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An ethnographic, action-based approach to human experience in virtual environments

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Abstract

This paper addresses a sensitive issue, of presence experienced by people interacting with a virtual environment (VE). Understanding 'presence', both theoretically and empirically, is important for designers interested in building effective computer-mediated environments for learning and work activities. The concept of presence has been treated mostly as a state of mind, to be investigated through 'objective' and 'subjective' measurement devices. The authors propose to add a different approach, which can address presence as an *action-based* process. This approach considers presence as the ongoing result of the actions performed in an environment and the local and cultural resources deployed by actors. In this sense, 'presence' can be captured by monitoring the sequence of participants' actions and the aspects of the environment that are involved in this process; discourse/interaction analysis represents a fitting method for this goal. Sequences of interaction with a virtual library are used to illustrate some core aspects of an ethnographic, action-based approach to presence, such as the action possibilities envisaged by participants, the configuration of the virtual objects, the norms that regulate the interaction, the resources that are imported in the VE. These aspects are a necessary step to understand users' presence in the VE and to plan consequent interventions to ameliorate the design of the interface.

There is implicit in the quality of a scene the quality of the action that is to take place within it. The set-stage contains the action ambiguously and in the course of the play's development this ambiguity is converted into a corresponding articulacy. (K. Burke, 1969, A grammar of motives, p. 6–7.)

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1. Introduction

The gamut of events taking place in computer-mediated environments has been recently enlarged by the diffusion of virtual reality. The fast pace at which virtual reality has made its way into the academic and applications fields, in fact, has brought to the foreground new issues and accentuated familiar ones in the area of human–computer interaction (HCI), gathering them under the umbrella concept of 'presence'. This concept has been used for several years in media and social studies (Biocco and Levy, 1995; Mantovani, 1996; Reeves and Nass, 1996; Lombard and Ditton, 1997) to indicate the ability of a communication medium to make the interlocutors available to each other; currently, it is used to indicate the overall experience of being in a mediated environment, especially in a virtual environment (VE) (Barfield et al., 1995). Asking what is involved in being present in a VE means recognizing that a technical description alone cannot account for the way in which the VE and its functioning are grasped by the users;[1] the analysis of the psychological experience becomes then part and parcel of the effort to develop a satisfactory and effective technological tool. In fact, when it comes to VEs, the same caution should be adopted as with any other human environment, where 'place' is distinct from 'space' (Thuan, 1977; Malpas, 1999; Gieryn, 2000). While 'space' is a physical dimension, 'place' is generated as activities and cultural meanings are imposed on it. In this sense, 'to have knowledge or understanding of the world in general (…) is fundamentally a matter of being able to act and move; to have a grasp of one's own location (…) is essentially tied to the capacity to navigate and to move within that space; the unity of a particular space is thus grasped through the unity of action and movement that is possible within that space' (Malpas, 1999, pp. 134–136). If the goal is to understand the users' presence in the simulated space, then partitioning the space according to physical parameters or identifying the boundaries of an object with a priori specifics written by the designers would be of little use. It would be preferable, instead, to orient to those demarcations that emerge from participants' engagement with the simulation and are then meaningful to the inhabitants of the VE (Crang et al., 1995).

The notion of presence has grown more and more sophisticated, as different perspectives and new layers of complexity have entered the picture. The original purpose that propelled the study of presence was to measure the sense of presence felt by the user as a way of assessing the so-called 'immersivity' of the system (Wann, Mon-Williams, 1996; Stanney et al., 1998). Therefore, a classic endeavour has become the search for a measurement tools that can capture the user's presence and

[1] The literature on HCI has already adopted this perspective; it has maintained throughout the last decade that the technical features of an object do not stand on their own, but are connected to the practices of the socio-cultural system in which the object is placed (engineers', users', artists', vendors'). From this perspective, the cultural and technical dimensions belong together, their connection being shaped by the actions performed with the object and made possible by cultural competence. (Latour and Woolgar, 1986; Winograd and Flores, 1986; Suchman, 1987; Zuboff, 1988; Fulk and Steinfield, 1990; Gagliardi, 1990; Orlikowski and Baroudi, 1991; Button, 1993; Hutchins, 1995; Zucchermaglio et al., 1995; Kling, 1996; Mantovani, 1996; Nardi, 1996).

rate it (Biocca, 1992; Steuer, 1992); this effort has produced various methods, normally distinguished as 'subjective' and 'objective'. '*Subjective*' methods rely on self-evaluations produced by participants and include a variety of techniques from administering questionnaires (Towell and Towell, 1997; Singer and Witmer, 1999; Lombard and Ditton, 2000), to collecting self-reported breakdowns in the sense of presence (Slater and Steed, 2000), comments and interviews. The problem is that it is unclear whether people are actually aware of their degree of presence or not; it is unclear, in other terms, whether they faithfully report on the actual nature of their experience or provide instead a post hoc elaboration of it.

To overcome this problem, *objective* methods have been proposed, which register the degree of presence experienced by participants without asking them directly. These methods include physiological measures such as skin conductance, heart rate, posture, ocular responses (Barfield et al., 1995); choice among conflicting stimuli coming from virtual and 'real' environments (Prothero et al., 1995); behavioural responses to unexpected or threatening stimuli (Held and Durlach, 1992; Freeman et al., 2000); emission of 'socially conditioned' responses such as ducking to avoid an object or putting out the hand in response to a hand-shake gesture (Sheridan, 1992). The main problem here is to establish the expected correlation of these 'objective' indexes with the inner sense of presence, given that a discrepancy has been registered between objective and self-reported measures (Stappers et al., 1999). Furthermore, many objective methods apply when the simulation tries to duplicate a real-life situation, not when an unprecedented one is created, since they rest on the assumption that the greater the presence, the more similar would be participant's behaviour to a real-world one.

