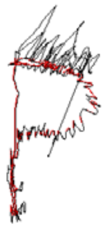


Figure 3

This perceptive activity is the object of various analyses and mathematical simulations in our team [5,10,11,13].

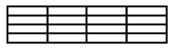
II. STUDY OF RECIPROCAL TACTILE PERCEPTION

II.1. Experimental device

The experimental device consists simply of the setting up a network of two "Tactile stylus". The numerical space shared via the network allows tactile encounters between the blind subjects or blindfolded participants. Each tactile stylus drives simultaneously: i) the movements of a matrix of receptive fields coupled to the same number of tactile stimulators; and ii) the displacements of a virtual body (avatar), i.e. of a body-image that the other user can perceive via his own receptive fields. Each subject explores their own graphics tablet and comes into contact either with objects in the shared environment, or with the body-image (avatar) of the other actor. One allows thus the constitution, for each user in interaction, of a common space of perceptive coordination.

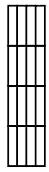
We present here only one of the preliminary experiments which we undertook. This experiment was carried out within the framework of a preparatory research task [4]. This work is about the perception that each subject has of their own image through the perception that the others have of him. We want to know if, in the dynamics of the perceptive interactions, it is possible, for a subject, to understand the image which he offers to the perception of other subjects. This experiment will have to be repeated and increased for confirmation.

In the experiment, the tactile stylus drive each one a matrix of 16 contiguous receptive fields coupled to 16 tactile stimulator. Subjects can have different perceiving-bodies and different body-images. There are three possible perceiving-bodies, i.e. three matrices of 16 receptive fields of different forms :



Hp : 4 x 4 receptive fields of 20 x 2 pixels

S : 4 x 4 receptive fields of 2 x 2 pixels



V : 4 x 4 receptive fields of 2 x 20 pixels

And there are three possible body-images, i.e. three forms of avatar which the partner can perceive. They are sets of pixels which move with the perceiving-body :

Hi

Si

Vi

Each subject can receive any possible combination of these bodies. To give just two examples (out of the 9 possible combinations), a perceiving-body Hp and an body-image Vi (figure 4), or a perceiving-body Sp and a body-image Hi (figure 5) :

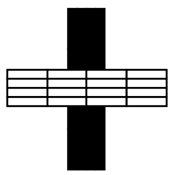


Figure 4

Figure 5

The preliminary experiment that we present here was carried out by two subjects “A” and “B” who passed the 81 sessions corresponding to all the possible combinations of their perceiving-bodies and body-images. Subjects know these repertoires of possible forms of their perceiving-body and body-image, but of course they do not know those with which one equipped them at the beginning of each experimental cession. All the possibilities are generated randomly. The two subjects share the same virtual space: when a receptive field of "A" covers a pixel of the body-image of "B", the corresponding tactile stimulator is activated. The two subjects collaborate and seek to facilitate the task of the other as much as they can. Each session can be divided into three stages for which one successively asks each subject to indicate:

-1- the form of its own perceiving-body

-2- the form of the body-image of the partner, and finally,

-3- the form of its own body-image.

The durations of stages 2 and 3 are limited to 6 minutes each.

II.2. Results

-1- First of all, stage 1, each subject seeks to identify himself as a perceiving subject, i.e. to guess the shape of its matrix of his own receptor fields.

Number of correct answers of subject "A" concerning its perceiving-body: 78/81 ; $\chi_1^2 = 145$, $P << 0.01\%$

Numbers of correct answers of subject “B” concerning its perceiving body: 77/81 ; $\chi_1^2 = 139$, $P << 0.01\%$

A pure random choice would have given on average only 27 good answers for each subject. The near-perfect answers are obviously very highly statistically significant. It is easy to understand that each subject can determine in an autonomous way its perceiving-body by interaction with motionless objects in the medium. For example, if the perceiving-body is of type Hp, the movement that the subject will have to carry out to pass a vertical line will be much longer than that necessary to cross a horizontal line.

-2- Then, stage 2, each subject seeks to recognize the body image of its partner.

Number of correct answers of subject “A” concerning the body-image of subject “B”: 76/81 ; $\chi_1^2 = 133$, $P << 0.01\%$

Number of correct answers of subject “B” concerning the body-image of subject “A”: 71/81 ; $\chi_1^2 = 107$, $P << 0.01\%$. Here again, a purely random choice would have given on average only 27 correct answers for each subject. The results are nearly as perfect as in stage 1, and the statistical significance is again extremely high. The subjects collaborate: each one immobilizes itself in turn to let his partner explore him quietly. The success of this stage corresponds to the capacity to recognize simple forms that we often observed with this device.

