Virtual reality as communication tool: a socio-cognitive analysis

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Abstract

Virtual Reality (VR) is usually described by the media as a particular collection of technological hardware: a computer capable of 3D real-time animation, a head-mounted display, data gloves equipped with one or more position trackers. However, this focus on technology is disappointing for communication researchers and VR designers.

To overcome this limitation this paper describes VR as a communication tool: a communication medium in the case of multi-user VR and a communication interface in sigle-user VR. The consequences of this approach for the design and the development of VR systems are presented, together with the methodological and technical implications for the study of interactive communication via computers.

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Introduction

Virtual Reality (VR) is usually described by the media as a particular collection of technological hardware. People identify VR with a collection of devices: a computer capable of 3D real-time animation, a head-mounted display, data gloves equipped with one or more position trackers. However, this focus on technology is disappointing to communication researchers and software developers. As noted by Steuer (1992), this approach "fails to provide any insight into the processes or effects of using these systems, fails to provide a conceptual framework from which to make regulatory decisions and fails to provide an aesthetic from which to create media products" (p. 73).

If VR cannot be reduced to a hardware system, where do we look to identify its "soul"? According to Bricken (1990) the essence of VR is the inclusive relationship between the participant and the virtual environment, where direct experience of the immersive environment constitutes communication. In this sense, VR can be considered as the leading edge of a general evolution of present communication interfaces like television, computer and telephone (Kay, 1984). Main characteristic of this evolution is the full immersion of the human sensorimotor channels into a vivid and global communication experience (Biocca & Delaney, 1995).

Following this approach, it is also possible to define VR in terms of human experience (Steuer, 1992): "a real or simulated environment in which a perceiver experiences telepresence", where telepresence can be described as the "experience of presence in an environment by means of a communication medium" (pp.78-80).

In this definition we can identify three keywords - perceiver, presence and communication - all strictly linked to a key aspect of VR experience.

In the next paragraphs we will try to explore these keywords trying to outline a socio-cognitive framework for the development of VR systems.

VR as a communication medium

Several researchers have defined VR a communication technology or a medium. For instance, Ellis (1991) described virtual environments as "communication

media", while Biocca & Levy (1995) noted that VR "is likely to emerge as the next dominant medium - if not the ultimate medium" (p.9).
It would be misleading, however, to think of single-user VR systems in this way. As noted by Schroeder (1996): "The notion of a communications technology normally implies that two or more people are involved and that the emphasis is placed on the messages that pass between them... it follows that the terms 'communication' and 'medium' should only be used in the context of multi-user VR" (p. 146).
Nevertheless, when VR is a communications medium in a multi-user configuration, it can be evaluated, as Palmer (1995) points out, "as a medium of interpersonal communication in the same way all media have been evaluated" (p. 291). In particular, multi-user VR can be considered as a particular form of computer-mediated-communication (CMC).

Stasser (Stasser, 1992) defined interpersonal communication as ***a process by which a group of social actors in a given situation negotiates the meaning of the various situations which arise between them***. This definition has two important implications which have a strong influence on multi-user VR, too. If interpersonal communication is a process of negotiation:
– the only way to understand it is by analysing the subjects involved in it in the environment in which they operate, meaning that the social context in which the VR experience occurs plays a crucial role;
– new processes and activities will develop during interaction which challenge and modify the initial relationship between subject and context.
Most researchers would broadly agree that these two statements are true. According to Mantovani (1996b), the early 1990s saw changes in the paradigms used in studies of person-computer and person-computer-person interaction. The main outcome of this has been the realisation that interaction can only be fully understood through detailed analysis of the social context in which it occurs (Mantovani, 1996a): "... at this point we no longer need to see people simply as 'users' of given systems, but as social 'actors'. In other words, whether expert computer users or not, people act independently and have their own reasons for what they do, and it is computers and systems that have to adapt to people, not vice versa" (p.63).

But how can we analyze the social context of multi-user VR? In the paragraphs that follow we shall explore the Situated Action Theory and the Positioning Theory, two

new socio-cognitive approaches which seem us to explain some of the issues just raised.

Situated Action Theory - SAT – developed within the field of socio-cogntive research known as "cognition in practice". Though based on traditional cognitivist analyses of information processing and symbolisation, SAT introduces a change of perspective in that it sees action not as the execution of a ready-conceived plan, but as adaptation to context (Suchman, 1987). As Suchman notes, "instead of separating action from the circumstances in which it occurs as the execution of a carefully thought out plan ... [SAT] tries to study how people use circumstances to develop an intelligent course of action" (p.167).