The above methods share some common characteristics: first of all, each measure is inevitably inferential; second, aspects such as performance in the environment, the relation with other people in the simulation and the intersection with settings other than the simulation are considered as external to the psychological experience per se, as variables exerting an influence on it. Third, the complex phenomenon of being present in a certain environment is rendered as a discrete value on a scale, whereas the rich, dynamic process through which it unfolds remains uncovered. At the root of these stances is probably the way in which presence is treated, namely as a private experience (Draper et al., 1998). As such, it can be studied either by asking people directly or by collecting its effects in the behaviour, but it remains an intimate state, utterly internal to the individual and captured as a static snapshot by the measuring apparatus.

For these reasons, this approach to presence in mediated environments has been accompanied by others, which are less concerned with measuring the experience and more with identifying its nature and components. Some authors have proposed more elaborate depictions of presence, partitioning it into simple, cybernetic and experiential presence (Draper et al., 1998); focus, locus and sensus (Waterworth and Waterworth, 2001); personal, social and environmental presence (Cuddihy and Walters, 2000); or according to the task performed (Schlörb, 1992). Some have studied the relationship between presence and place (Riva, 1998; Murray et al., 2000), the different conversational patterns that emerge while interacting with a VE

(Bowers et al., 1996) or the effect of different embodiments (Benford et al., 1995). Some have unearthed some overlooked issues, such as the alternation of emersion and immersion during a virtual session (Waterworth and Waterworth, 2001; Slater and Steed, 2000) or the blurring distinction between person and environment (Flach and Holden, 1998; Zahoric and Jenison, 1998; Sheridan, 1999; Mallon and Webb, 2000). Some others have addressed the issue conceptually, to find out alternatives to the mental, intimate model of presence, by endorsing, for instance, an ethnographic, action-based framework.

This latter framework is the product of inputs coming from anthropology, cultural psychology, discourse analysis and human geography. This approach recognizes that presence is an ambitious concept referring to the user's experience in the VE, which is complex, contextualized and dynamic. It stresses the reciprocal contribution of both the environment and its inhabitants in configuring each other and the central role of local action in shaping presence (Flach and Holden, 1998; Zahoric and Jenison, 1998; Cuddihy and Walters, 2000; Sheridan, 1999; Mantovani and Riva, 1999; Riva and Mantovani, 2000; Schubert et al., 2000). It then invites us to:

- focus on the *process through which presence is constituted and changed*,
- focus on the *relationship* between the user and the physical and social environment,
- treat presence as a publicly *accessible* phenomenon,
- *problematize* the configuration of the virtual body, the boundaries of the VE, the objects recognized in the simulation,
- discard a specific configuration of presence as the true one, allowing instead *various* configurations according to the users' pragmatic concerns and the different resources deployed.

These remarks hold even if the final purpose is to estimate the degree of presence. In order to make sense of the measures obtained, we need to specify the coordinates of the construct under assessment, i.e. who is present, where s/he is present and for which purposes.

In the following sections, we will elaborate this depiction of an ethnographic, action-based approach and unpack it into a series of hints for the analysis of presence, namely—in this model—for the analysis of the psychological experience of acting in a VE. We will discuss the advantages of including an ethnographic, action-based approach in the theoretical toolkit and suggest discourse and interaction analysis as a powerful method to carry out this study.

2. An ethnographic, action-based approach to presence

2.1. The analytic focus

Had we to translate the general claims illustrated above into a methodological grid, we would start by setting *action* as the focus of analysis. What is meant here by 'action' with respect to other models that have been preoccupied with it?

Traditionally, action is taken to be the terminal stage of a process initiated in the mind of the actor with a plan (Miller et al., 1960), an attitude (Fishbein and Ajzen, 1975), a decision (Simon, 1979). In contrast, here action represents the main arena of psychological processes, which overflows the boundaries of the mental domain for its tight relationship with the context (Suchman, 1987).[2]

Focusing on action has the payoff of avoiding restrictive dichotomies: action is at the same time observable ('objective') and the product of local, specific circumstances ('subjective'); it employs symbolic resources as well as material ones; it connects the microdimension of the individual conduct with the macrodimension of cultural practices. The fulcrum is action and anything that becomes part of it gains its relevance as a resource. The term 'resource' (Potter and Wetherell, 1987; Suchman, 1987) is adopted because it implies no specific causal mechanism on action and no dimension (environmental, cognitive, behavioural) is given priority over another, as it happens when other concepts such as categories, stimuli or signals are used. 'Resources' can be available in the local context, like a material tool or a previously agreed commitment, or brought into the context, like the cultural practices responsible for the ordered phases of an activity. To avoid arbitrary attributions and make the analysis 'accountable', one has to carefully report which cues in participants' action point to which resources.

Discourse and interaction analysis (Shiffrin, 1984; Suchman and Trigg, 1991; Jordan and Henderson, 1995; Goodwin, 2000) are qualitative methods for the systematic analysis of action. Discourse analysis has developed from the basic idea that we do things with words, as the title of a seminal book by Austin (1962) runs, and analyses the action realized by people talk. It has subsequently extended to other kinds of action, such as gestures, gaze, posture adjustments, spatial-positioning, tools usage (Atkinson and Heritage, 1984; Hanks, 1990; Duranti, 1992; Goodwin, 2000; McNeill, 2000) and has been applied to the study of HCI (Bowers et al., 1996; Heath and Luff, 1996; Goodwin, 1999), sometimes with the label of interaction analysis (Suchman and Trigg, 1991; Jordan and Henderson, 1995). Besides the

[2] Another theoretical tradition that puts great emphasis on action is activity theory (Engeström et al., 1999). Founded by the Russian psychologist Leont'ev and elaborated by many scholars in the field of HCI (Nardi, 1996), it is concerned with the exaggerated emphasis usually accorded to ideas and symbols in social theories and maintains instead that social phenomena are basically pragmatic, physical and material. It also includes the dynamics of change in the model: mindful of the Marxist notion of dialectic and conflict, it sees transformation as produced by contradictions in the components of the activity system. Finally, it joins the Vygotskian tradition and cultural psychology in highlighting the role of artefacts in the development of human faculties. In this respect, activity theory is totally consonant with the ethnographic, action-based approach. It sometimes departs from it when action is depicted as an individual endeavour, even though inserted in a socio-cultural context, and is formalized without preserving participants' distinctions and categories.

