

11 Ergonomics of Virtual Environments for Clinical Use

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Abstract. Usability is defined by the International Standards Organization as “the effectiveness, efficiency and satisfaction with which a certain user may achieve a specific objective in a particular environment” (ISO DIS 9241-11). This definition highlights the need for considering the specific destination of a certain technology and reflects the current trends in Human-Computer Interaction (HCI). In compliance with these remarks, the evaluation will be described here of a Virtual Environment (VE) for the treatment of male sexual dysfunctions; the common assumption will be avoided according to which a VE is a space separated from its ‘real’ surroundings [6, 7] and the full environment where the Virtual session takes place will be addressed instead. After a description of the conceptual framework adopted, the paper will dwell on one method among those deployed for the evaluation, namely the analysis of ‘situated actions’. Four aspects will be dealt with: (a) the interplay of various concurrent settings during the virtual session; (b) the users’ comprehension of the symbols used in the VE; (c) the structure of the relationship between users and guide; (d) the breakdowns during the human-VE interaction. The goals and the intended meanings of the simulation as set by the designers became the main parameters for the evaluation.

1. The object of evaluation

This chapter illustrates the criteria for the usability evaluation of an immersive Virtual Environment (VE) developed within the European Project ‘VEPSY updated’; it was directed to the treatment of male patients suffering from sexual impotence, part of a longer treatment carried out with several different methods (for a description of the therapeutic rationale see chapter 5.4 in this book). The version evaluated (which differs from the final one) contained no explicit mention to the clinical problem it was meant to treat; it was a three dimensional environment, containing four main paths [Note 1] in a large Mediterranean forest with grass, trees, flowers and other vegetation (Figure 1). As the session started, the patient was supposed to enter one of the four paths according to the therapist’s suggestion and to go through several encounters of evocative meaning. He was sitting on a swivel chair, wearing the immersive gears (head mounted display) and operating on a joystick fixed on an armrest of the chair according to hand preference; the therapist sat next to him and watched the virtual environment from a monitor. Patient’s and therapist’s roles during the immersive sessions differed yet complemented each other: the patient performed the actual movements in the VE, described what went on and asked for



Figure 1. A view of the VE considered for the ergonomic evaluation

clarifications; the therapist chose the path, oriented the patient's behaviour and provided the 'correct' description of the events. The therapeutic environment was therefore created by the patient's and therapist's interaction with each other and with the technical equipment.

The peculiarity of this environment does not reside so much in the characteristics of the technology to be assessed as in the complexity of interactions taking place around it: in addition to the immersed user, the setting includes a non-immersed person, the therapist with a crucial role in the fruition of the VE: he intervenes on the patient's movements and mediates the interpretation of the events. As a further element of complexity, the experience has a symbolic dimension, whose readability is as crucial as the comprehension of the interface. Particular attention, however, has to be paid to the boundaries of the ergonomic evaluation, to exclude the clinical rationale embodied in the system. It is the therapist's responsibility, in fact, to validate the therapeutic method, while the ergonomic evaluation of the system should concentrate exclusively on its comprehensibility and on a satisfactory functioning.

A usability evaluation requires a model of human-computer interaction that offers clear definitions of the objects to be evaluated and a methodology coherent with the conceptual framework and the specific goals of the system. The usual constructs of ergonomic analysis, however, are not straightforwardly applicable in this case: who is the intended user, the patient or the therapist? Where does the action occur, on the simulation or on the therapists' cabinet? Which aspect of the system should be assessed, the operation on the interface or the symbolic meaning possibly conveyed by the three-dimensional environment? Given the complexity of the environment in which the immersive treatment is performed, an explicit theoretical reflection is needed in order to make the articulation of the system components explicit. This chapter will describe the framework that guided our evaluation and present some of the results obtained.

2. Conceptual framework: the hybrid environment of the VE in use

According to the International Standards Organization (ISO DIS 9241-11), a tool is usable when it allows "a certain user to achieve a specific objective in a particular environment with effectiveness, efficiency and satisfaction". This definition invites to avoid generic assessments and tune the usability of a tool to the precise requirements of the activity to

which it is destined. The current trends in the field of human-computer interaction (HCI) [1, 2, 3, 4, 5], in fact, highlight the strict connection of a tool with its context of use. This represents the most recent stage in a historical progression through at least three different units of analysis [17, 18]. In a first stage, usability evaluation concentrated mainly on the technical features of the system (hardware reliability, software robustness, comfort of the interactive devices) and was carried out on the basis of engineering practices and norms. At this level, the object of evaluation was the functioning of the system as a technical product.