This necessitates profound changes in how "social context" has previously been defined. In SAT, social context is not something physical and highly stable like an organisation or the power structure within it. As Mantovani (1996a) stresses, contexts are not given, but made, so that:

– context is conceptual as well as physical: actors perceive situations using cultural models, and act accordingly in cultural ways;

–context is unstable: cultural models are constantly modified by subjects' actions and choices.

Thus, SAT implies a radical redefinition of the meaning of communication. Context may be co-constructed by social actors, but they use communication to exchange meanings, not pieces of information. More precisely, the content of communication is interpretations of the situations which actors are involved in. In this sense, the most effective way of clarifying the meaning of messages is to relate them to a shared context of meaning.

However, this is more difficult in VR than in other computer-based activites. As noted by Oravec (1996), VR forces individuals "to deal with such issues of image manipulation and distortion on an immediate and personal basis, as participant immersed in fast-moving interaction" (p. 51). This adds layers of complexity to an already-overwhelming set of social constructs.

To overcome this problem, VR designers usually use some tricks. For istance, more of the effort of the design of multi-user VR is focused toward developing tools for the creation of faces. This choice reflects the considerable societal attention on the face as medium for expression and information display. In particular, facial expressions go beyond verbal reports to enhance context comprehension.

In general, development of multi-user VR systems requires conceptual mechanisms with which groups can be constructed and vehicles through which groups can express themselves (Oravec, 1996).
But how VR users relate themselves to the virtual groups created by multi-user VR systems? To a large extent VR users view themselves in the VR experience in terms of how they manage the other users with which they are associated, in particular by relating to such cultural objects such as "consistency", "integration" or "balance".
Studies of Positioning Theory (PT) have served to reinforce this view. As recently formulated by Rom Harré (1989; Harré & Van Langenhove, 1991), PT replaces the traditional concept of role with the concept of positioning. The main difference between the two is that a role is a stable and clearly defined category, while positioning is a dynamic process generated by communication.
As Davies and Harré (1990) point out, subjects' selves during interaction "participate in an observable and subjectively coherent way in the joint production of story lines" (p. 48). In this phase subjects see themselves as "contradictors" (Davies & Harré, 1990) and use the positioning process to construct "a variety of selves" (p. 47) closely linked to the outcome of interaction.
In psychology, these ideas have carried over into the work of Gergen (1982) and Bruner (1993), too. Gergen in particular has looked in detail at the construction of self, in studies of how an individual's self-esteem and concept of self vary in a set of different situations. These studies show that the concept of self varies both in relation to the kind of people the subject frequents, and in response to the positive and negative comments they make. On the whole, then, the self may be seen as a product of the situation in which the subject acts. For his part, Bruner, though accepting the subject's autonomy, speaks of "creatures of history" whose selves are both "a guarantee of stability and a baramoter reflecting changes in the cultural climate" (pag. 108).

So, the critical question is: in which way multi-user VR experience is related to the co-construction processes typical of positioning? Our starting point will be CMC. According to Riva & Galimberti (1997) CMC may be regarded as a form of virtual conversation, i.e., rarefied, 'pared-down' conversation lacking the rules which alone can ensure that effective interaction takes place. Infact, computer mediation creates an aysymmetrical relationship between sender and receiver which:
– enables the sender to send information and initiate cooperation, but does not guarantee that the receiver receives the message;

– offers the receiver no guarantee that the sender's declared identity is the real one.

That this dual effect is a powerful influence on positioning and construction of self is more than evident in virtual reality communication (Riva & Galimberti, 1997). As we have seen before, the virtual environment itself can be considered a kind of interlocutor because it adds to the positioning process objects and meanings which are alien to the interacting subjects. Moreover, in virtual reality there is no guarantee that the declared identities of the interactors are the real ones (Mantovani, 1995; Mantovani, 1996a). As Mantovani (1996a) notes, "Virtual reality is a communication environment in which the interlocutor is increasingly convincing in terms of physical appearance, yet increasingly less tangible and plausible in terms of personal identity. This paradox results from juxtaposing a convincing simulation of the physical presence of the other, and the disappearance of the interlocutor's face behind a mask of false identities" (p.197).