Phenomenology has been among the first paradigms to highlight action as the organizing criterion according to which the world is experienced and organized. Fascinating studies have been produced in this vein (Merleau-Ponty, 1970; Lakoff and Johnson, 1999; Murray and Sixsmith, 1999; Murray, 2001). It appears that the main difference between this approach and ours is that phenomenology translates actions in terms of individual experience, and cultural aspects intervene later (lived body versus culturally experienced body, as explained in Ihde, 2002); an ethnographic, action-based approach, instead, considers experience as inherently social, cultural, relational as well as material and physical.

necessary familiarization with the context and its practices, the analytic procedure consists mainly of the following phases: first, videotapes of the interaction with the technology are recorded. Then those 'fragments' are extracted from the corpus of videodata that contain an occurrence (or 'specimen') of the phenomenon of interest. Finally, all fragments are transcribed according to a transcription code, the single actions are parsed and the meaning that emerges from the sequence of actions is analysed, by paying attention to order and contextual relevance (Levinson, 1983). Let us give an example to better illustrate these latter points with respect to the structuration of presence during the interaction.

2.2. Discourse analysis and presence: an example

Excerpt 1 is part of a fragment in which the experimenter intervenes to give explanations; a collection of similar fragments was used to study the preferred type of directive adopted by the experimenter during immersive VE sessions (Spagnolli, 2001a, b; see also Section 3c). The participant is equipped with helmet and joystick and explores a VE, which resembles a real library she is familiar with. At the very beginning of the exploration she has some problems in crossing the threshold of the virtual library: she tries to move forward but she is stopped by the edge of an antitheft device she is bumping against. (The transcription code is reported in the appendix. R stands for 'researcher' and P for 'participant'.) Let us examine the excerpt in discourse analytic terms, first, and for what it entails about presence, next.

Excerpt 1

1 P: Oh I cannot get in¿
Ah non posso entrare¿

2 R: Well: you're bumping against that post there, but: >go, go<.
eh: stai sbattendo contro quel paletto lì, però: >vai, vai<.

3 P: ⌊*((she looks around in the simulation and stops))*

4 excuse me but,=
e ma scusa,=

5 *((she clicks on the button of the joystick;*
⌈*she goes forward and clicks again))*

6 R: =⌊ g↑o forward please. (.1) Uhm, turn to that side over there,
=⌊*(v↑ai pure avanti. (.1) Eh, girati dalla parte di là,*

7 P: ((she moves to the left)) Oh I can move.
Ah mi posso muovere.

8 R: Y↑es: yes, spin.
s↑ì: sì, ruotati.

At the onset of the extract, the participant makes an assessment. It is marked by the so-called change-of-state token 'oh' (Heritage, 1984), which highlights a sudden realization, and by a diagnosis, namely the impossibility of performing an action (notice the emphasis on 'I cannot'). Considering that the intonation (not available in the transcript) makes explicit her low 'epistemic stance' (degree of certainty, Chafe and Nichols, 1986) and that the interlocutor is an expert, her assessment works as a question to the researcher. The researcher, who is in the same laboratory while the session is running, takes up the question and provides a reply in terms of agreement/disagreement with the assessment. His turn starts after a word (eh:) delays his answer; this normally heralds a dispreferred response (Pomerantz, 1984), in this case a disagreement. In fact, the researcher describes the scene where the participant is located (pointed at by the expression 'that post over there') in terms of a different action that counters the implication of the participant's assessment (aborting the course of action).

So far, the first exchange has been examined in terms of the verbal actions performed, the resources making them recognizable and their sequential relation. Let us now consider this sequence for what it entails about the participant's pragmatic presence in the VE and in particular let us notice how the actions possible in the simulation are gradually explained. First the participant makes clear her course of action (getting in); then the researcher describes the situation in terms of another action (bumping), singles out a feature of the environment which is relevant to this new reading ('that post') and clarifies a relationship of non-exclusion with the action that has been stopped ('but: >go, go<'). Not only does the researcher's observation represent an alternative interpretation of the action possibilities; it comes after the participant's problem, so that going forward and bumping into something are possibly *interlaced* actions: each time an attempt to go forward gets frustrated again, the presence of an obstacle may be checked as an explanation. In fact, some minutes later, the participant will be stopped again and when suggested to proceed anyway, she will object 'yes, but there is the table', thereby attributing her impossibility to proceed to an obstacle standing in her way.

This is of course but a little portion of what goes on in extract 1. In the rest of the paper, we will enumerate various other aspects of presence and illustrate them with examples.

2.3. The virtual library

This paper does not report on a research project in particular, but selects examples from various data collections or research projects to illustrate the basic agenda of an ethnographic, action-based approach. The material supplying the examples consists of 20 video-recorded sessions and has been used for several studies (on the effect of different signals in directing escape during emergency, Mantovani et al. (2001); on the negotiation of agency and control, Spagnolli (2001b); on the structure of ineffective movements during the navigation, Spagnolli (2002); on the misinterpretation of possible actions, Spagnolli et al. (2002); on the effects of technical breakdowns on the sense of presence, Spagnolli and Gamberini (2002)). In each

session, a participant navigates in a VE for about 5 minutes to become familiar with the equipment and the simulation.