In a second stage, the interface mediating the exchanges between humans and the system became the focus of the analysis, to assess whether the characteristics of the interface met the characteristics of the human cognitive processes or not [6,7]. The possible errors in perceiving, understanding and operating on the interface were examined [8, 9].

Eventually, a third approach has brought to the foreground the context in which the tool is used, made of various social, cultural and infrastructural resources; the analysis is carried out on actual episodes of interaction of the final users with the technology [1, 10].

This latter stage has also modified the way in which the earlier objects of usability evaluation (the technical characteristics and the interface) are considered. As several research streams in HCI have claimed (Situating Action Theory [1], Activity Theory [11], Workplace Studies [12] Scenario-based Design [10], Distributed Cognition [13]), it is not possible to make reliable predictions on the introduction of a new technology on the basis of technical considerations alone. Technologies have been re-described as ‘symbolic’ objects as well as technical ones [14, 15], because a tool makes sense only when its technical properties are interpreted by the users. At the same time, the psychological properties of the individual user are not exhaustive descriptors of those ‘symbolic’ elements, because the whole system of activities, priorities and relationships would remain excluded [16]. The ‘human factors’ of the ergonomic tradition are re-located within the broader scenario of material, cultural and social resources [18].

When it comes to the evaluation of virtual environments, these remarks acquire particular relevance. In fact, the evaluation of VEs still tends to be carried out from a rather outdated perspective, where engineering criteria and classic human factors are considered as the only elements influencing the satisfaction and effectiveness of the immersive experience, and the context of use is treated as a marginal or disturbing element [19, 20, 21]. This is probably due to some presuppositions according to which a VE should provide a synthetic, illusionary world competing with the real one as a robust domain of experience. The ISO definition encourages the evaluator to consider the actual environment created by the use of the VE [23], and to take into account the various cultural, infrastructural and social resources structuring the immersive experience. Therefore, a different perspective is taken in our evaluation, where the VE is considered as a field of possible actions centered but not limited to the three dimensional graphic simulation alone [22, 29] experience.

Figure 2 offers a schematic view of the VE in use, a hybrid environments gravitating around the action in the simulation and including various resources: (a) the user’s relationship with the technology, (b) other people’s relationship with the technology (in our case, the therapist), (c) the user’s relationship with the other person and their conjoined interaction with the technology (d), the physical setting where the session is hosted. These elements represent the immediate, local context of the technology in use. In addition, the use is influenced by macro-dimensions, such as the cultural and the institutional ones, via the usage practices and the goals that take part to interaction with the VE. This combination of resources develops dynamically and can give rise to multiple solutions, as varying goals and practices emerge or the user is also involved in other settings.

