



From the body to the tools and back: A general framework for presence in mediated interactions [☆]

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ABSTRACT

Different neuropsychological studies clearly show that the perception of our body and its surrounding space is not a given fact but it is influenced by the outcome of our actions (both direct and mediated by the use of tools). In this view, a possible starting point for a better understanding of Presence in computer-mediated interactions is the study of mediated action and its effects on our spatial experience.

Following a cognitive perspective, the presented framework describes Presence as an intuitive feeling which is the outcome of an experience-based metacognitive judgment that controls our action. This process monitors pre-reflexively our activity by using an embodied intuitive simulation of the intended action developed through practice (implicit learning).

When actions are implemented using one or more tools, it is possible to distinguish between two different types of mediated action: first-order (I use the body to control a proximal artifact, e.g. a tennis player striking the ball with the racquet) or second-order (I use the body to control a proximal artifact that controls a different distal one, e.g. a crane operator using a lever to move a mechanical boom to lift materials). These two mediated actions, when produced intuitively, have different effects on our experience of body and space: a successfully learned first-order mediated action produces incorporation – the proximal tool extends the peripersonal space of the subject – while a successfully learned second-order mediated action produces also incarnation – a second peripersonal space centered on the distal tool.

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1. Introduction

I'm now writing this paper using the keyboard in front of the monitor of my PC in my office. I can transparently transform my thoughts in finger movements on the keyboard that become a meaningful sentence through a word processor on the screen in front of my eyes. Pressing the keys I feel my hands present on the keyboard. I'm preresflexively sure – no reasoning is required – that I'm in the space in front of the monitor, that my fingers are over the keyboard.

This example shows clearly how in our daily life the experience of presence is strictly related to the one of space (Spagnoli and Gamberini, 2005): I'm present *in* a space. This concept is well reflected by the definitions provided by the Merriam

Webster dictionary: “presence” is both “the fact or condition of being present” and “the part of space within one’s immediate vicinity”; “present” is “being in view or at hand” (Merriam-Webster, 2010).

Unfortunately, the link between space, presence and telepresence is little explored in the recent scientific literature about this topic. A few exceptions come from Baumgarten and colleagues (2006), Jäncke and colleagues (2009), Lee and colleagues (2004), Schloerb (1995) and Wirth and colleagues (2007). For example, the International Society of Presence Research, defines “Presence” (a shortened version of the term “telepresence”) as a “psychological state in which even though part or all of an individual’s current experience is generated by and/or filtered through human-made technology, part or all of the individual’s perception fails to accurately acknowledge the role of the technology in the experience” (International Society for Presence Research, 2000). But am I present only when I’m experiencing a virtual reality environment?

In this paper we will try to present and discuss a related but different theoretical stance based on following four pillars emerging from the recent work of cognitive sciences:

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1. *Cognitive processes can be either rational or intuitive*: Starting from this premise we will try to argue that Presence is an intuitive feeling that is the outcome of an experience-based metacognitive judgment.
2. *Skills become intuitive when our brain is able to simulate their outcome*: Starting from this premise we will try to argue that Presence monitors intuitively our activity processes using embodied intuitive simulations.
3. *Space is perceived in terms of the actions we could take towards them*: Starting from this premise we will try to argue that the feeling of Presence in a real or virtual space is directly correlated to the outcome of the actions the subject can enact in it.
4. *The use of tools shapes our spatial experience*: Starting from this premise we will try to argue that the intuitive and effective use of tools shapes both our perception of space and our feeling of presence.

2. Intuition vs. reasoning

A first problem related to the research about presence is its role in cognitive science: what is its foundation in terms of the cognitive processes involved in it? In this paragraph we suggest that presence is an intuitive metacognitive judgment that monitors our actions.

Recent research in cognitive psychology underlines the role of nonconscious mental structures and processes in driving the subject's experience, and action. For example Kahneman, a psychologist who in 2002 was awarded the Nobel Prize in Economics for his work on the psychology of intuitive beliefs and choices, identified two generic modes of cognitive function (Kahneman, 2002): "In the terminology that became accepted much later, we held a two-system view, which distinguished intuition from reasoning... an intuitive mode in which judgments and decisions are made automatically and rapidly, and a controlled mode, which is deliberate and slower." (pp. 449–450).