Navigation is in immersive, individual mode. By 'immersive' mode we mean that access to the VE is enabled by a head-mounted display (HMD), replacing the visual perception of the laboratory with that of the VE and providing the sound from the simulation. By 'individual' modality, we mean that only one participant at a time is present in the simulation. The VE reproduces a real library all participants are familiar with.[3] The movement in the VE is enabled by a triple-button joystick and by an Intersense device tracking the participant's head rotation. The three buttons on the joystick control, respectively, the movement forward and backward on the *Z*-axis and the activation of a limited number of virtual objects. The Intersense tracker registers the head rotation on the *X*- and *Y*-axis producing a correspondent shift in the VE displayed. Interaction is possible with a limited set of objects, mostly doors. To activate an object in the virtual library, participants have to look in its direction to place the viewfinder on it and click on the dedicated button of the joystick. Lateral movements to the right or the left are produced by head rotation. Objects are 'solid', meaning that they worked as obstacles if bumped into. The view is egocentric, meaning that participants can see the environment as if standing there, the view changing at the rotation of their head on the *x*- and *y*-axis.

A safety box surrounds a limited area in which participants move during the immersion, to prevent them from wandering and inadvertently colliding with the furniture in the laboratory. A researcher is always available in the same room throughout the session, watching the simulation on a computer monitor and intervening in case of need. This setting (Fig. 1) allows participants and researcher to talk to each other; sometimes, although rarely, the researcher intervenes in the VE on behalf of the participant from a desktop computer.

During each session, data are captured from two sources, one consisting of the VE itself and the other of a camera pointed at the participant in the laboratory. They run in parallel on a monitor during the session, with a final effect similar to Fig. 2, and are recorded as such on videotapes. Participants have previously received identical instructions as to the way the equipment works, but inevitably do much of their training within the simulation, as long as novel situations come up.

[3] The virtual library was developed with Superscape VRT 5.6 and presented in 256 colour mode at a resolution of 640×480 video pixels. The immersive system was constituted basically of an 800 MHz Pentium III computer (512 Mb RAM, Matrox G400), one Intertrax-30 tracking device from Intersense and one HMD VR8 from Polhemus.

The study of 'troubles' in action, such as contradictions, misunderstandings, error and incidents are familiar issues in HCI (see for example Flanagan, 1954; Winograd and Flores, 1986; Reason, 1990; Carroll et al., 1993; Csikszentmihalyi, 2000). The notion of breakdown has been imported from Heidegger's philosophical work to represent the moment in which the instrument becomes visible. In general, the breakdown of the expected course of action is a moment in which the agent has a chance to consider the premises of her/his action and problematize them (Koschman et al., 1998).

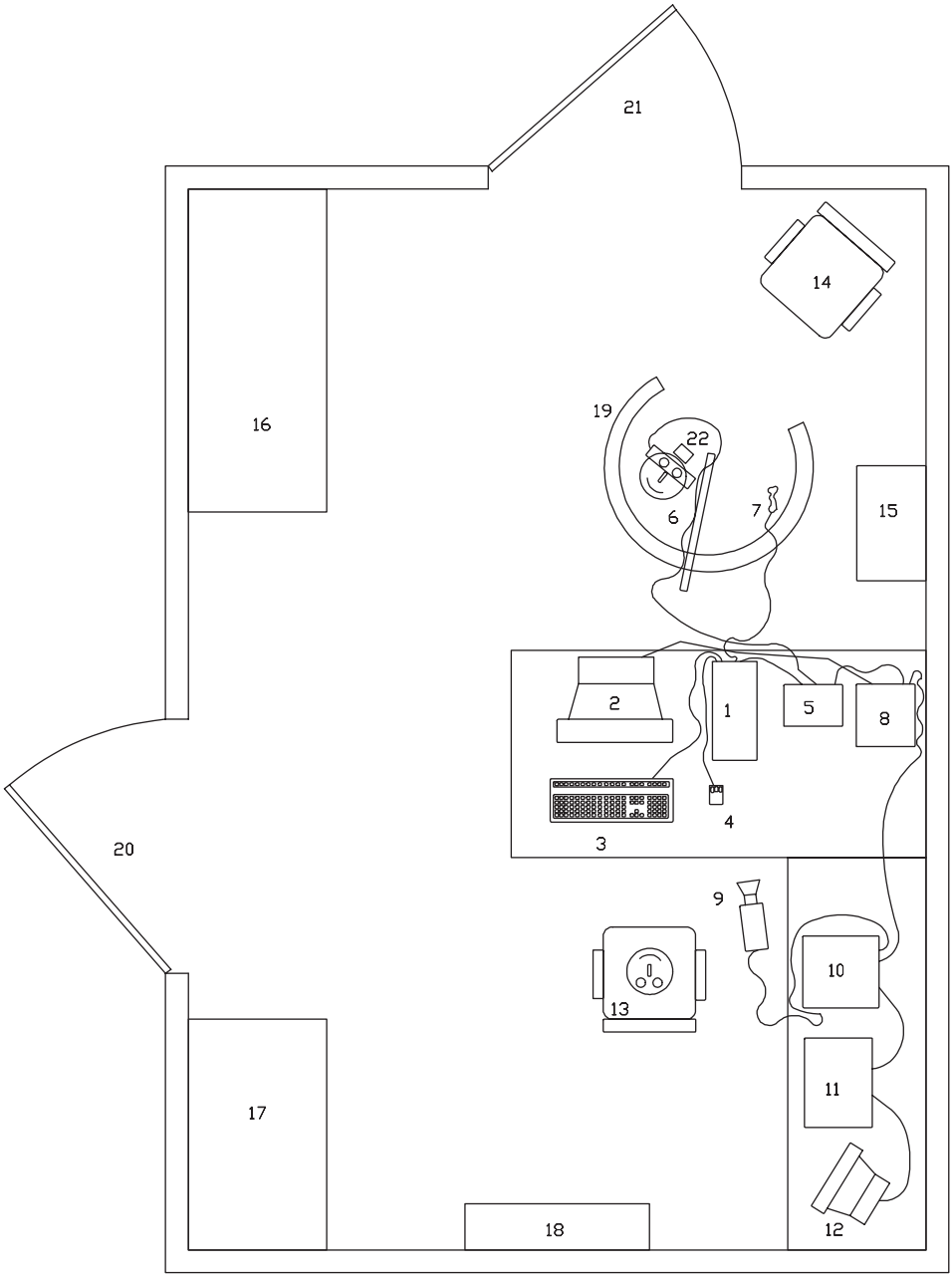

Fig. 1. A map of the laboratory where the immersive sessions took place (22 = participant, 19 = safety fence, 1/2/3/4 = desktop computer, 13 = researcher, 9 = camera, 10 = monitor).