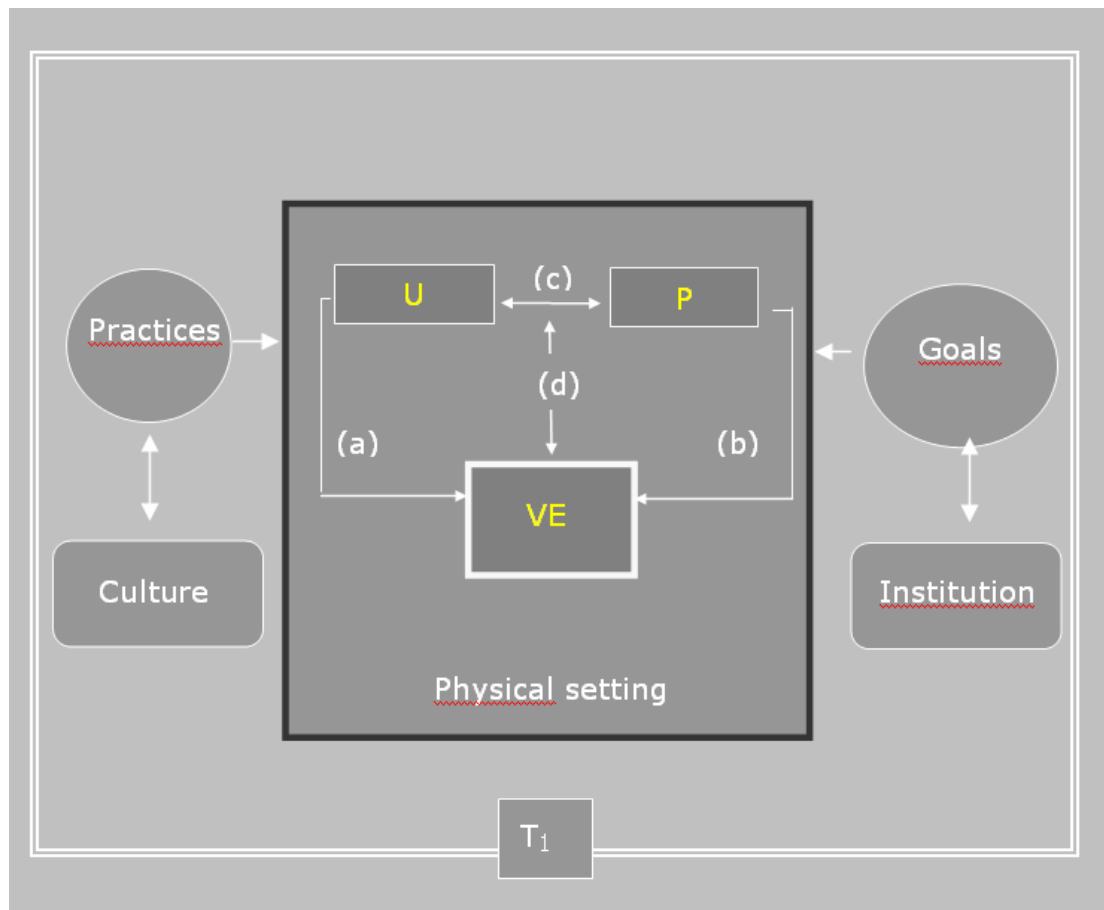


Figure 2. A schematic representation of the hybrid environment of the VE-in-use at a certain moment in time (T_1) with the user (U), the Virtual Environment (VE), other people (P)

As the model illustrates, the environment in which the VE is used is composed by several elements intertwined, not only by the user's relation with the interface; thus only by considering those elements together can we have a realistic depiction of what is the actual use of VE.

3. Methods

Once the characteristics of the VE in use are outlined explicitly, we had to set out an evaluative methodology sensitive to the theoretical framework adopted. Three methods have been chosen: two classic ones, pluralistic cognitive walkthrough and expert evaluation [24, 25], and a more recent one, inspired by Discourse and Interaction Analysis [26, 27].

'Pluralistic cognitive walkthrough' consists of asking people with a different perspective on the system to engage in a task scenario; in the version elaborated here, one participant is immersed in the virtual environment, while the other is observing the interaction on a monitor. They are asked to carry out a task together and to comment on the characteristics of the virtual environment relevant to them. 'Expert evaluation' consists in having the system studied by an expert, who is requested to evaluate each individual element with reference to a list of design principles. Experts were invited to navigate the virtual environment and report on any possible source of human error they could figure.

Comments were collected by the evaluators on the minimal system configuration required, the technical functioning of the interface (input/output devices, requirements,

frame speed, tracking system), the perceptual precision of the graphic, the smoothness in the navigation and the quality of the multimedia simulation.

The third method was meant to address the symbolic and social components of the VE-in-use and will be described in the rest of this chapter. The unifying element of the hybrid environment sketched in Figure 2 above is not the physical environment, nor the digital one, but the action in the VE which is the reference point for the other components of the model; for this reason, Discourse and Interaction Analysis have been adopted as the third method, for they take the action performed in a certain situation, or 'situated action', as their unit of analysis. In this tradition, action is either verbal (reminiscent of the speech act theory according to which people do things with their words) and non-verbal; a phenomenon of interest is studied by observing the way in which it emerges from the sequence of actions. To avoid hermeneutic speculations, the analysis is substantiated by what is demonstrably done by the users. Finally, its heavy reliance on the sequential order of the events and on the contingencies of the action meets our theoretical attention to the dynamic context of the VE-in-use.

