

# 6 On the Relationship between Presence and Usability: a Situated, Action-Based Approach to Virtual Environments

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**Abstract.** In assessing the usability of a virtual environment, a valuable hint may be offered by a good model of the user's experience, which is usually described as the experience of being 'present' in the environment created by the virtual technology. However, this convergence of usability and presence risks to be undermined by a rather restricted definition of the concept and the habit of evaluating only a limited portion of the environment in which the user is actually present. From this point of view, the major problems reside in the divide between the symbolic and the physical realm, on the one side, and between the simulation and the real world, on the other. In this chapter, we argue that a situated, action-based approach to virtual environments may avoid these drawbacks: users' presence is taken to emerge from the actions performed and usability is referred to the complex object created by the situated interaction with the simulation. After discussing these points, the final section will describe some aspects of an evaluation recently carried out by the authors, where this framework has been applied.

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## 6.1 Introduction

Presence is usually paraphrased as the psychological sense of “being there” or “to be in” or “exist in” a certain environment [1-4]. Although this concept has been widely studied and discussed since its initial adoption, [5] it remains quite controversial. To begin with, a distinction is maintained between the technology and the so-called ‘psychological response’ to it, as if the physical and the symbolic dimensions were separated [1, 6]. This view has been contrasted with other perspectives in the field of human-computer interaction, according to which the technical and symbolic aspects do not exist apart from each other but are instead reciprocally defined [7, 8]. Furthermore, many shortcomings derive from the fact that the concept of presence usually leans heavily upon ‘immersion’ as a defining characteristic: first of all, the concept of ‘immersion’ falls again into the above mentioned dichotomy, being alternatively considered as a psychological state [9] and as a property of the technical interface [6] [Note 1].

Second, ‘immersion’ is a condition in which the user is isolated from the external stimuli, but such condition is neither feasible nor necessary: even the most sophisticated virtual systems do not actually create this condition yet, while other computer-mediated environments are reported to induce a sense of presence in the user without being immersive at all [10]. Finally, users’ action is often distributed between the Virtual Environment and the Real Environment.

In the VE for clinical purposes that will be examined in the present chapter, for example, the user navigates in an immersive VE and, at the same time, interacts with the psychotherapist in the ‘real world’. Mantovani and Riva [11], along with other authors in the field [12-17], have proposed a definition of presence that avoids many of those pitfalls and offers a more inclusive depiction: they consider presence as a *cultural-pragmatic construction* [18] namely the product of the action performed in the environment, where the perceptual stimuli sent to the participant and the technical quality of the interface are but two ingredients.

In fact, if we are to evaluate the usability of a VE and reduce the number of problems during the interaction with it, we cannot consider slips, mistakes and errors [19] as the simple products of the problem-solving process. The situations in which the virtual environment is used are as unexpected and ambiguous as those of ordinary life and include material as well as social, cultural and symbolic aspects [18]. In this vein, a usability evaluation would profit from a definition of presence that values the complexity of this experience and highlights the various elements taking part to it, including the relationship with settings other than the virtual one.

In the following paragraphs, we will discuss the advantages of redefining presence from a situated, action-based perspective, in order to fulfill the needs of the usability evaluation of virtual environments. We will conclude by offering some instances of an evaluation recently carried out by the authors.

## 6.2 Different approaches to presence and their methodological implications

The contribution to usability evaluation of virtual environments offered by the studies on presence risks to be very limited; research efforts have been mostly devoted to finding out a measurement tool that can capture participant’s sense of being in the simulation and rate it, but to date, they have not produced effective and systematic measures [20]. In addition, they reflect an approach to presence that is quite restrictive.

Basically, two strategies to measure presence have been proposed so far, an ‘objective’ and a ‘subjective’ one. The *subjective strategies* rely on the evaluations produced by

participants themselves and include a variety of techniques from subjective rating scales or questionnaires [9, 10, 21-24], to self-reported break-downs of the sense of presence [24], to reports, comments and interviews [26, 27], to comparison-based predictions in which the subjects' task is to evaluate the difference between real and virtual scenes [28]. All these methods are easy to administer and interpret [20] but – except for the last one – they need the participants to know what is meant by 'presence' [29] and are subject to 'response biases' [30].

