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Challenging Presence

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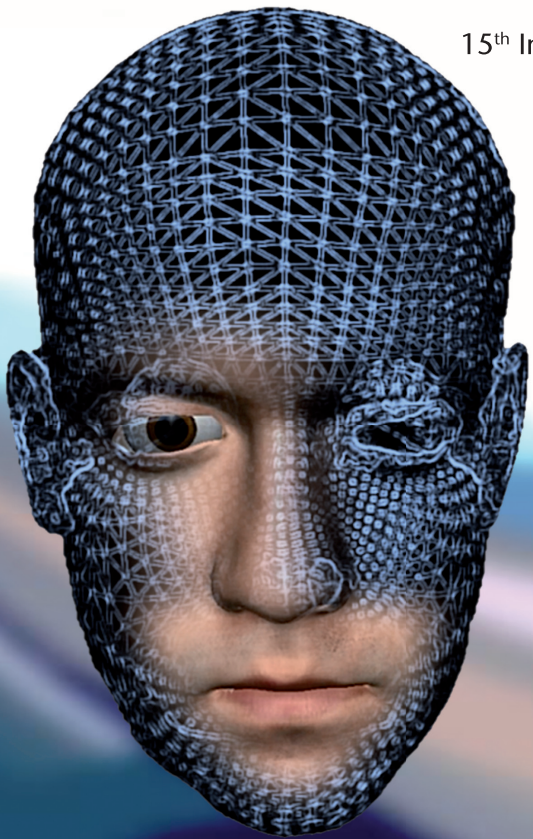

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Keynote

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In Search of the Fixed Points on the Presence Scale

Antal Haans

Abstract. We may learn more about what it means to be present in a mediated or virtual environment through our attempts at measuring it as through experimentation and philosophical reflection. This requires however that we take a more fundamental stance to measurement. Taking the definition of presence as the perceptual illusion of non-mediation as our starting point, the possibility of different levels of presence — states in between being present fully in either the real or the virtual environment — will be discussed based on an embodied framework. In this framework different intermediate states of presence are based on the extent to which the automatic body schema procedures have fallen for the illusion of non-mediation; are treating the simulated content as if it were real. Measuring presence then involves considering the whole of the organism when observing its response to the virtual content: not only people's self-reported experiences and volatile behaviors, but automatic behaviors and environmentally induced visceral responses as well. Correlational approaches to combine these observations into a presence measure will not only be unsuccessful, they are also misdirected. Instead, we must search for a set of responses that are transitively ordered in a manner that is the same for all individuals. The discovery of such an invariant and transitive order will be similar to establishing the fixed points on the temperature scale. The promise is the objective assessment of presence, and an understanding of what it means to be present without having to revert to operationalism or latent variable theorists' doctrines.

Keywords. Presence; Media technologies; Objective Measurement; Rasch model; Embodiment; Body schema

Introduction

In this keynote lecture, I will focus on the measurement of presence in relation to the use of immersive media technologies, such as teleoperation systems and virtual reality (VR). It is my conviction that we can learn as much—if not more—about what presence is through our attempts to measure it as through philosophical ponderings and experimental investigations. This requires, however, that we abandon Stevens' operationalist approach, and adopt a more fundamental stance toward measurement: Not assignments of numerals according to any rule (Stevens, 1975), but measurement as the discovery of relationships (i.e., ratios) between objects or events to a unit (Michell, 1999).

A quick glance over the presence literature is sufficient, even for the novice, to realize that there is little agreement on how presence should be measured.

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What they will find is a variety of instruments and methods based on self-reported cognitions or experiences (e.g., Witmer & Singer, 1998; Lessiter, Freeman, Keogh, & Davidoff, 2001), and behavioral (e.g., Usoh et al., 1999) and physiological observations (e.g., Meehan et al., 2005). With the latter approaches, the comparison is often sought between a person's performance in VR and how a person would respond in a real environment (e.g., feeling anxious about and/or refrain to jump into a deep virtual hole). Far apart as these different approaches may seem, they are all valid, and we need to simultaneously consider all these different types of observations if we want to measure presence. I will propose one measurement model that may be suited for that task.