4. Data collection procedure

The evaluation procedure tried to approximate the real usage procedure but the clinical treatment itself was kept out of the testing, since we were not entitled to any intervention of clinical nature. Thus, participants were not reportedly suffering from sexual impotence and a researcher played the role of the guide according to a usage protocol drawn up in collaboration with the therapist. In the following paragraphs, instead of 'patient' and 'therapist' we will then refer to 'users/participants' and 'guide/ researcher/ experimenter'.

The evaluation procedure involved 4 male students, aged 19 to 23 years. They were all students in psychology with normal (or corrected to normal) vision. Before the immersive experience, they were all asked to fill in an informed consent form. At the same time, their "awareness" of the goal of the system was manipulated by letting only half of them read a description on the whole therapeutic protocol of which the virtual immersion was a module. The immersive session remained the same for the two groups, since no direct mention to sexual issues was contained elsewhere in the VE. In this way we could observe if awareness of the clinical goal affected the understanding of the simulation; for example, "aware" (or *contextualized*) participants could perceive more easily and correctly the symbols present in the simulation.

The immersive session was divided in 3 parts, one for each rout available, with pauses between them [Note 2]. The sequence of interaction with the technology was videorecorded with the 'split screen technique' [30], thanks to which the events taking place both inside and outside the virtual environment appear in parallel on the same screen. After the session, all participants were asked three questions: *1. What meaning do you give to this experience? 2. How did you feel during the session? 3. How do you feel now?* All video-recordings of the sessions and audio-recordings of the interviews were transcribed. The analysis was carried out with the third method described above, inspired by discourse and interaction analysis, on the following aspects:

- a) The interplay of various concurrent settings: the intent was to see if there were different environments in which the action of the user could be located and if any interference among them could reduce the usability of the VE;
- b) The users' comprehension of the symbols and the role played to this respect by the awareness of the specific therapeutic goals of the system;
- c) The structure of the relationship between user and guide;

d) The breakdowns occurring during the human-VE interaction.

Let's consider these points in detail. Point (a) was addressed by examining the users' speech during the session and in the post-session interview to find any reference to the nature of the activity he was engaged in.

The criteria according to which point (b) and (c) could be evaluated were provided by the therapist who wanted the VE to '*enhance the patient's self-confidence and create a shared experience where the patient could feel supported and accompanied*'.

Consequently, the analysis of the interaction (c) was directed to verify the coherence of the usage procedure with the intended 'sharedness' and 'supportivity' of the whole experience, by examining:

- who had the initiative of a certain activity,
- who made the decisions,
- who initiated the correction of inappropriate actions,
- which actions were interrupted and continued by the other person,
- how consistent was the distribution of control between P and T throughout the session and how smooth their collaboration (ready responses to the other's prompts),
- who provided the interpretation of the events and how open to negotiation such interpretation was,
- how able was the guide to anticipate doubts.

To evaluate the users' comprehension (b) of the system, a list of the expected meaning of the objects along with the expected sense for each route in the session was obtained from the designers and used as a reference (see Table 1 below).

Table 1. A list of the expected meanings of the objects in the three routes

<i>First part:</i>	<i>(participant should refer)</i>
1 kitchen and living room	To feel at ease, in a comfortable place
2 toys	To sensations related to childlike experience
3 see-saw video	To loneliness or, on the contrary, to contact with other people.
4 Tower in the garden	To a sensation of anxiety, curiosity or indifference with respect to entering the tower. Consider whether they stopped in front of the tower or hesitate before entering.
<i>Second part</i>	
5 sword	To the object as a symbol of power and virility, to which they might be not interested.
6 old man	To him as a hold wise man, symbolizing disinterested help
7 Male characters	To the comparison with people of their own sex.
8 female characters	to encounters with the other sex
9 Women offering fruit	To a prize for having defeated the enemies
10 throne	Victory and, thus, to a prize related to the power reached through enemies' defeat.
11 cormorant	To success in achieving the goal
<i>Third part</i>	
12 first girl	To active involvement in helping the girl, symbolic of the capability and the acquired confidence in helping the other sex
13 second girl	To a feeling of confidence in relating to the other sex

Reference to the meaning of the symbolic objects and to the sense of the routes were looked for in users' speech during the session and the interview (Table 2) to establish if they were totally, partially or not consistent at all with the expected ones.

