

Self-Presence Standardized: Introducing the Self-Presence Questionnaire (SPQ)

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Abstract

The concept of self-presence describes how the self is extended into mediated environments through virtual self representations. Until now, there has been no standard measurement of self-presence because the previous definitions of this concept have not utilized a holistic definition of the self. Addressing this need, the present paper proposes a standardized Self-Presence Questionnaire (SPQ) based on a three-level definition of the self. Data from a pilot study (N=31) provide a preliminary test of the SPQ's validity as well as an exploration of relationships with other relevant variables, such as avatar design time and social presence. Although these results must be treated cautiously because of the low number of participants, the SPQ appears to be a promising standard measurement of self-presence, but should be examined and developed further in subsequent research.

Keywords--- Self-Presence, Presence, Avatars, Identity, Computer-Mediated Communication

1. Introducing Self-Presence

The notion of *self-presence*, which initially appeared as a tangent to the concept presence, broadly describes the extent to which the self is present (relevant) in media use. Avatar #1 is anthropomorphic, looks like its user and is controlled by a mouse and keyboard. Avatar #2, simply an arm on a screen, is controlled by a pointer with 6 degrees of freedom. Avatar #3, an alien figure, is controlled by an array of electrodes in the user's cap. Do the users connect with their avatars differently? How? Why are such differences important to the users' experience with the media? The concept of *self-presence* could provide insights into these questions and thus the ways that people use media, but until recently has not received much attention nor been given a standard definition.

The term "self-presence" was introduced by Biocca [1] to represent users' mental model of themselves inside the virtual world as it relates to the perception of their body, physiological states, emotional states, perceived traits, and identity. Lee [2] extended the definition to mean a psychological state in which virtual selves are experienced as the actual self (identity and/or body) in sensory and non-sensory ways. Based on these definitions, this concept of *self-presence* has been examined by various researchers [e.g., 3-5], but the operationalizations have

differed dramatically. For example, Ratan, Santa Cruz and Vorderer [3] treated *self-presence* as the connection between an individual's and an avatar's identity, whereas Jin and Park [4] treated *self-presence* as the connection between an individual's and an avatar's physical location and movements. Both studies examined how the self is relevant in media use, but considered different aspects of the self and therefore used the same term to describe separate (though related) concepts. This indicates that a standard measurement of *self-presence*, based on a multifaceted and holistic definition of the self, would be useful to researchers who utilize this concept.

Extending Biocca's [1] and Lee's [2] definitions in this regard, Ratan [6] has developed a theoretical framework of *self-presence* which draws from the fields of neuroscience [7-10], psychology [11-17], embodied cognition [18-19], and communication [20-29]. Fundamentally, this framework is based on Damasio's [8] three-levels of self. The first level, the *proto-self*, is the sense of physical being, which is based on a neural map of body schema. Next, the *core self* is an emotional state (at the fundamental physiological level), generated through encounters between the *proto-self* and objects in the environment. And last, the *autobiographical (extended) self* is the idea of self, or identity, that is dependent on memories of past experiences. These three levels constitute the holistic explication of self necessary for a multifaceted definition of *self-presence*. Thus, Ratan [6] defines *self-presence* broadly as "the extent to which some aspect of a person's media use is relevant to the user's *proto* (body-schema) *self*, *core* (emotion-driven) *self*, and/or *extended* (identity-relevant) *self*" (p. 10). It should be noted that *self-presence* is theorized to occur only during mediated, though not necessarily virtual, experiences. Further, it is a psychological state, though it may be affected by various individual traits.

Each level of *self-presence* is also defined more specifically and independently of the others. *Proto self-presence* is defined as the extent to which a media tool (interface) and corresponding virtual self-representation are integrated into body schema. *Core self-presence* is defined as the extent to which mediated interactions between a virtual self-representation and virtual objects cause emotional responses in individuals. *Extended self-presence* is defined as the extent to which some mediated identity is important to the individual. Providing an in-depth analysis of these definitions is beyond the scope of the current paper, but a summary of this theoretical framework can

be found in Table 1. Based on Ratan’s [6] framework, the present paper suggests a standard measurement of *self-presence*

that addresses each level of Damasio’s [8] holistic self.