When discussing the measurement of presence, several questions should be addressed. If presence is an attribute of something, then what kinds of objects may possess it? Is it even the kind of attribute that can be measured, or can objects perhaps only be ordered according to their presence? Is presence merely the result of something, or does it have some sort of causal power in and of itself? The latter is usually assumed with psychological and thus not directly observable attributes. By treating an attribute as a latent variable we may infer about an object's attribute level through the attribute's effects on the object's behavioral performance using, for example, Item-Response Theory (IRT) or Common Factor models (Borsboom, 2005). However, such an assumption puts us at risk of making a category mistake as it involves the assumption that something exists—which we call presence—besides a person's visceral, cognitive, or behavioral responses to the virtual or mediated environment (Ryle, 1949). Such strong assumption, as I will argue, may not be needed.

I expect there will be little disagreement regarding the answer to the first question. Presence is an attribute of the user, and media technologies do not possess this attribute (Slater, 2003). For this purpose, we usually make a distinction between presence and immersion; the latter being defined as the capacity of the technological system to elicit presence in its users.

Presence, in turn, has been defined as the sense of "being there" (Sheridan, 1992), or "the subjective experience of being in one place or environment, even when one is physically situated in another" (p. 225; Witmer & Singer, 1998). A more comprehensive definition of presence has been proposed by Lombard and Ditton (1997) as "the perceptual illusion of non-mediation." They thus define presence through the notion of media transparency: The user "forgets" about the technology and perceives and acts in the mediated or simulated environment as if he or she were physically there (IJsselsteijn, 2005).

Presence defined as the perceptual illusion of non-mediation is a natural consequence of how we as humans are embodied (Haans & IJsselsteijn, 2012; also Biocca, 1999; IJsselsteijn, 2005; Slater & Usoh, 1994). One aspect of our human embodiment is the body schema, which we recently defined as a dynamic distributed network of procedures aimed at guiding behavior. This network operates largely outside our conscious awareness, and supports such automatic tasks as keeping track of the position of body parts in time and space, estimating distances to objects, action selection, muscle activation, keeping balance, and so forth. By doing so, the body schema allows us to use the various parts of our morphology as a coherent functional unit; that is, without too much conscious effort. The body schema thus renders the workings of the body transparent to its owner; allowing us, for example to, walk without having to pay attention to each individual step we take. This network of procedures is also highly flexible in accommodating technological tools as functional extensions of the body, allowing for the same transparency in the use of tools as in the use of our natural bodies.

The second question—is presence the kind of attribute that can be measured?—is more difficult to answer. Lombard and Ditton (1997) argued that the illusion of non-mediation, and thus presence, is an all-or-nothing phenomenon: You are either situated in the virtual environment, or you are situated in the real environment. Presence thus is regarded to be somewhat like the

Necker cube, where one can only experience one of two possible orientations at a time, but neither both at once, nor something in between. If they are correct, then presence is not the type of attribute that can be measured (in the strict meaning of the term), despite the many attempts to the contrary. To be able to quantify differences between individuals, the attribute in question should at least exist in a matter of degree (the physical attributes length and temperature possess that characteristic). What is left to measure for the presence researcher, according to Lombard and Ditton, is the proportion of time a user was present in the virtual or mediated environment. An opposite approach is to count breaks-in-presence or BIPs (Slater & Steed, 2000; which when extended may offer a fundamental approach to measuring presence; cf., Slater, Lotto, Arnold, & Sanchez-Vives, 2009).

However, the fact that many presence measurement instruments have been proposed suggests that it is generally believed that there exist intermediate states between being present in the real environment and being present in the mediated or virtual environment (e.g., Witmer & Singer, 1998). But what then would such intermediate states of presence be like: What would it mean for an individual to fall only partly for the illusion of non-mediation? Although I know of no research that has demonstrated this for the Necker cube, it would not be too much of a stretch of our imagination to speculate about the possibility that, although our consciousness only allows the cube to be in one orientation at a time, some of the cognitive or perceptual processes running in the background of our consciousness may accept both orientations at once. It is even less of a stretch to imagine that the user of a particular media technology does not fall consciously for the illusion of non-mediation, but that some of the automatic or unconscious processes operating from within the individual are fooled nonetheless. Consider the following example I adapted from Dennett (1996): We may not feel consciously present in the VR environment, but the optical flow and virtual objects in our peripheral vision may nonetheless affect the length of our steps when navigating through the simulated world. We are generally unaware of the many automatic body schematic procedures that guide our bodily actions, but their combined efficacy becomes strikingly apparent at times, for example, when we realize having driven considerable distances in our cars while our consciousness had drifted off in thoughts.