1st part of the session: The participant does not refer to the concept of childhood. What is observed is *inconsistent* with the initial expectations concerning the general understanding of the path.

2nd part of the session: The participant defines this experience as a 'social' task (22:07), characterized by positive and negative interactions (22:10) with respect to a not well identified aim (22:38).

This observation is *consistent* with the initial expectations concerning the general understanding of the path.

3rd part of the session: The participant does not explicitly refer to this criterion, but his argumentation contains some indexes that the situation is perceived as more complex than the previous ones, as it involves social aspects (13:3)

This observation is only *partially consistent* with the initial expectations.

The results were finally reported in a table and the aware/non aware users compared.

As to point (d), the goal was to analyze the spontaneous problems that emerged during the usage of the system. The rationale for identifying such episodes in the video-recordings was to start from an interruption in the action flow and stop when the broken course of action was restored or abandoned. 'Breakdowns' here were not only technical breakdowns of the system, but more generally any breakdown in the interaction with the VE, wherever the cause was located, either in the simulation or out of it [28]. The discrepancies in the action flow reveal some inadequacy in participant's action and are analyzed with respect to the context in which such inadequacy comes up.

The results were finally reported in a table and the aware/non aware users compared.

5. Results

5.1 The interplay of various concurrent settings.

From the analysis of participants' comments and speech, we distinguished three possible descriptions of the experience: therapy for sexual dysfunction, the actual storyboard (narrative) of the simulation and the VE as an entertaining device. During both the simulated sessions and the post-session interviews the *narrative* was generally recognized whereas the *sexual implications* were scarcely mentioned. The experience was frequently interpreted as a projective test or in terms of everyday life situations (the enemies stand for any kind of adversities one can find, not just male competitors; the throne was seen as the risk of resting on one's laurels).

The reference to the VE as *entertainment* was manifest in comments such as: "nice experience", "interesting", "peculiar", "new", "weird", "magic potion", "story", "adventure", in the recurrent characterization "curious" in reply to the question "how did you feel?" and in the appreciation for the "fun" of some episodes, such as the "fight" against the boys. Participants often mentioned the realism of the environment (noting also some incongruent elements such as the ocean in the middle of a country landscape or a sudden disappearance of the path) or of the performance (the trial, the adventure per se).

Table 2. A copy of the evaluator's notes where the points in users' discourse are indicated in which some reference is made to the symbols

<p>1. <i>kitchen and sitting room</i>: The participant does not refer specifically to kitchen and sitting room; however, he says that the house, in general, transmits him a feeling of safety (18:16). What is observed is only <i>partially consistent</i> with the initial expectations.</p> <p>2. <i>toys</i>: The participant does refer neither to toys nor to childhood. This fact is <i>inconsistent</i> with initial expectations.</p> <p>3. <i>see-saw video</i>: The participant refers to the see-saw video as an element not well integrated in the environment (17:7). This observation is <i>inconsistent</i> with the model's expectations.</p> <p>4. <i>the tower</i>: The participant refers to a strange sensation, related to tension (17:23-25) before entering the tower, as he doesn't know what to expect, justifying this perception with a feeling of uncertainty that the shape of the tower (narrow and long) causes to him (18:15-21); anyway, he does not hesitate in entering. He sets this anxiety against the sensation of pleasant curiosity felt before entering the house and the subsequent perception of safety and control during the exploration of the house itself. Despite the strong emotions experienced with regards to the tower event, he is not able to supply an explanation of the possible symbolic meaning of the tower itself: he claims to have guessed that the tower has a specific meaning, but he thinks not to have understood its sense. (18:8,9) What is observed is <i>largely, but not completely</i>, consistent with the initial expectations.</p> <p>5. <i>the sword</i>: The participant does not refer neither to sword nor to power. This observation is <i>inconsistent</i> with the expectations of the model.</p> <p>6. <i>old man</i>: The participant refers that the old man helps in resolving a difficulty (22:13). This observation is <i>in line with</i> the initial expectations.</p> <p>7. <i>enemies</i>: The participant defines the interaction as a negative one, based on the way in which they are named (enemies) and on the type of action suggested, that is their elimination (22:10,19). This observation is partially <i>in line with</i> the initial expectations.</p> <p>8. <i>women</i>: The participant refers to them as figures having a dull effect (23:34), or with reference to the positive character of the interaction. (22:21) This observation is <i>only partially consistent</i> with the initial expectations.</p> <p>9. <i>Women offering fruits</i>: Girls offering fruits are cited by the participant only as human figures in motion, and thus characterized by a fake effect (23:34). Anyway, the interaction is positive (22:21). This fact is <i>inconsistent</i> with the initial expectations.</p> <p>10. <i>the throne</i>: The participant does not make any reference of this kind. This fact is <i>inconsistent</i> with the initial expectations.</p> <p>11. <i>the cormorant</i>: The participant defines it as a 'see bird' and, thus, as difficult to be interpreted in the context of the preceding social interactions (I'm not able to understand how does it make sense in that framework; (22:24); It is defined as part of a contemplative-like experience. This observation is <i>inconsistent</i> with the initial expectations.</p> <p>12. <i>first girl</i>: The participant does not make any reference of this kind. This fact is <i>inconsistent</i> with the initial expectations.</p> <p>13. <i>second girl</i>: The participant does not make any reference of this kind. This fact is <i>inconsistent</i> with the initial expectations.</p> <p>14. <i>couple</i>: The participant does not make any reference of this kind. This fact is <i>inconsistent</i> with initial expectations.</p>