It is certainly no accident that members of electronic communities very often adopt false 'nickname' identities, and openly accept them in others. Within the same community, a person (Stone, 1991) may "construct and project mask-like identities which function as delegated puppets-agents" (p. 105). Gender switches are also commonly made, often for rather specific reasons – to get to know people of the opposite sex with a view to meeting them; to explore the emotions of people of the opposite sex – although the fun of simply 'dressing up' and pretending to be someone else is also a factor.

But there is a problem here: how can you communicate and activate the positioning process in multi-user VR without staking your own identity on the outcome? As we have seen, communication always requires a framework of rules and meanings, and this is especially true of CMC in which many features of face-to-face conversation are 'rarefied'. According to Stone (1991), one solution is to represent yourself by "coding cultural expectations at a symbolic level" (p. 102). In constructing a false identity, the subject has to make wider use of social stereotypes than would be the case in normal conversation if he wishes his identity to be recognised and accepted. This means that CMC, and virtual reality in particular, may force subjects to resort to massive use of stereotypical attitudes and behaviours, otherwise they are unlikely to achieve any shared understanding of actions and situations (Mantovani, 1995).

As Meyrowitz (1985)points out, our social context has changed because of thetechnology of communication. The influence of social context on the construction of identity is beginning to wane, especially in younger people, as

reference communities like the family, school or church, which in the past anchored social contexts in shared sets of rules, gradually loosen their grip.
The present situation would seem to be that the new media are accelerating the dissolution of traditional rule-based social contexts whose gradual disappearance is gradually emptying the media themselves of meaning.
Many of the developers of multi-user VR systems are aware of this and are conscious of the need to "create community" in the context of their efforts (Oravec, 1996). Even if many of the traditional means for creating community are not available, a great effort is given to the creation of virtual town squares or meeting rooms. According to Coate (1992) the work of maintaining virtual communities is similar to the one of an innkeeper: facilitating interaction and keeping order among patrons. Infact, if multi-user VR has to serve as community for its users, it have to embody, or replace with adequate substitutes, some functions of community life that parallel those currently provided by "traditional" communities. According to Cultler (1995), in the socially constructed space ofCyberspace, where interaction produces culture, information isthe only real medium of exchange an individual has with which to build a presence. Information exchange becomes the carrier for expressing self-concept and eliciting emotional support. Affiliations whichform around general and special interests are limited only by theability of individuals to process all the interactions that flowthrough the network to the desktop.The range and relative newness of affiliations means thatthey have little or no time bound histories. As noted by Cutler (1995), "commitment torelationships and community does not come out ofprevious relationships but out of the temporal mutuality of interests" (p. 21).
At the same time, however, there may be changes in how personal identity develops. Identitybuilding through communication works because people can interact.Thus the opportunity for interaction becomes the key tounderstanding places where identity may be formed andaffiliations made. Through discourse made possible bymulti-user VR, individuals find or form groups thatshare interests.

VR as a communication interface

In the previous chapter we defined multi-user VR as a communication medium characterized by an high level of interaction. But how we can define single-user VR?

As we seen before, the use of the word "communications technology" implies that two or more people are involved and that the emphasis is placed on the messages that pass between them (Schroeder, 1996). However, the notion of "information" contained in "information technology" can imply conveying something to a single person rather than an exchange between two or more users. So, is possible to define single-user VR as an information tecnology (Schroeder, 1996). But single-user VR is just an information technology?

Even if the precise differences between VR and other information technologies are bound to vary and depend on the characteristics of the VR system, nevertheless there is a key difference between them: VR provides a manipulable and navigable space in which communication takes place (Biocca & Levy, 1995; Palmer, 1995; Schroeder, 1996).

Biocca & Delaney (1995) defined a a communication interface as the interaction of the physical media, codes and information with the sensorimotor channels of the user. In this sense, single-user VR can be considered a communication interface.

The question of the design and representation of this interaction is a fundamental question in user-interface design, and has attracted much attention since the end of the 1960s.

As noted by Smith (1977), one of the most important aspect of the efforts to design adequate user interface has been the introduction of powerful metaphors: "Images are metaphors for concepts. They provide an alternate reality which is simultaneously concrete in structure and analogic in representation... The visual medium is an extremely useful metaphorical tool not only because it has powerful representational capabilities but also because it has a rich set of topological transformations within its own domain." (pp. 23-24).