Fig. 2. A frame from the videotapes, with the laboratory (left) and the VE (right).

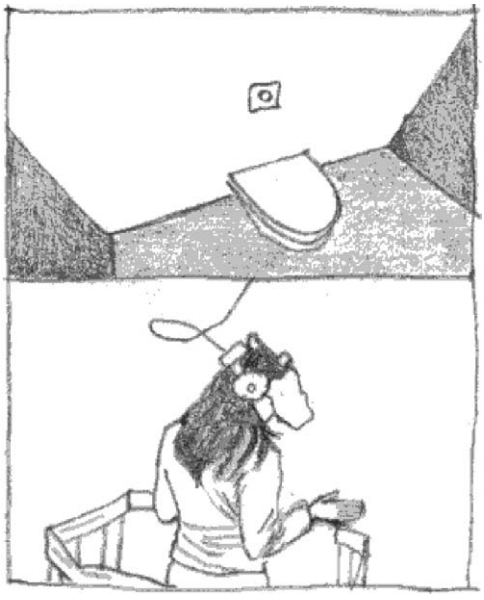

Fig. 3.

3. The ongoing structuration of presence: what to look for

3.1. What actions do participants envisage?

One way to explore the construction of presence, is by checking the action possibilities that participants have recognizably envisaged in the VE. Let us do it in

the following excerpt (see also Figs. 3 and 4). The researcher has just suggested that a virtual bathroom can work. The participant is now looking at a prop in that virtual bathroom, namely a WC, and wonders how she can interact with it.

Excerpt 2

1 P: >yes but how< am I supposed to do: that though.
>sì ma come< fa:ccio pero'.

(.2) *((she stands in front of the WC, fig.3))*

2 R: cl↑ick on it
cl↑iccagli sopra

(.4)

3 P: I go?
mi metto?=

4 R: =< See your viewfinder?>
=<vedi il tuo mirino?>

5 P: Yes- ↑ oh:: okay.
sì-↑ah:: okay.

6 R: ⌈ Click on it.
⌈*cliccagli sopra.*

7 P: ⌊*((she reaches out her arm downwards, fig. 4))*

This brief fragment shows that the interaction relies on the ability to recognize the action possibility offered by the VE and that this recognition develops stepwisely in the sequence. In fact, what has changed from lines 1–3 when the participant is confused to line 5 when she exhibits a sudden understanding (by cutting off what she was saying in a loud 'oh' and the agreement token, 'okay') is that a new element has come into play. The researcher's suggestion in line 4 ('see your viewfinder?') singles out a feature, i.e. the presence of a tiny viewfinder in the participant's visual field, which opens up previously unseen possibilities and reorganizes the user's resources for acting in the environment. She starts the action right away, by clicking on the target, in a (temporary) resolution of her original puzzlement. The reorganization of her presence engendered by this action is more incisive than one may think, as the movement of her hand holding the joystick reveals. Such movement is superfluous from a strictly technical point of view (no device is tracking that movement), but is part of what a pointing movement should be like to her.

A fruitful way to study presence is then to detect the possibilities for action envisaged by the users. Those possibilities depend on some features of the environment and on the users' practical knowledge. The 'affordances' of an

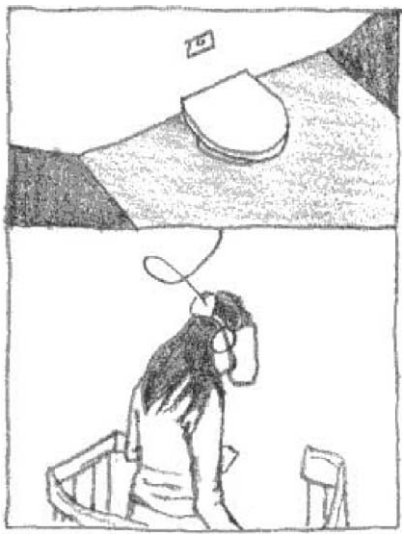

Fig. 4.

environment, namely those elements that invite a certain usage, like handling a handle, sitting on a seat (Gibson, 1979; Norman, 1988) are not an intrinsic, universal feature, but are there to be made sense of (Costall, 1995; Kaptelinin, 1996). This can be used for example to verify whether some functions of a technology are transparent enough and what are the conditions on which misunderstandings get worked out (Spagnolli et al., 2002).[4]

3.2. *What do virtual objects look like for the participant?*

The profile of the VE and its objects may not be as straight-forward as we may think it is. Some aspects may remain invisible, and others may acquire special significance; some partitioning may have no bearing, some boundaries may be set. It is by carefully inspecting the configuration of participants' movements that we can see which aspects of an object are actually taken into account.

Let us consider a particular kind of virtual object, namely the participant's virtual body and the way it gets structured in our virtual library. Lateral movements,

[4] Another component of the practice used by the researcher to legitimate his/her intervention is contained in the first exchange. In such exchange, s/he names the course of action the participant is involved in and then makes a suggestion; in this way, the researcher's intervention is introduced as a form of assistance to a course of action already chosen by the participant, and not as a preemption of the participant's will.

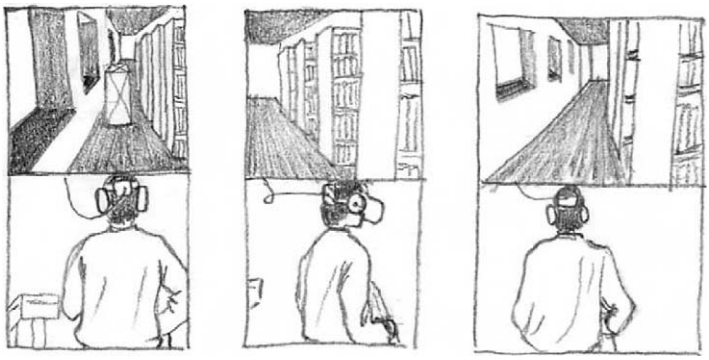

Fig. 5. The three drawings show various moments in sequence. The uppermost frame of each drawing shows the VE, the lowermost frame shows the participant in the laboratory.