In synthesis, the awareness of the specific therapeutic goal of the sessions helped some participants to clarify what happened but remained quite hidden, which is of no surprise since our participants' were not, by design, 'patients' undergoing a sexual therapy. The entertaining nature of the experience enriched participants' use of the VE and made it pleasant.

5.2 Users' comprehension of the symbolic meanings

Overall, non-contextualized participants showed a modest comprehension of the symbolic value of the object-events encountered; likewise, they showed a modest comprehension of the three routes of the immersion. References to the expected meaning were vague and indirect. Contextualized participants, instead, showed a better grasp of the meaning of the object-events, although not an excellent one. With respect to the routes, one of them showed a good alignment to the intended meaning, the other one an indirect one (Table 2).

The clarification of the nature of the symbols is required, to isolate them from other aspects equally noticed by the participants. Anecdotically, a participant engaged in the cognitive walkthrough, where no guide was present, did not consider the movie with a man walking hand in hand with a girl at the end of the session as a representation of himself with the girl, but of someone else who 'stole' the girl from him.

Table 3. The consistence of the perceived meanings with the expected ones
(0= no consistency, 1= partial consistency, 2= full consistency)

	Participant 1 (not contextualized)	Participant 2 (not contextualized)	Participant 3 (contextualized)	Participant 4 (contextualized)
1 st route	1	0	1	2
2 nd route	0	2	2	2
3 rd route	0	1	1	1
kitchen and living-room	0	1	1	1
toys	1	0	1	2
see-saw video	0	0	0	0
tower	0	1	2	2
sword	0	0	2	2
old man	2	2	2	2
enemies	0	1	0	2
women	0	1	0	1
women offering fruits	0	0	0	0
throne	0	0	0	1
cormorant	0	0	0	0
first girl	0	0	0	2
second girl	0	0	2	2
couple	0	0	0	0