This is expecially true for VR, a medium that has the potential to involve users in sensory worlds that are indistinguishable or nearly indistinguishable from the real world.

However, as noted by Bardini (1997), one of the most compelling snares is the use of the term metaphor to describe a correspondence between what the users see on the screen and how they should think about what they are manipulating.

According to Kay (1990) the correspondence between what the user sees on the screen and what he/she thinks he/she manipulates (in other words between what the user visualizes and his/her internal model of action) is better seen as an ***illusion*** than as a metaphor. Designing this illusion is designing the user-interface.

In this conception, the user's quest for the truth of the interaction is directed by the designer of the interface. When a user is moving a ball (task) in the virtual environment using a dataglove, he/she manipulates an iconic representation of the ball that is designed to stand for the ball in his internal model of what he/she is doing. For most users, moving the ball in the virtual environment is a quite straightforward action, analogous to moving the "real" ball on his/her "real" environment. Or so says the metaphorical conception of what is happening: it belongs to the user to realize this analogy. But if, like Kay, you consider this analogy as an illusion, the role of the designer is to make the user believe that what he/she does when he/she moves the virtual ball is an analog to moving the real ball (Bardini, 1997).

In order for a virtual environment to work, the person has to have some idea about what the virtual reality system expects and can handle, and the computer has to incorporate some information about what the person's goals and behaviors are likely to be (Bardini, 1997). These two aspects, the user's "mental model" of the virtual reality system and the computer's "understanding" of the person, are just as much a part of the interface as its physical and sensory manifestations (Laurel, 1990; Laurel, 1991). So, the interface can be considered as the representational space where user and designer meet (Laurel, 1991).

But what are the modalities of their meeting? According to Bardini (1997), characters such as the virtual ball or interface agents in general similarly define, and are defined by, the theatrical frame of the interface as a whole. The efficacy of the virtual environment as actant depends on developing convincing "characters" in the "narrative" of the user-interface (Laurel, 1990; Laurel, 1991). If their negotiation is successful, user and designer reach a consensus on the competence of the agent to perform a task (moving the virtual ball), and the medium (the VR hardware) disappears in the process: User and designer agree on the "truth" of the representation embodied in the agent, and, in consequence, his/hers/its action appears as "real."

However, we also need to direct our attention to the "physical" properties of the space of the interface: the properties of the interface that refer to the body and the perceptions of the person using or designing the system.

Basically, sensorimotor structures are the substance of experience, and experiential structures "motivate" conceptual understanding and rational thought. As noted by Bardini (Bardini, 1997), perception and action are embodied in self-organizing sensorimotor processes; it follows, then, that experience both makes

possible and constrains conceptual understanding across the multitude of cognitive domains (Varela, 1992). So, the body is integrated with the mind as a representational system, or as the neuroscientist, Antonio Damasio (1994), puts it, "...the body as represented in the brain, may constitute the indispensable frame of reference for the neural processes that we experience as the mind; that our very organism rather than some absolute experiential reality is used as the ground of reference for the constructions we make of the world around us and for the construction of the ever-present sense of subjectivity that is part and parcel of our experiences; that our most refined thoughts and best actions, our greatest joys and deepest sorrows, use the body as a yardstick" (p. xvi).

If the body is the fundamental frame of reference for our experience, what is its relationship to user-interface in computers?
Actually the development of advanced computer interfaces appears to be increasingly characterized by what Biocca (Biocca, 1997) calls ***progressive embodiment***. Progressive embodiment is defined as the "steadily advancing immersion of sensorimotor channels to computer interfaces through a tighter and more pervasive coupling of the body to interface sensors and displays" (Biocca, 1997).
In most virtual environments systems, but especially in immersive virtual reality systems, progressive embodiment of the user inside the interface presents significant design challenges (Biocca, 1997):
- ***Designing a space for bodily action***: we need the illusion of a stable and coherent spatial environment with at least most of the sensory properties of the physical world;
- ***Design of other intelligent beings***: we need to create the perception of other intelligent beings. The challenge is giving the user full first-person interaction with other intelligent beings animated by a complex expressiveness.
- ***Design of the represented body***: we need to define the characteristics of the represented body (avatar). This is not a simple task because the VR system maps the user's body directly to the first person experience of a full virtual body. Infact, the virtual body provides feedback about the location of limbs and head in space.
But what does it mean to be embodied? In other words, what are the psychological effects of embodiment in virtual environments? According to different authors (Barfield & Furness, 1995; Biocca, 1997; Held & Durlach, 1992; Steuer, 1992) the psychological effects of progressive embodiment can be expressed as various forms of what is called presence. As we have seen in the Introduction, using the

concepts of presence it is possible to define VR in terms of human experience (Steuer, 1992). Infact, when we experience our everyday sense of presence in the physical world, we automatically generate a mental model of an external space from stimuli on the sensory organs (Loomis, 1992). So, the default sense of presence is the basic state of consciousness in which the user attributes the source of the sensation to the physical environment.