Table 1. Summary of the Self-Presence Framework

	Proto Self-Presence	Core Self-Presence	Extended Self-Presence
Definition	The extent to which a media tool and corresponding virtual self-representation are integrated into body schema	The extent to which mediated interactions between a virtual self-representation and virtual objects cause emotional responses.	The extent to which some mediated identity is important to the individual.
High Self-Presence Implies	Media tool feels and is treated like an extension of body.	Strong emotional responses when interacting with virtual objects.	Mediated identity holds great personal significance.
Relevant Aspect of Self	Body schema.	Emotional responses.	Identity.
Possible Correlates	Time spent using virtual environments; level of technology expertise; game genre (FPS)	Mood	Extraversion; time spent developing mediated identity; game genre (MMOG)
Possible Causes	Extent of natural movements and natural (haptic) feedback afforded by media tool.	Extent to which virtual self-representations appear and are oriented like real body parts.	Number and significance of potential connections with others.
Sample Questionnaire Questions	“When using the virtual environment, to what extent do you feel like your hand is inside of the virtual environment?”	“To what extent do you feel happy when your video game character kills a monster?”	“To what extent does your avatar’s appearance represent some aspect of your identity?”

2. Measuring Self-Presence

The Self-Presence Questionnaire (SPQ) proposed here addresses each level of *self-presence* and is based on the expectations set forth by Ratan’s [6] description of the theory. Questions gauge the extent to which media use is relevant to an individual’s *proto self*, *core self*, and *extended self*. A full list of questions can be found in the Appendix, though because this project is in its early stages, these questions are subject to change. Updates on the SPQ can be found at <http://self-presence.com>.

In order to measure *proto self-presence*, questions should address the integration of a media tool and virtual self-representation as part of the body schema. Subjective ratings of the integration of false body parts into body schema were found to be positively related to neural activity in the premotor cortex [10], where body schema is processed, and so a subjective questionnaire of proto self-presence is likely to be valid. Using research on this topic as a guide [15], questions should be asked that gauge the extent to which a media tool is considered to be an extension of the individual’s body. An example of such a question is, “When using the virtual environment, how much do you feel like your avatar is an extension of your body within the virtual environment?”

For *core self-presence*, questions should address how mediated interactions between virtual self-

representations and virtual objects induce emotional responses. Because emotional responses to media occur even when there is no self-representation within the medium [23], these questions should imply that there is an interaction between the virtual self and virtual objects, not just passive media consumption. An example of a *core self-presence* question is, “To what extent do you feel happy when your video game character kills a monster?”

In order to measure *extended self-presence*, questions should address the extent to which identity expressed in a virtual context is important to the individual. An example of this is, “How important is it for your profile to portray a specific identity for your avatar?” These questions should take into account that people present various aspects of their identity depending on the context [16, 30-31] and that an individual’s identity can be expressed quite differently online and offline [17, 27-29]. Therefore, the questionnaire should explicitly note that when responding to questions about identity, individuals can, but do not have to, consider an identity that is different from their offline identity.

3. Method

As an early test of reliability and validity, the SPQ was administered to a small group of virtual world users. Unfortunately, there were not enough participants in this

pilot study (N = 31) to conduct a reliable factor analysis. Still, the results are presented here in order to provide a preliminary examination of the SPQ with the expectation that a full dataset is forthcoming. Given this caveat, the primary intent of this analysis was to assess whether the items of the SPQ form distinct but interrelated factors, as the theory suggests. Further, the SPQ's construct validity was explored by examining whether any of the levels of self-presence were related to other variables, such as avatar design time, social presence, and appreciation of the virtual world experience.

3.1. Participants and Context

Participants included 31 students (24 male and seven female) between the ages of 23 and 46 ($M = 26.16$, $SD = 4.25$) with different cultural and educational backgrounds from two universities in Switzerland. The pilot study was carried out within an interdisciplinary seminar on "Strategic Management and Artificial Intelligence", entitled "Managing the Unexpected". Participation in this study (i.e., exploring a 3D collaborative virtual environment and completing questionnaires) was a mandatory part of the seminar.

3.2. Materials and Measures

A 3D virtual world built with Sun Microsystems' Project Wonderland toolkit (version 0.4)¹ was offered to the students for their team work. This virtual environment offered various collaboration tools, such as in-world video-players, shared applications, and real-time webcam streams of the physical rooms. Users communicated via text chat, audio, and a set of basic avatar gestures. Freedom to customize avatar appearance and graphics quality in general were limited (as compared to similar commercial applications) in this pilot study, but these facets of the environment are expected to improve in the full study.

The SPQ proposed above was used to assess *self-presence* (see Appendix). Social presence was measured with a scale established for use in virtual reality contexts [32]. Avatar design time was measured with the question, "How much time did you spend designing and modifying your avatar appearance in Wonderland?" Appreciation of the virtual world experience was derived from the composite of responses on 5-point scales to four semantic differential pairs of adjectives, as follows: exciting/boring, useful/useless, motivating/frustrating, and inspiring/uninspiring. Cronbach's alpha for this composite measure was .82.