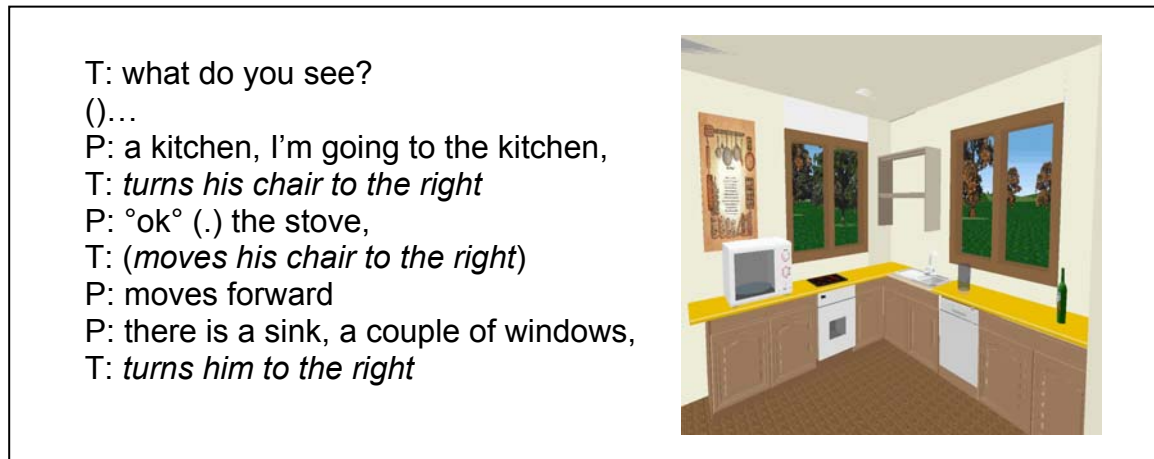


Figure 3. An example of the interaction between guide and participant.

When informed of the goal of the clinical system, users considered the experience quite plausible. The relaxed tone of the experimenter, the music and the narrative contributed to mitigate the unease possibly engendered by the novelty of the experience, but for sure the therapy framework, better than the narrative alone, provided a meaning to the experience, which on the contrary kept escaping non-contextualized participants. After the first part of the session, all participants' comments referred somehow to the 'strangeness' of the experience; after the second and third part, however, only non-contextualized participants kept on referring it.

5.3 *The relationship between users and guide.*

The protocol succeeded in directing the participants during the virtual journey: video clips left no other choice but watching them, to the point the participants sometimes complained about their passive role; the experimenter rotated the swivel chair to correct the movements of the participants throughout the whole session and changed their visual field, solicited the desired action and anticipated the events to be focused on. Participants aligned to the expected kind of conduct and asked for permission before taking initiatives. The guide decided the actions to perform, the participant followed his suggestions; the former initiated the descriptions, the latter completed them (as in the passage shown in figure 3).

Misunderstandings were usually identified by the experimenter who was the one to initiate repairs, thus confirming his/her role as expert in the situation.

5.4 *Emerging breakdowns during human-VE interaction*

Among the most recurrent breakdowns observed, there were the following:

- Video clip onset. Presumably, the activation area of the video clips surrounded the object to which they were associated so that, when objects were approached, the related video clip started. The problem was that – being the activation area 360° degrees wide with respect to the objects - videos became active even if the objects were not actually present in participants' view. In those cases, the logic connection among object and video clip was missed.

- Interruptions in the video clip of the running girl. This video clip contained a couple of interruptions during which the participant was suddenly transported back in the country landscape for some tenths of a second. Since the participant was invited by the narrative to ‘follow’ the girl, the interruptions were devised to enable him to move forward, since no movement was possible while the video clip was running. Yet, the connection was barely apparent and a sense of passivity prevailed.
- Instructions could be improved by anticipating the events, thus preventing too many questions from interrupting the smoothness of the experience. It would also be useful to base instructions on elements that are currently visible in the landscape, to avoid further confusion. Sometimes, actions were announced in the narrative that could not actually be performed by participants, thus engendering some misunderstandings. For example, after instructions like ‘let’s take this sword’ or ‘there is a sword over there’, participants tried to turn to the sword and/or to reach it, although the sword was automatically owned just by passing by it. Finally, the shared nature of the experience could be *more clearly* addressed by controlling the way pronouns were used in the instructions (plural versus singular) and by making the representation of the participant more coherent, since sometimes the view was egocentric, sometime body parts were visible (when handling the sword or holding the cup), sometimes the user was embodied by a fully visible character in the landscape.

6. Conclusions

Besides the specific list of remarks collected from the evaluation and turned to the coordinators of the project, a general conclusion can be drawn on the satisfaction and effectiveness of the VE with respect to its declared goal, namely to ‘*enhance the patient’s self-confidence and create a shared experience where the patient could feel supported and accompanied*’. The first goal was facilitated by the processes of familiarization with the virtual environment, by the contextualization to the goal of the session and by the protected nature of the experience. The second goal was facilitated by the synchronic collaboration between experimenter and participant and made possible by the scaffolding function of the protocol, even at the risk of designing a very passive role for the user.