The existence of intermediate states opens up the possibility for individuals to be ordered according to their presence, and perhaps to even quantify individual differences. The proposed intermediate states also imply that presence is more than the subjective experience of being there. Instead, it is the extent to which the organism as a whole—and not just its consciousness—is fooled by the media technology; fooled into treating the virtual or mediated environment as if it were real (also Slater et al., 2009). We should thus consider not only a person's self-reported cognitions and experiences, but also his or her visceral and behavioral responses to the virtual content; the latter involving observations of automatic and semi-conscious behaviors, for example whether reflexes or gaze patterns match those observed in real life (Sheridan, 1992; Slater et al., 2009), as well as volatile behaviors like refraining to jump into a virtual hole in the floor (Usoh et al., 1999). All these different types of responses could be used as items in a presence measurement instrument.

Correlational attempts to combine these different observations into a presence measure are most likely to fail. Only measures of the same attribute are required to correlate, not the ordinal observations on which these measures are based. Temperature measurements obtained with one instrument should correlate strongly with measurements of the same objects obtained with another, but the nominal observations of whether or not objects are hotter than frozen water do not tell us anything, and do not need to tell us anything about how these objects' temperatures compare to that of boiling water.

What is required, however, is that different presence-related observations (automatic and volatile behaviors, cognitions and environmentally induced visceral responses alike) can be ordered in a transitive manner that is more or less similar for all people (see Figure 1).

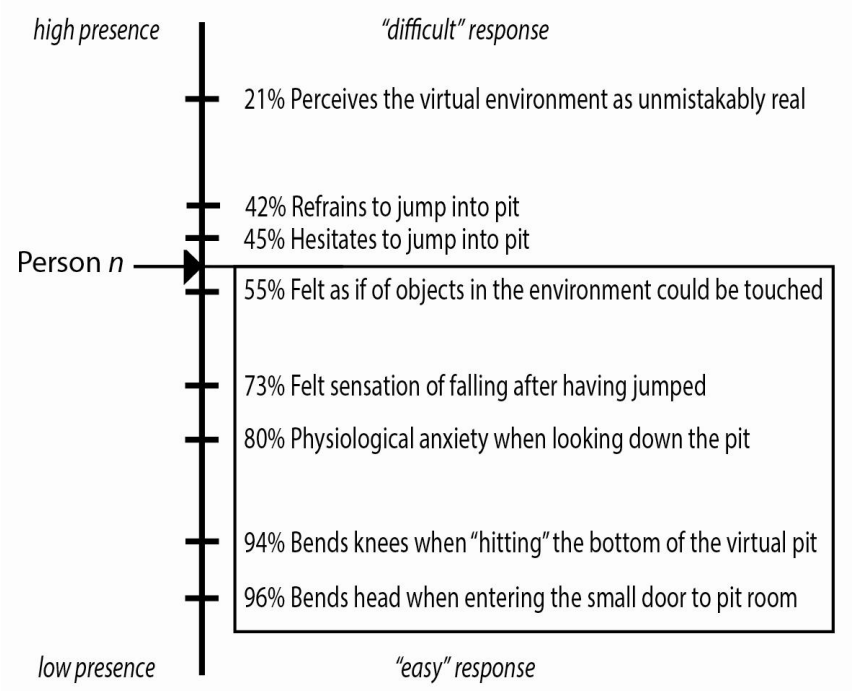

Figure 1. Hypothetical position of 8 fixed points along the presence scale for a pit environment (Usoh et al., 1999) and the performance, or presence, of a single individual n. Percentages reflect the estimated probabilities for any individual with *n*'s level of presence to display each response.

Automatic responses, followed by visceral responses, are expectedly observed in the majority of the participants, as these reflect that the organism's body schema has fallen for the 'illusion'—beliefs that the computer-generated sensory information impinging on its sensory receptors are in fact produced by a real rather than a virtual environment. Demonstrating such responses to the VR environment does not necessarily mean that an individual also refrains from certain volatile behaviors as jumping in a deep virtual hole in the floor. Only individuals who also cognitively accept the virtual world as real are expected not to jump; participants, thus, who are more present in the environment. Conversely, we expect individuals who refrain to jump into the pit, or who—with an extremely immersive VR environment—state that the environment they just visited was unmistakably real, also to demonstrate the automatic behavioral and visceral responses elicited by the virtual world. In other words, the various responses to the VR content differ in how "difficult" they are to perform as the more difficult responses reflect higher levels of presence, and thus require more immersive media technologies in order to be displayed.