*Objective measures*, instead, estimate the degree of presence from its indirect, observable correlates such as behavioral or physiological reactions to stimuli presented during the experience in the virtual world. They vary from behaviors like startle response [31] to head positioning, orienting response and socially conditioned responses such as ducking to avoid an object [3]. Barfield and Weghorst [32] introduced physiological indicators as presence measures: cardiovascular response, skin conductance, muscular tension and ocular movement after specific stimuli or events in the VE. However, the demonstration that these stimuli are directly connected with the level of presence in VE needs more systematic research [20].

In general, the image of presence that pervades those studies is that of a mental, private state [34], internal to the individual and located into its cognitive-emotional functioning. *This image (1) assumes the existence of a divide among the symbolic and the physical realm, on the one side, and (2) locates the user either inside or outside the simulation, on the other.*

### **6.3 Not only cyberspace: action in “hybrid human environments”**

The separation of the psychological realm from the physical and the simplified idea of a full immersion into the simulation are also at the core of common opinions on computer technologies and virtual reality, which have gathered around extreme poles. Optimists celebrate the liberation from the limits set by our natural environment; according to them, virtual reality indulges our dreams of an ideal, pure dimension of life, where our existence is transposed on a digital code [34]. The conventional physical constraints can be overridden; prejudices rooted in physical differences (genre, race, age) cannot be applied any longer, time and space cease to hamper the willingness of people to meet and reach interesting destinations [35-37]. Cyberspace would have the purity of our mental life without being a solipsistic experience, ushering a utopian digital society of electronically interfaced people, where even dead can be bypassed, our spirit freed from the destiny of our body. Pessimists have expressed their greatest concerns on the advances of virtual technologies. Body and action are considered the fundamental warrants of resistance and social emancipations; moving onto a virtual mode of existence would do nothing but dissolve this warrant.

The idea is that people would be left pray, unaware, of an entertaining illusion of reality, the engagement in the world being replaced with the engagement in a fake one.

This position renews the position of the mass-media critics [38], according to which the diffusion of images confounds the audience with a mere simulacrum of reality; images appear as if they were produced by real objects, while they are instead void of substance.

The danger inherent in cyberspace would be more insidious than in other mass-media, because here the illusion of reality and intersubjectivity is enhanced [39]. The scenario is an Orwellian, alienated world in which humans are captives of an entertaining copy of reality.

To avoid these simplifications and the assumptions they derive from, many authors have worked at a more elaborated depiction of presence. Some have proposed the partitioning

among simple, cybernetic and experiential presence [33], focus, locus and sensus [40], personal, social and environmental presence [13] or according to different tasks to be performed [41]. Some have approached presence with other purposes than measurement, for instance to investigate the relation with place [42], the type of conversational patterns [43], the kind of embodiment [44], thus liberating a more lively image of this experience. Some have unearthed what has been overlooked before, such as the alternation of emersion and immersion during a session [25, 40] or the mobile distinction between person and environment [14-16, 45].

A proposal that seems particularly promising is to take action as the organizing criterion of presence and as the analytic focus (among them, [11-17, 46]). Presence may be studied by analyzing the sequential details of the interaction with the virtual environment and the aspects that converge on it: the material and symbolic resources exploited, the cultural competence used and the social relationships established. This model is specifically meant to avoid the shortcomings registered by other approaches to presence. According to this model, the material and symbolic resources are both necessary components of presence because they are constitutive part of action, from which presence derives. In addition, since it is hard to locate users' activity in the confined space of the virtual environment and rule out the effects it has on other simultaneous environments, presence is better conceived as distributed over both the virtual and the real environment. This happens not only because attention shifts from one environment to the other [25], but also because the environment is "hybrid" in the first place. When we shift attention from one sensorial modality to the other, we don't feel as if we are moving from one place to another and we do not feel a diminishing sense of presence. On the contrary, it is exactly by shifting the focus of attention that we experience action as an integrated, united phenomenon, where variegated circumstances are coped with and our strategies updated.