Fig. 6. The two drawings show various moments in sequence. The uppermost frame of each drawing shows the VE, the lowermost frame shows the participant in the laboratory.

to the right or to the left, could be performed by moving forward and by rotating the head in the desired direction, as with a rudder (see Section 2.3). At least, this is the designers' intention and the explanation given to all participants; however, they come up with peculiar solutions, as the three following examples show (Figs. 5–7).

In the first example, the participant is moving forward along a corridor and notices an obstacle in her way (Fig. 5, picture 1). In order to avoid it, she does not rotate her head and adjust her direction slightly to the right. Instead, she breaks the movement into segments, by rotating her body 90° to the right, moving forward (Fig. 5, picture 2), then rotating 90° to the left, and moving forward again (Fig. 5, picture 3). In this way she obtains the result of circumventing the obstacle by its side without intervening on her movement forward, which is separated

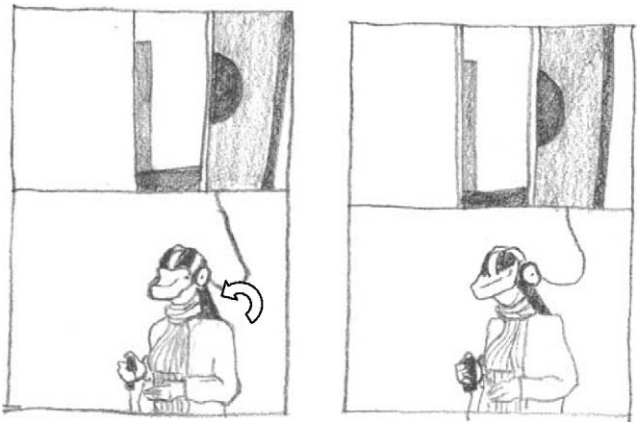

Fig. 7. The two drawings show various moments in the sequence. The uppermost frame of each drawing shows the VE, the lowermost frame shows the participant in the laboratory.

from the head- (in this case 'body-') rotation. Movement forward and direction change are decoupled, combined in sequence but not integrated simultaneously. Such organization of the functional possibilities of the virtual body makes the circumvention more controlled, more dramatic and longer. While it may result from a poor familiarity with the equipment in this fragment, belonging to the training phase, it is actually quite common in other phases of the navigation as well, for it proves appropriate under particular circumstances (Gamberini et al., 2003).

In the second example, the participant is trying to go through a door, which is a little too far to her left (Fig. 6, picture 1). Instead of rotating her head to the right, she steps laterally to the right by sliding her whole body and keeping her head still (Fig. 6, picture 2), with no result because the head movement only is be tracked by the virtual system. She possesses a version of her virtual body, that is confused with the functions of her natural body.

In the third example the participant has half of the door opened in front of her (Fig. 7, picture 1). When she tries to enter, she hits the wall to the left, so she's advised to rotate her head to the right in order to adjust her position and be able to sneak through the opened half of the door. The way she interprets such a suggestion is by bending her head towards her right shoulder, on the coronal plane of her real body (Fig. 7, picture 1). It looks as if she is trying to activate a sensible lateral area commanding the movement to the right or to convert the movement from the horizontal to the coronal plane. As in the second example, the functionalities of the virtual body are interpreted ineffectively by the participant.

These examples show that for the organization of their virtual movements, participants can go back to different resources and come up with peculiar solutions. Some of them may prove dysfunctional, but others can do their job pretty well. The

examination of the way in which some aspects are taken into account and others ignored can serve many purposes: we may want to compare the properties recognized with the expected ones; we may want to discover the unexpected ones, which escaped the imagination of the designers; we may want to verify what participants react to, if we are to manipulate some variables for experimental purposes.

3.3. What norms regulate the organization of a VE?

The ethnographic, action-based approach is not only concerned with dissecting a specific episode, but also with generalizing from several cases to abstract regularities (system-oriented versus interaction-oriented analysis, Alasuutari, 1995; Schegloff, 1996, p. 437). The database can then be inspected to see what are the regularities in the way some actions are performed, thereby revealing a 'norm' that establishes, following the Webster Dictionary, 'a principle of right action binding upon the members of a group and serving to guide, control or regulate proper and acceptable behaviour'. 'Norm' will be operationalized here with the notion of 'preference' in pragmatic linguistics, which identifies an unmarked, more usual alternative to carry out a verbal act (Levinson, 1983).

For example, in the VE examined here, more than one person can control the movements performed by the same virtual 'body'. In general, the participant is the only actor in the simulation and virtual movements are attributed to her/him. What happens when the researcher intervenes to control the movements? How is control distributed? Our data (Spagnolli, 2001a, b) have shown that there is a recurrent pattern in these episodes, in which the less intrusive forms of intervention are adopted first and if they do not prove successful, a more intrusive form takes their place. Consider the following sequence. The participant is stopped by an obstacle and tries to figure out how to bypass it and continue the exploration.