Establishing such invariant transitive order of items according to their difficulty is crucial for objective measurement. In such an order, each of the behavioral, visceral, or cognitive responses to the VR environment can be regarded similar to the fixed points on a temperature scale (e.g., temperature at which water freezes, or starts to boil). If the position of the tick marks along the temperature scale is not independent of what object's temperature is assessed, then these objects cannot be numerically compared. At the same, time we would have little confidence in our understanding of what temperature is.

The proposed relation between people's level of presence and their responses to the computer-generated content is described mathematically by the Rasch model (Bond & Fox, 2007). This model prescribes the required invariant order of item difficulties. If people's responses to the vir-

tual or mediated environment fit the Rasch model, then we can differentiate individuals with respect to their presence on a scale of equal additive units.

We have recently started to explore the measurement of presence using this method in our own lab. I will discuss some of the preliminary results, and the challenges that need to be faced. These challenges will not be met easily, but through our attempts we learn about what it means to be pre-sent as well (for an example in a different domain, see Haans, Kaiser, Bouwhuis, & IJsselsteijn, 2012).

Fundamental measurement allows us to obtain a definition of presence that involves neither operationalism, nor the assumption of presence as a causal latent variable. We may simply argue that there is nothing beyond the behavioral, visceral, and cognitive responses to the computer-generated content that we may call presence; presence is these responses and cognitions and the way they are organized in the transitive order.

References

Biocca, F. (1997). The cyborg's dilemma: Progressive embodiment in virtual environments. Journal of Computer-Mediated Communications, 3(2).

Bond, T. G., & Fox, C. M. (2007). Applying the Rasch model: Fundamental measurement in the human sciences (2nd ed.). Mahwah, NJ: Erlbaum.

Borsboom, D. (2005). Measuring the mind: Conceptual issues in contemporary psychometrics. Cambridge: Cambridge University Press.

Dennett, D. C. (1996). Kinds of minds: The origins of consciousness. New York: Basic Books.

Haans, A., & IJsselsteijn, W. A. (2012). Embodiment and telepresence: Toward a comprehensive theoretical framework. Interacting with Computers, 24, 211-218.

Haans, A., Kaiser, F. G., Bouwhuis, D. G. & IJsselsteijn, W. A. (2012). Individual differences in the rubber-hand illusion: Predicting self-reports of people's personal experiences. Acta Psychologica, 141, 169-177.

IJsselsteijn, W. A. (2005). Towards a neuropsychological basis of presence. Annual Review of CyberTherapy and Telemedicine, 3, 25-30.

Lessiter, J., Freeman, J., Keogh, E., & Davidoff, J. (2001). A cross-media presence questionnaire: The ITC-Sense of Presence Inventory. Presence: Teleoperators and virtual environments, 10, 282-297.

Lombard, M., & Ditton, T. (1997). At the heart of it all: The concept of presence. Journal of Computer-mediated Communication, 3(2).

Meehan, M., Razzaque, S., Insko, B. ,Whitton, M., & Brooks Jr., F. P. (2005). Review of four studies on the use of physiological reaction as a measure of presence in stressful virtual environments. Applied Psychophysiology and Biofeedback, 30, 239-258.

Michell, J. (1999). Measurement in psychology: A critical history of a methodological concept. Cambridge: Cambridge University Press.

Ryle, G. (1949). The concept of mind. London: Hutchinson.

Sheridan, T. B. (1992). Musings on telepresence and virtual presence. Presence: Teleoperators and Virtual Environments, 1, 120-125.

Slater, M. (2003). A note on presence terminology. Presence-Connect, 3(3).

Slater, M., Lotto, B., Arnold, M. M., & Sanchez-Vives, M. V. (2009). How we experience immersive virtual environments: the concept of presence and its measurement. Anuario de Psicología, 40(2), 193-210.

Slater, M. & Steed, A. (2000). A virtual presence counter. Presence-Teleoperators and Virtual Environments, 9, 413-434.

Slater, M. & Usoh, M. (1994). Body centred interaction in immersive virtual environments. In N. Magnenat Thalmann & D. Thalmann (Eds.), Artificial Life and Virtual Reality (pp. 125-148). Chichester, UK: John Wiley.

Stevens, S. S. (1975). Psychophysics. New York: Wiley.

Usoh, M., Arthur, K., Whitton, M. C., Bastos, R., Steed, A., Slater, M. & Brooks Jr., F. P. (1999). Walking > walking-in-place > flying, in virtual environments. In Proceedings of the 26th Annual Conference on Computer Graphics and Interactive Techniques (pp. 359–364). New York: ACM Press.

Witmer, B. G. & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. Presence: Teleoperators and Virtual Environments, 7(3), 225-240.