The evaluation of the VE usability, provided a chance to define and apply a broadened model of VE in use. The methods we adopted have triggered a subsequent series of efforts towards mixed quantitative and qualitative methodologies for the analysis of the social and symbolic aspects of a VE. The adoption of action as the unit of analysis provides a recent interpretation of the classic ‘user-centeredness’ invoked in ergonomics, since it can capture the details of the interaction and represents a direct source of information, sensitive to actual structure of the interaction and of the resources that shape it. Within the appropriate conceptual framework, whose clarification we tried pursue as a necessary condition for a good methodology, situated action can be captured at various levels of details and in various formats [30].

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8. Notes

- 1) Each of the four routes available in the VE showed a specific sequence of events and objects. The paths depart spatially from a starting spot towards different directions (figure 4) and develop as follows:

ROUTE North: after turning twice, participants find themselves in front of a house. The house contains 2 rooms, a living room and a children-room full of toys. By exiting from the backdoor, participants can reach a garden with a medieval stone tower on the horizon.

ROUTE South: after a few steps, participants find a floating sword, which they can acquire by just passing by it. After that, there's a first bush. By reaching the bush, they start a full-screen filmed sequence, displaying a hand with a sword that tries to make its way through the shrub. Afterward, participants have to go through a second bush and watch another videoclip which is similar to the previous one except for a broken sword, shown in the last frame of the video. After a right turn, participants meet an old man figure, and a third video starts, where the old man offers a potion to the participant. As participants start walking again, they find another bush. Once the bush is entered, a fourth video starts. This video displays the same scene as the first one, with an unbroken sword. After that, there's a fork in the path. Participants are invited to go straight on and reach a forest. In the forest, participants see other six videos. Videos one and two display a blond woman dressed in white; videos three, four and five display a black-haired woman dressed in white. Video six displays a man (meant to represent the participant) and a woman, walking hand in hand.

ROUTE East: after a right and a left turn, participants find a group of male figures. Participants are invited to shoot them. After that, they find a short staircase with a door at the top. Behind the door they find a group of female figures. Beyond the group, there are other steps with a throne at the top of them. Once the throne is reached, participants see two full screen videos displaying two women who offer them some fruits. After the throne, there's a fork in the path. Participants are invited to turn left and head for the town. To reach the town, they need to walk across a tunnel. In town, participants reach a fire-balloon, which starts to raise in the air and show the land below.

ROUTE West: This route is almost a labyrinth with some forks and three couples of columns. Participants are asked to reach all columns. When they take the wrong path, they have to restart from the last columns they reached

- 2) All routes except for the west one were evaluated, as agreed with the therapist.

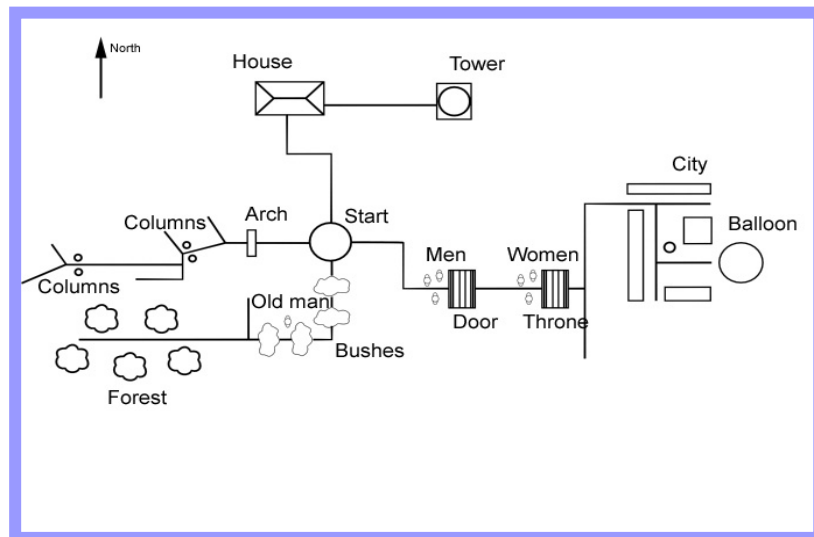


Figure 4. Bird eye view of the virtual environment

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