As noted by Stanovich and West (2000) in the last 40 years, different authors from different disciplines suggested a two-process theory of reasoning. Even if the details and specific features of these theories do not always match perfectly, nevertheless they share the following properties (see Table 1).

In sum, intuitive operations are faster, automatic, effortless, associative, and difficult to control or modify. Rational operations, instead, are slower, serial, effortful, and consciously controlled. As underlined by Koriat (2007) this distinction "...implies a separation between two components or states of consciousness – on the one hand, sheer subjective feelings and intuitions that have a perceptual-like quality and, on the other hand, reasoned cognitions that are grounded in a network of beliefs and explicit memories. It is a distinction between what one feels and senses and what one knows or thinks." (p. 301).

Contrary to common thought, however, Intuition is not innate only. Research on perceptual-cognitive and motor skills shows

that they are automatized through experience and thus rendered intuitive (Kihlstrom, 1987). In the case of motor skill learning, the process is initially rational and controlled by consciousness, as shown, for example, by the novice driver's rehearsal of the steps involved in parking a car: check the mirrors and blind spots; signal to the side of the space; position the car beside the vehicle I'm parking behind, etc. However, later the skill becomes intuitive and consciously inaccessible by virtue of practice, as shown, for example, by the difficulty of expert drivers to describe how to perform a complex manoeuvre to others, and by the fact that conscious attention to it actually interferes with their driving performance.

In sum, perceptual-motor skills that are not innate – e.g. driving a car – may become automatic through practice, and their operations thereby rendered intuitive. Using a metaphor derived from computer science, this process can be described as "knowledge compilation" (Kihlstrom, 1987; Selman and Kautz, 1996): a knowledge given in a general representation format (linguistic-semantic) is translated into a different one, more usable and less computationally demanding (perceptual-motor).

Are Presence and Telepresence intuitive or rational cognitive processes? On one side, it is evident that presence is the *outcome* of an intuitive cognitive process: no rational effort is required to experience a feeling of presence. On the other side, however, presence is *different* from an acquired motor skill or a behavioral disposition.

A possible path to find a better answer comes from the concept of metacognition. Koriat (2007) defines "metacognition" as "the processes by which people self-reflect on their own cognitive and memory processes (monitoring) and how they put their metaknowledge to use in regulating their information processing and behavior (control)" (p. 289). Following the distinction between Intuition and Reasoning, researchers in this area distinguish between *information-based* (or theory-based) and *experience-based* metacognitive judgments (Koriat, 2007; Koriat and Levy-Sadot, 1999). Information-based metacognitive judgements are based on a deliberate use of one's beliefs and theories to reach an evaluation about one's competence and cognitions: they are deliberate and largely conscious, and draw on the contents of declarative information in long term memory.

By contrast, experience-based metacognitive judgments are subjective feelings that are product of an inferential intuitive process: they operate unconsciously and give rise to a "sheer subjective experience". An example of these metacognitive judgment are (Price and Norman, 2008): the "*feeling of knowing*" (knowing that we are able to recognize the correct answer to a question that we cannot currently recall), or the "*feeling of familiarity*" (knowing that we have encountered a given situation before, even if we don't have an explicit memory of it).

As Koriat and Levy-Sadot (1999) argued, "The cues [for these metacognitive judgments] lie in structural aspects of the information processing system. This system, so to speak, engages in a self-reflective inspection of its own operation and uses the ensuing information as a basis for metacognitive judgments" (p. 496).

In other words, we can try to describe presence as the sheer subjective experience of being in a given environment (the feeling of "being there") that is the product of an intuitive experience-based metacognitive judgment.

3. Intuition as simulation

At this point a critical question is "What is intuitively judged by Presence?". Different authors have suggested a role of presence in the monitoring of action. For example, Zahoric and Jenison (1998) underlined that "presence is tantamount to successfully supported

Table 1
Intuition vs. reasoning.

	Intuition	Reasoning
Process	Relatively fast, parallel, automatic, cognitive effortless, associative, acquisition by biology, exposure and personal experience	Relatively slow, serial, controlled, cognitive effortful, rule-based, acquisition by cultural and formal tuition
Content	Percepts, imagery and motor representations	Conceptual/linguistic representations
Outcome	Impressions	Judgments

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