#### **6.4 Enabling the user to handle the situation: usability in VE.**

Classically, when we speak of usability evaluation we think of the empirical studies carried out to analyze a technological prototype or product [47]. The final goal of all evaluation techniques is to provide a feedback to the designers in order to support their work in an iterative development process [48]. As Rosson and Carroll [47] say, "usability evaluation helps designers recognize that there is a problem, understand the problem and its underlying causes in the software and plan changes to correct the problem". Although the International Standards Organization has formulated a well-received formal definition, according to which usability consists of "... the effectiveness, efficiency and satisfaction with which a certain user may achieve a specific objective in a particular environment", the concept of usability remains hard to handle [49], especially because of the huge number of technologies available and the difficulty in conjuring up effective measures.

In the development of virtual environments, the concept of presence has acquired a special relevance. However, the studies accrued so far have shown a contradictory influence of presence on the user's performance [20], which has cast some doubts on the way in which it can help the usability evaluation [Note 2]. These contradictory results may be due to the serious limits of defining presence as a mental state and to a restrictive definition of 'performance' as confined within the boundaries of the virtual environment.

By a closer inspection of the setting in which virtual environments are applied, in fact, be they clinical [50-54], experimental [55], or training [18, 56], it appears that participants focus on resources both internal and external to the virtual environment, which are relevant to their situated activity.

The need for a situated perspective has been strongly sustained in the literature on human-computer interaction. In contrast to much work on usability, where perception, learning, memory and attention are considered “separate” and action is seen as the execution of plans stored in the long-term memory, the research on situated cognition [57] links the psychological processes to the physical and the social world [58, 59]. Making an environment usable, then, does not mean to isolate the participant from the external world; it seems more appropriate to place participants’ action in a physical and symbolic scenario, hybrid in its reality, where the virtual experience is intertwined with the experience in the ‘external’ world. This general position implies that the evaluation of the virtual system should extend beyond the limits of the virtual setting per se and the logic of an individual operating on an interface. The Virtual Environment should be considered as the fulcrum of a larger set of converging elements and its evaluation should address the specific, contextualized sequence of action performed by users.

## **6.5 A case study: evaluating Optale’s virtual environment**

In this section we would like to illustrate how the situated, action-based approach can figure in a usability evaluation. We will draw on the work we carried out to evaluate the system developed under the supervision of dr. Optale and devoted to the therapy of male sexual impotence within the European Project ‘VEPSY updated’. In the course of his therapeutic process, the immersed patient follows several different paths where he is exposed to events and encounters of evocative meaning (a group of girls, a broken sword).

All over the session, the therapist orients the patient’s navigation, by suggesting him how to act in the varying circumstances of the navigation and by explaining the events, while the patient tries to implement the suggestions, describes what is going on and asks questions when in doubt. The setting is then represented by the patient-VE-therapist system and the evaluation ought to address the interconnected activities constituting this system.

After evaluating a list of aspects of the virtual environment with two heuristic methods (cognitive walkthrough and expert evaluation), which will not be presented here, we adopted a method inspired by interaction and discourse analysis [60, 61], because their theoretical tradition shares the premises of a situated, action-based approach. We run four sessions involving as many users and a researcher, who was playing the role of the therapist according to the protocol drawn up in conjunction with the psychologist responsible for the treatment. All sessions were videorecorded with the split screen method explained in [18, 56], thus enabling the evaluators to monitor the events taking place both inside and outside the virtual environment. All utterances and actions in the videorecordings were transcribed and examined; the focus was on the sequence of actions performed in the setting and the various material, symbolic, cultural and social elements with a significant role in the development of the action sequence.

We will dwell for illustrative purposes on two aspects, the structure of the interaction between therapist and patient and some of the problems registered in the use of the system.

We will indicate the specific aspects of the interaction we focused on.

### *6.5.1 The interaction between therapist and patient*

The interaction between therapist and patient, apart from being a constituent part of the setting, is also a necessary part of this therapy package in order to equip any psychologist with the necessary information to run the sessions on his/her own. We wanted to assess how the interaction between therapist and user contributed to improve the usability of the

system, i.e. its satisfaction and effectiveness. In other words, we needed to evaluate the extent to which the structure of the interaction facilitated or undermined the achievement of the goals of the system.