However, behind this state of consciousness we find many different perceptual, psychological and social issues. This situation is refelected by the six interrelated but distinct conceptualizations of presence (Lombard & Ditton, 1997) we can find in literature:

- ***Presence as social richness***: the extent to which a medium is perceived as sociable, warm, sensitive, personal or intimate when it is used to interact with other people;
- ***Presence as realism***: the degree to which a medium can produce seemingly accurate representations of objects, events, and people, i.e. representations that look, sound, and/or feel like the "real" thing;
- ***Presence as immersion***: the degree to which a virtual environment submerges the perceptual system of the user;
- ***Presence as transportation:*** this conceptual definition of presence involves the idea of transportation. Three distinct types of transportation can be identified: "You are there," in which the user is transported to another place; "It is here," in which another place and the objects within it are transported to the user; and "We are together," in which two (or more) communicators are transported together to a place that they share.
- ***Presence as social actor within medium***: this conceptualization of presence involves social responses of media users to entities (people or computer characters) within a medium: media users respond to social cues presented by persons they encounter within a medium.
- ***Presence as medium as social actor***: the last definition of presence involves social responses of media users not to entities within a medium, but to cues provided by the medium itself (use of natural language, interactions in real time, etc.): basic social cues exhibited by the medium lead users to treat the medium as a social entity.

As noted by Lombard & Ditton (1997), all these definitions share a central idea: the perceptual illusion of nonmediation. Following these authors, the term ***perceptual*** indicates that the illusion "involves continuous (real time) responses of the human

sensory, cognitive, and affective processing systems to objects and entities in a person's environment". And, what's more, a subject experience an ***illusion of nonmediation*** when "fails to perceive or acknowledge the existence of a medium in his/her communication environment and responds as he/she would if the medium were not there". So the key issue for developing satisfying virtual environments is measuring the ***disappearance of mediation***, a level of experience where the VR system and the physical environment disappear from the user's phenomenal awareness.

Conclusions

In conclusion, we can describe VR as a communication tool: a communication interface in the case of single-user VR and a communication medium in multi-user VR. In this sense, VR can be considered as the leading edge of a general evolution of present communication interfaces, whose main characteristic is the full immersion of the human sensorimotor channels into a vivid and global communication experience (Biocca, 1992; Biocca & Delaney, 1995).

Two are the core characteristics of this experience: the perceptual illusion of nonmediation and the sense of community. The first characteristic of a satisfying virtual environment is the ***disappearance of mediation***, a level of experience where both the VR system and the physical environment disappear from the user's phenomenal awareness.

The second characteristic is the ***sense of community*** developed by interaction. Through interaction made possible bymulti-user VR, individuals find or form groups thatshare interests. So, information exchange becomes the carrier for expressing self-concept and eliciting emotional support.

This approach has important methodological and technical implications for the study of interactive communication via computers. On the one hand, the psychosocial dimension of interlocutor individuation has become increasingly important. "Sender" and "receiver", both of which are abstract, monofunctional entities, have been replaced by interlocutors endowed with thoughts, emotions, affects, and a psychosocial identity which expresses their positioning within families, groups, organisations and institutions.

In parallel with this, however, we have seen the increasing de-materialisation of interlocutors, or rather, the increasing marginalisation of their physical presence. The increasing ***irrelevance*** of the face-to-face mode in interaction has enabled VR

designers to mediate/represent the subjectivity of interlocutors using ***simulacra*** of various kinds. The anthropomorphism of the tools they have devised ranges from a simple puppet-like avatars (minimum) to ones with facial expressions (maximum), but this has never obscured the (psychosocial) subjective presence of the interlocutors who use them. This has lead to Cyberspace - the virtual space inhabited by electronic network users - whose main characteristic is interaction, from which a new sense of self and community can be built.

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