Excerpt 3

1 P: °So° I'll turn °now°.
⌈°*qui'di*° *mi giro* °*adesso*°.

2 ⌊*((she turns to her left))*

3 R: y↑es: yes. You can go as if you were in the library.
s↑ì: sì. Vai pure come se fossi in biblioteca.

4 P: ((*she's stopped by the alarm board*))

5 P: Oh I cannot get in.
Ah non posso entrare.

```
6  R:   Well:  you're bumping onto that post there, but: >go, go<.
        eh: stai sbattendo contro quel paletto lì, però: >vai, vai<.

7  P:   ⌊((she looks around and stops))

8       excuse me but,=
        e ma scusa,=

9      ((she clicks;
       ⌈she goes forward and clicks again))

10  R: = g↑o forward please.(.1)Uhm,turn to that side over there,      ⇐
       = (v↑ai pure avanti. (.1) Eh, girati dalla parte di là,

11  P: ((she moves to the left)) Oh I can move.
                                 Ah mi posso muovere.

12  R: y↑es: yes, spin.
       s↑ì: sì, ruotati.                                              ⇐

13  P: ((she moves slowly to the left))

14 R: ↓ spin around yourself.
       ↓ruota su te stessa.                                           ⇐

15  P: ((she's not moving))

16  R: sposta la testa °allora°.

       Move your head °then°.                                         ⇐

17  P: ((she leans her head on the right shoulder
       and moves her body to the right))

12  R: no, turn ar(h)ound(h):.
       no, gira int(h)orn()ho:.                                       ⇐

19   (.3)

20      ° do like this, look°,
        °Fai così guarda°,

21  P: Excu:se me, but why c(h)an't I get in?
       ma scu:sa, perche' non r(h)iesc(h)o a entrare?

22  R: ((he reaches her and make her turn clockwisely,                 ⇐
       checking her position in VE on a  monitor))

23      Ok. (.1) Go.
        ok. (.1) Vai.
```

The sequence displays a series of attempts on the researcher's part to describe the way in which the participant can move laterally to avoid bumping against the obstacle. The first description of the movement is in terms of environmental coordinates, for the movement is described by reference to the environment (‘`that side over there`’, line 5). It is followed by a series of more intrusive suggestions,

in which the body of the participant is the centre of the coordinates and plain orders are given (‘spin around yourself’, line 9; ‘Move your head’, line 11; ‘turn ar (h)ound(h)’, line 13). Finally, the researcher leaves his desk in the laboratory and goes to the participant to move her physically in the right direction. This orderliness in the way different kinds of suggestions are employed by the researcher, according to which the more intrusive type is left as a last resort, represents a preference for keeping the researcher’s control at a minimum. It also resonates with other aspects at stake in these interactions, such as the following.

1. The tendency to depict the researcher as external to the virtual field of action (Spagnolli, 2001a).
2. A general rule of non-intrusion that usually holds for any research setting, dictated by a concern on contamination.
3. The goal of the interaction, which is for the participant to learn to navigate in the virtual library, not to be replaced by the researcher when some problems come up.

In synthesis, the analysis of the interaction can highlight the preferences in participants’ conduct and the relationship with other preferences, either emerging from the data or available in the cultural context (such as the ‘dos’ and ‘don’ts’ in an experimental setting) and accessible as ethnographical knowledge. Longitudinal studies can unveil which habits are developed by a community of users to structure the interaction within a VE.

3.4. Which resources are imported into the VE?

In the VE, participants recognize some viable courses of action; many elements concur to make these action possibilities evident in particular. Among them, prior experience in other similar situations is a rich source of hints.

Let us consider the sequence below. The participant is exploring the virtual library; she has just gone past the copy centre and is now approaching the bathroom.

Excerpt 4

```
1   P: ⌈((she's going towards
       the door of the bathroom))

2      ⌊Can I go in the bathroom as well?
       anche in bagno  posso entrare?

3   R:  yes. (.) It also works, the bathroom.
        sì. (.) Funziona anche il bagno.

4   P: ↑what?
        ↑cosa?

5   R: ↑it also works.
       ↑funziona a:nche.
```

```
6   P: no(h)o really.
       no(h)o addirittura.

7  R:  yes if: you press:: you can see the water.
       sì se: schiacci:: si    vede l'acqua.

8   P: ⌈((she looks around))

9      ⌊° the  sink  should  be right here ⌈in front.°
       °il lavandino dovrebbe essere qua davanti.°
10                                        ⌊((turning to the right
11     = No, (.)nei:ther.
       = No, (.)nea:nche.
```

The participant asks a question at line 2 referring to a door she's approaching as 'the bathroom'. However, no mention has been made before to the nature of that room, nor was there any signal indicating its function. Still, she is very specific and confident on the room being 'the' bathroom. How does she know? Later in the sequence she takes the researcher's suggestion to try and use the bathroom. While looking around, she explains what she's up to, namely looking for the sink. Her search does not proceed at random, though, given that she's making a precise hypothesis on the location of the sink ('the sink should be right here in front'). How does she know? The mystery is solved if we recall that the VE resembles the real library students are well acquainted with. And this participant happens to be a student, who occasionally resorts to the real library to orient herself in the virtual one (the location of the bathroom, the position of the sink). This prior knowledge offers a frame of reference to the geography of the virtual space by way of similarity with the geography of a similar real space, the Psychology Library. This influence is strong, especially because the exploration so far confirms the similarity. Notice, however, how these expectations may be misleading when departed from without any clear feedback: in the real library the sinks are immediately visible through glass doors; here the doors are opaque and much of the furniture is so low that the participant needs to look down to notice it. This results in a lack of feedback that makes her abandon the search quite soon. The design of the rooms is not able to convey cues and, paradoxically, its clear resemblance with familiar places makes her exploration more difficult.

Resources are imported in the VE that can hamper or facilitate the interaction because of the expectations they generate; for these reasons, the nature of the expectations orienting action is worth studying.

3.5. How rich is the environment to participants in terms of projected activities? How robust?

Different people approach the VE with different repertoires of resources. Some users may be videogame addicts, some may have seen VR application in movies or exhibitions, some others may have used the computer for writing only. In addition, as participants interact with the VE their competence gets deeper not merely because

of a longer exposure but because of the variety of situations they face, which gives them different perspectives on the simulation. Excerpt 3 above, where the researcher was able to provide various descriptions of a lateral movement, is a case in point: it shows both the knowledge asymmetry among participant and researcher and the richness of alternatives the researcher may come up with as an expert. Excerpt 5 below provides another example of such asymmetry. The participant is looking for a door; at a certain point he asks:

Excerpt 5

13 P: ⌈ thi:s one.
*q*ue:sta.

The researcher suggests going forward,

14 R: ⌊forw- go a little forward,
°ava° — vai un po′ avanti,

15 more forw-
ancora avan-

only to realize that the participant is moving to the wrong place. What is at the origin of the misunderstanding? The participant takes 'go a little forward' as a confirmation and interprets the direction 'going forward' in accordance with the resources at his disposal. Given that he only sees one possible target and that this target is almost in front of him (Fig. 8a), he goes forward towards it and clicks on it.