The overall goal of the virtual experience within the therapy for male sexual impotence was twofold: to enhance the patient's self-confidence and to create a shared experience where the patient could feel supported and accompanied. Therefore, it was crucial to ensure that the control on the virtual experience was distributed between patient and therapist so as to facilitate those results. This point has been checked by analyzing the sequence of actions to see:

1. *which kind of actions user and patient were respectively allowed by the protocol:* we observed how user and patient collaborated to perform the navigation in the VE (who had the initiative of a certain activity, who made the decisions, who initiated the correction for inappropriate actions, which action were interrupted and continued by the other person). We also checked how consistent was a certain distribution of the activities throughout the sessions and verified whether the collaboration was getting smoother and how ready was the response to each other's prompts. The conclusion we reached was that participants were expected to go forward and face obstacles and events, and produce descriptions of the ongoing events. The therapist was entrusted with any decisions, from the direction of the movement to the interaction with the objects in the simulation, and with all the major corrections, including the adjustment of the patient's body position.
2. *how the interpretation of the events was scaffolded by the therapist's commentary:* we observed who provided the interpretation of the events and how open to negotiation such interpretation was. In the (simplified) transcript below, for example, the patient encounters a human image in the virtual country and defines it (line 3); the therapist replies with a different definition (line 4), which is subsequently adopted by the patient (line 5).

1 Patient: I see a figure  
2 Therapist: [try and approach it  
3 Patient: [(he stops) [(beggar) wearing a hood  
4 Therapist: an old man  
5 Patient: an old man, yes.  
(Mauro, 6)

We also checked how able was the therapist to anticipate doubts, how felicitous and appropriate were the descriptions; for example, after phrasings such as 'let's take this sword' or 'there is a sword over there', participants tried to turn towards the sword and/or to reach it, although the sword was automatically owned just by passing by it, like the passage below shows.

1 Therapist: by the side of this path there is a sword.  
2 Patient: yes.  
3 Therapist: which we can take,  
4 Patient: yes,  
5 Therapist: after going up the staircase.  
6 Therapist: by taking this sword  
7 Patient: (*from the top of the virtual staircase*) may I tak-?  
8 Therapist: (we're going to)

- 9 Patient: should I take it now?  
10 Therapist: you'll take it just by going on  
11 Patient: Oh I'll take it automatically?  
12 Therapist: yes, automatically, by walking  
13 Patient: (*resumes walking*) okay.  
(Mauro, 5-6)

We also checked the effectiveness of the on-line therapist's commentary for patients' ability to make sense of the situation: to this goal we contrasted two conditions in which patients were either cognizant or unaware of the therapeutic purpose of the session and registered the meaning that were attributed to the events and the reported sense of 'weirdness' in the two conditions. The result was that the narrative proved able to highlight the aspects of interest in the landscape and isolate them from other aspects equally noticed by the participant even in the condition with unaware patients.

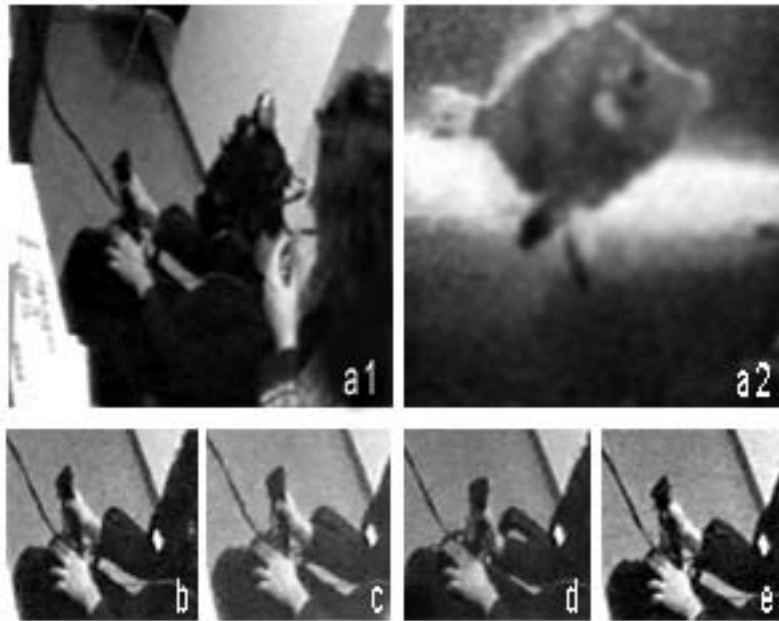
3. *which degree of control was left to the user by the simulation:* we checked whether long sequences of events were provoked by a user's choice and whether those sequences could be stopped or not. We also checked whether the simulation offered some opportunities to perform actions other than the one expected. It turned out that the sequences realized through videoclips reduced the extent to which the user could influence (and jeopardize) the unfolding of the events.