-3- And finally, stage 3, each subject must recognize its own body-image.

Number of correct answers of subject "A" concerning its own body-image: 48/81 ; $\chi_1^2 = 24.5$, $P < 0.01\%$. Number of correct answers of subject "B" concerning its own body-image: 46/81 ; $\chi_1^2 = 20.0$, $P < 0.01\%$. The results are less perfect than in stages 1 and 2, but still statistically highly significant.

Number of correct joint answers of the two subjects concerning their own body-image: 32

A pure random choice of the two partners would have given on average only 9 correct joint answers. The significant success of this stage ($\chi_1^2 = 66$, $P << 0.01\%$) is very revealing on reciprocal perception insofar as each subject does not have any direct access to its own body-image (as in vision we have no access to our own face). It can be guessed only via the way in which its partner perceives him. It is then interesting to examine the interdependence between the answers at the various stages and between the partners. First of all, we do not observe a correlation between the mutual resemblance of perceiving-bodies or body-images of the two partners and their success in the crucial task to recognize their own body-image ($\chi_1^2 = 0.47$, $P>50\%$). As opposed to what one could have thought our resemblance does not help us to recognize us mutually. However, there is a correlation between the successes of the two partners as for the recognition of their own body-images ($\chi_1^2 = 4.60$, $P < 5\%$). But, one does not find a clear dependence between the success of the recognition of the body-image of the other (stage 2) and the success of the recognition of his own body-image (stage 3) (for the subject A : $\chi_1^2 = 0{,}95$; for the subject B : $\chi_1^2 = 0{,}048$). The dependence which one observes is rather between the success of a subject for the recognition of the body-image of the other (stage 2 of a subject) and the success of the recognition by this other subject of its own body-image (stage 3 of the other subject) (for the subject A : $\chi_1^2 = 1.75$, $P < 20\%$; for the subject B : $\chi_1^2 = 2.94$, $P < 10\%$; for the two together, $\chi_2^2 = 4.69$, $P < 10\%$) .

This experiment is very preliminary, and we are repeating it more systematically. But we can already propose to draw from them some assumptions for future research.

III. HYPOTHESES AND REFLEXIONS

It seems to us that results of this experiment, if they are confirmed, should have a very general value. Indeed, by its simplicity, the interaction device that we set up can be understood as a purified form of reciprocal perception in general, i.e. of any situation where, via a perceptive modality, employing a prosthetic device or not, subjects perceive themselves mutually.

To look further into the comprehension of this mutual perception we are currently undertaking the study of the cross dynamics of the perceptive trajectories of the two subjects in interaction.

The perception of others has nothing to do with the perception of an object. In the perceptive crossing, each one explores by its active touch the movements which its partner carries out to perceive him. The various moments of this cross dynamics - alternations between posture of object or subject, oscillation in phase or opposition of phase, dephasings and rephasings, collective drift,…- characterize for each one, not the perception of a thing, but rather that of a *perceptive power* different from oneself. Others are recognizable like such, not by its image, but by its perceptive activity. This meeting charges the perceptive activity of deep emotional contents. It becomes possible to constitute deictic perceptions by which one can indicate an object to the perception of the other, which allows the deployment of a system of differences and qualification of objects, for example by mimetic desire.

In addition, with the same experimental device, some other experiments in progress aim, for example, at understanding the conditions of a mutual spatialization of the points of view, or to understand the mechanisms of a form of intentional imitation being able to explain deictic glances.

One of the reasons most generally advanced by blind people to refuse the prosthetic devices proposed to them is the image that they believe that they present to others [9]. They fear to be carrying a monstrous equipment, and do not accept to be transformed into a "cyborg" for others. Also, they do not have access to this image which they present to others. All the observations reported in the literature are about a purely individual use of sensory substitution systems. The user, surrounded by sighted persons, is isolated in his particular mode of perception. But we suppose that the adoption of a prosthetic device, like all new technical devices of perceptual supplementation, depends on the emotional *values* of the new perceptual experience that it offers. And we think that these values could emerge from a common history built in the course of interactions between several subjects in a common environment defined by the same means of access [8]. However, our experimental study seems to show that, in the case of a reciprocal perception, if each subject reaches the same space of interaction by the same mediations, it becomes possible to recognize, through the use of this mediation, the image which the subject presents to the point of view of others. This could be the starting point so that shared emotional values specific to this perceptive experiment emerge.

At the same time, the main result of our experiment, about the interdependence of perceptive activities, could have an important ethical consequence: my active perception of others helps them to recognize themselves (but does not help me to recognize myself). Conversely, it is the other who, by his way of looking at me, helps me to constitute an image of myself, to recognize my own face.

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