The researcher cuts off his own words and corrects the participant.

17 ↓ no: not against the glass::
*n*o : non contro il vetro ::

From the researcher's point of view, the participant was positioned at the beginning of a corridor and the window in front of him had previously been excluded as a target. The only movement 'forward' to make sense was along the corridor, at the end of which there was the right target. In fact, when the participant was already very close to the window the researcher said 'more forw-((ard))' (line 15), meaning that he was referring to a farther away target and that the movement of the participant was just the first step of a longer walk. This is visible a moment later, when the participant moves in the correct direction (Fig. 8b).

In this example, the different familiarity with the opportunities available in the VE is at the origin of a misunderstanding. If a certain degree of asymmetry is acceptable and even inevitable, some of it may result in persistent misunderstandings and poor satisfaction. This may happen for example in different communities using the same VE for different purposes. Exploring the asymmetry would be useful to tailor a training to different classes of users.

(a)

(b)

Fig. 8. The pictures show different moments in the participant's movement: (a) Towards a glass wall in the VE, mistaken for a glass *door*. An office space and a human character can be seen through the glass wall. (b) *Along* a corridor in the VE to reach the grey door to his left.

4. Conclusions

In this paper, we have illustrated a method for studying human interaction with a VE. In order to do this, we referred to the concept of presence in a mediated environment, and have proposed an agenda that focuses on the nature of presence, its coordinates and construction, whereas the main concern in this field of research is on measuring the degree of presence felt by users (for a note on different definitions of presence see Gamberini and Spagnolli, 2003b). With reference to those models that have proven useful to study the human experience in a particular environment, such as anthropology, human geography, cultural psychology, presence is seen here as the dynamic creation of a cultural agent, emerging out of the practical engagement in the environment. This approach is especially recommended when we want to investigate the different configurations elaborated by participants, the

process in which presence develops, the contextual resources deployed, the actual actions performed when something relevant happens.

In this light, the following questions provide some good hints.

a. What actions do participants envisage?
b. What do the virtual objects look like for the participant?
c. Which norms regulate the organization of a VE?
d. Which resources are imported into the VE?
e. How rich is the environment to participants in terms of projected activities? How robust?

The information gathered with this kind of analysis may be used to design a more effective and satisfying environment or to plan appropriate training sessions. However, ambiguity and asymmetry are ineliminable from a technological artefact and are clarified only in the practice of use (Carroll and Campbell, 1989; Mantovani and Spagnolli, 2001). We have offered interaction/discourse analysis as a method to carry out the analysis in consonance with an ethnographic, action-based approach; of course, other methods can be adopted in conjunction with it or alone. For the time being, discourse analysis is among the few approaches to highlight the meaning emerging from the details of action by sticking to what is relevant to participants; unfortunately, it is also time-consuming, so it needs to be applied strategically, on a selected collection of cases and in conjunction with other techniques.

A final point that has not been illustrated in this paper is the following.

f. What is the composition of the VE? This aspect has been long overlooked, presence being usually synonymous with total absorption in the VE (Biocca, 1997, p. 15); it needs to be addressed though, since elements external to the digital simulation may be involved in the action in VE, e.g. the interactive devices. Furthermore, many VEs are designed to be navigated with the contribution of some non-immersed users (an audience or a guide) or the combine the visual appearance of an object in the VE with a solid, touchable object of the same shape in the real environment (Hinckley et al., 1994). Hence, if we are to understand the user's presence in a wide range of virtual systems, it becomes decisive to adopt an approach that does not draw the confines of the VE rigidly around the 3D simulation, but that can handle mixed, hybrid VEs as well as traditional ones (Gamberini and Spagnolli, 2003a).

Within this enlarged conception of VE we can imagine a way to assess the user's presence in the simulation and decide whether a certain disruption in the flow of action represents a departure from the VE or not (Spagnolli and Gamberini, 2002). We can anchor the sense of presence to the current activity of the participant and determine how much it is centred on the VE: the more peripheral his/her activity with respect to what we consider as 'VE', the less present the user, to an extreme in which action does no longer concern, not even instrumentally, the navigation in VE (Spagnolli and Gamberini, in preparation). In order to do this, though, we need task-specific and user-oriented coordinates of what would represent a central activity in the VE examined.

5. For further reading

The following reference may also be of interest to the readers: Merleau-Ponty, 1970

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Appendix

(based on Gall Jefferson's code; for a broader description, please refer to Ochs et al., 1996, pp. 461–465).

[[	overlap onset at the start of an utterance
[	overlap onset
=	latched utterances
(0.5)	pause, in tenth of a second
(.)	micropause
:	stretching of the preceding sound
-:	falling intonation contour
:̲	rising intonation contour
.	falling or final intonation contour
-	cut-off or self-interruption
↑↓	sharp rise/fall in pitch or resetting of the pitch register
word	emphasis (proportional to length of line)
WORD	especially loud sound
∘∘	softer sound
hh	marked expiration, whose length is represented by the number of letters
(h)	exhaling within a word (e.g. while laughing)
·h	inhaling
(( ))	transcriber's descriptions of events (e.g. cough, telephone rings,) or non-verbal actions
> <	compressed talk (rushed pace)
< >	stretched talk (slowed pace)
(word A)/(word B)	alternative hearings of the same strip of talk

( )	inaudible talk; the distance among the brackets should represent the length of the missing talk
(word)	tentative identification of inaudible talk
,	'continuing' intonation
?	rising intonation
¿	mild rising intonation

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