We concluded from this and other considerations that the relationship between patient and therapist was structured so as to facilitate the goal of providing a shared experience and a sense of self-confidence to the patient, to the point that sometimes their tight interdependence faded into the users' passivity.

### 6.5.2 Problems in the navigation

As it has mentioned above, a classic endeavor is to examine the problems complained by the users or identified by the evaluator and suggest some modifications to the system in order to prevent similar problems from occurring again. We registered the major problems and concentrated on *the details of the action leading to them and the resources available to the user*. Two recurrent problems in the use of Optale's system, for example, had to do with the videoclips. Some of the events taking place in the simulation were fixed sequences, recorded on a videoclip and activated as the user approached a specific object in the simulation; for example by approaching the image of an old man, a video started where the same old man offered a cup of magic fluid to the user.

1. *confusion about the feasible actions during the videoclips:* this problem has been unearthed by paying careful attention to the videorecordings of the interaction. Although during the videoclips, users' actions had no effect on the simulation, we noticed that at the end of each videoclip the users were already moving in the simulated country. Excluding the possibility that participants' movement started at the exact end of a video clip, since they ended quite abruptly, we supposed that the users were operating on the joystick while the video was still running, without realizing the ineffectiveness of such attempts. As shown in Figure 1 below, the videorecordings confirmed this hypothesis, showing that the users were moving the joystick long before the end of the video.



**Figure 6.1** The picture displays the participant in the laboratory during the immersive session (a1) and the simultaneous image appearing in the virtual environment, namely the video clip of an aquarium (a2); throughout the video clip, the participant operates on the joystick as it appears from the sequence of zoomed images in the lowermost part of the figure (b,c,d,e), where the inclination of the joystick varies.

This meant that the temporary suspension of the usual action possibilities during the video clip was unclear to the users and so was their role. The ineffectiveness of their users' efforts was also obscured by the video clips, because they showed some events that could have been taken as a positive feedback, as if the progression of the events were actually prompted by the operation on the joystick. We suggested the provision of instructions on this point to the users.

2. *delayed activation of the video clips*: we observed that the activation of the video were sometimes delayed with respect to the moment in which the sensitive object were approached; the result was that the logical connection among the object and the video disappeared. This observation echoes some users' comments in an after-session interview, about the videos being confusing. At a closer inspection, we noticed that the activation was not actually random or late but that the sensitive area surrounding the object was so wide that even if the object was approached sidewise or from other directions than the initial one, the video started anyway. So we proposed as a possible solution the activation area to be reduced so that the video would start only when the users approaches the object from the right side.

## 6.6 Conclusions

In this chapter we have proposed to adopt a situated, action based approach to presence and usability. Usability is referred to the human situated action within the hybrid environment that is created by using the virtual technology. Presence is considered as emerging from the sequence of action the user performs, integrating the physical and mental dimension of the user's presence and including what happens outside the virtual setting.

The methods we adopted for the evaluation of the effectiveness and satisfaction of a virtual system for clinical purposes was to highlight the sequential, detailed interaction

with the virtual environment and the various aspects converging on it: the material and symbolic resources exploited, the cultural competence used and the social relationships established.

This approach relies on observable events, but differs from a behavioral, objective approach in many respects. First of all, the environment is not considered as a physical space, but as a place organized by humans according to their practical goals. Second, presence is a public, social phenomenon, because people cannot but being engaged in a relationship with the social and physical environment. Third, action is the unit of analysis in usability evaluation, not because it is a symptom of the users' experience, but because it is a constitutive part of it.

## 6.7 Notes

1. The concept of immersivity has been ambiguously adopted to identify the psychological state of perceiving oneself inside the VE affected by the degree of isolation from the physical environment. To avoid redundancy with the notion of presence, Slater and Wilbur have proposed to maintain the term presence to refer to the psychological state induced by the VE and use immersivity to refer to the technical characteristics of the VE that isolate the user from other sources of stimuli.
2. Some studies have shown a positive relation among the reported degree of presence and the ability to perform a particular task (a tracking task in [62], a sensori-motor task in [63]); some show no relation between these two variables (see [20] for a comprehensive review).

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