3.3. Procedure

Students met physically for the seminar throughout the semester, but teams of four to five students were comprised of members from each university in order to encourage the use of electronic media for collaboration on group assignments. In addition to group assignments, they were required to write individual papers on their experience with the 3D virtual environment and to provide suggestions for improvement of the platform for collaborative work.

Although using the 3D virtual world for collaboration was not mandatory, students were required to participate in two feedback sessions with their supervisors in a mixed reality setting using a combination of the 3D virtual world and video-conferencing (see Figure 1). The SPQ and the social presence measures were administered as online questionnaires after the second feedback session. Students received detailed feedback on the purpose and results of the study at the end of the semester.

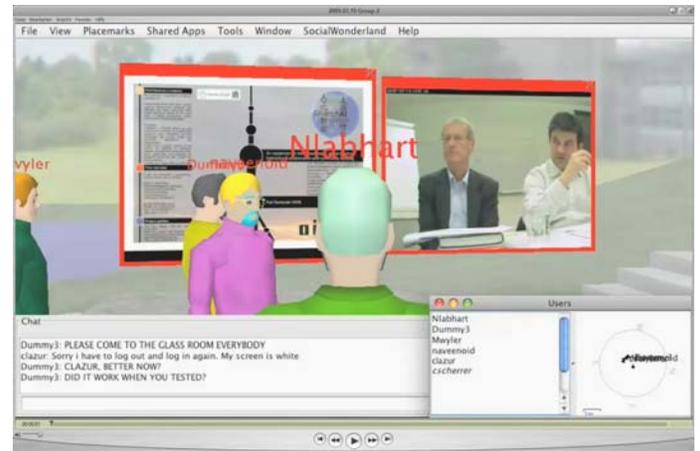


Figure 1. Seminar feedback session in a mixed-reality setting with video-conferencing and a 3D virtual world.

4. Results

Although the present sample size is not large enough for a reliable factor analysis, an exploratory principal-axis factor analysis with an oblique rotation (because dimensions of *self-presence* are theorized to be interrelated) was conducted in order to provide a preliminary assessment of the SPQ. This analysis indicated that all of the items formed distinct factors that were consistent with the levels of *self-presence* (proto, core, and extended) proposed in the theory. The pattern and structure matrices can be found in Tables 2 and 3. Cronbach's alpha for *proto self-presence* was .94, for *core self-presence* was .93, and for *extended self-presence* was .95, indicating high internal consistency for the items within each factor. Thus, the items were averaged in order to create composite measures of each level of *self-presence*.

A zero-order Pearson correlation analysis was used to test the interrelations between the levels of *self-presence* as well as relationships with the other variables measured. As the theoretical framework of *self-presence* suggests [6],

1 <https://lg3d-wonderland.dev.java.net/>

the levels of *self-presence* were positively related to each other. As a whole, the SPQ was positively related to self-reported avatar design time, social presence, and

Table 2. Pattern Matrix of SPQ
Variables correspond with question #s in Appendix.

	Component			
	1	2	3	4
Proto1	.859	.003	-.161	.016
Proto2	.819	.101	-.186	.099
Proto3	.910	-.086	.281	-.008
Proto4	.487	.181	-.237	.413
Proto5	.568	.179	-.294	.327
Proto6	.619	-.254	.261	.410
Proto7	.849	.145	.076	-.041
Core1	.437	.000	-.222	.523
Core2	.321	.194	-.367	.582
Core3	-.143	-.024	.204	.972
Core4	.094	.030	.081	.850
Core5	.190	.206	-.054	.708
Extended1	-.084	.831	.281	-.038
Extended2	-.099	.876	.185	-.207
Extended3	.207	.543	.103	.136
Extended4	.021	.610	.040	.294
Extended5	.060	.826	.046	.130
Extended6	.285	.318	.355	.230
Extended7	.546	.406	.379	-.084
Extended8	.477	.458	.224	-.024
Extended9	-.048	.917	-.229	.182
Extended10	.053	.298	.726	.139
Extended11	.223	.871	-.025	-.105

appreciation of the virtual world experience. As for the sub-levels of *self-presence*, both *proto* and *extended self-presence* were positively related to self-reported avatar design time, though the latter far more than the former. Further, both *proto* and *core self-presence* were positively related to social presence and appreciation of the virtual world experience. The correlation coefficients for these relationships can be found in Table 4.

5. Discussion

An initial test indicates that the SPQ's three distinct factors (Tables 2 and 3), which are highly internally consistent, correspond with the three levels of *self-presence* theorized in this paper. Further, the composite measures of each level are interrelated (Table 4), as the theory suggests. While there was an additional factor on which most of the items did not load highly as well as overlap for some items between factors, these unexpected findings may be due to the small sample size. Although this conclusion cannot be reliably supported until a full study is conducted, results from the present pilot study suggest that the SPQ might be an appropriate standard measure of *self-presence*.

Table 3. Structure Matrix of SPQ
Variables correspond with question #s in Appendix.

	Component			
	1	2	3	4
Proto1	.860	.310	-.105	.500
Proto2	.905	.408	-.101	.589
Proto3	.887	.375	.310	.486
Proto4	.780	.431	-.140	.739
Proto5	.808	.418	-.194	.697
Proto6	.763	.209	.226	.688
Proto7	.891	.506	.175	.485
Core1	.720	.268	-.184	.766
Core2	.707	.385	-.273	.815
Core3	.410	.279	.206	.888
Core4	.592	.354	.114	.914
Core5	.671	.483	.038	.877
Extended1	.254	.875	.542	.174
Extended2	.155	.832	.455	.008
Extended3	.514	.702	.293	.421
Extended4	.440	.721	.243	.492
Extended5	.476	.905	.317	.417
Extended6	.568	.619	.479	.496
Extended7	.689	.726	.542	.356
Extended8	.665	.718	.400	.390
Extended9	.418	.880	.066	.431
Extended10	.299	.595	.827	.275
Extended11	.521	.923	.267	.287

Although the general SPQ measure was positively associated with avatar design time, most of this relationship is being driven by the *extended self-presence* component. The correlation between avatar design time and *proto self-presence* is not strong and lacks theoretical basis, so it should only be addressed if this relationship is found to persist in future research. Because *extended self-presence* is defined as the extent to which some mediated identity is important to the individual, it follows theoretically that someone who experiences higher levels of *extended self-presence* would spend more time developing a virtual self-representation. Thus, the positive correlation between *extended self-presence* and time spent designing an avatar supports the construct validity of this level of the SPQ.

The positive relationship between social presence and the general SPQ is not as easy to explain. First, it is worth noting that the correlation is not very high and is driven more by *proto* than *core self-presence* (not at all by *extended self-presence*). Because this is only a correlation analysis, the direction of influence cannot be determined. Being physically and/or emotionally extended into a virtual environment may augment the feeling that other virtual beings are socially present within that environment. Or perhaps feeling as though other virtual beings are socially

Table 4. Pearson correlations between SPQ, SQP subscales, and other variables

	SPQ_Total	SPQ_Proto	SPQ_Core	SPQ_Extended
SPQ_Total	1.00			
SPQ_Proto	-	1.00		
SPQ_Core		.80**	1.00	
SPQ_Extended		.58**	.51**	1.00
Avatar_design_time	.56**	.37*	.31	.76**
Social_presence	.38*	.49**	.44*	.08
Appreciation_of_VW_experience	.42*	.54**	.48**	.02

$N = 31$, Note: * $p < .05$, ** $p < .01$

present facilitates the extension of body and emotions into the virtual environment. Given the hierarchical relationship of Damasio's [8] levels of self, the former explanation seems more likely than the latter, but future research should utilize controlled experiments to further explore and properly determine the directionality of this relationship. The potential implications of this relationship are notable because they may provide insights about social processes in virtual environments from a previously unexplored perspective.

The positive relationship between appreciation of the virtual world experience and the general SPQ is also notable. This relationship is driven nearly equally by *proto* and *core self-presence* (not at all by *extended self-presence*), implying that feeling physically and/or emotionally extended into the virtual environment improves an individual's experience within that environment. Most virtual environment producers strive to induce such appreciation within their users and thus a proper understanding of *self-presence* may be useful to them. Further, such appreciation may augment other outcomes associated with the use of virtual environments, such as learning or behavior modification. Thus, *self-presence* is a potentially valuable topic for researchers in the area of serious games [38].

6. The Future of Self-Presence

The present results represent only a small step toward establishing a standard measure of self-presence. Subsequent research with larger sample sizes should further validate the SPQ, using not only self-reported measures for comparison but also behavioral measures. For example, *proto self-presence* may be related to cognitive load, *core self-presence* may be related to physiological measures of arousal, and *extended self-presence* may be related to amount of personal information entered while constructing a virtual identity.

Self-presence may also vary depending on the virtual environment or game genre. For example, some genres focus more on creating first-person presence-inducing virtual environments, which is likely to be related to *proto self-presence*, whereas others focus more on social cooperation, which requires the exchange of identity relevant-information and thus relates to *extended self-presence*. First-Person Shooters (FPS) qualify within the former category [25] whereas MMOGs qualify within the latter [26], and thus FPS players should score

higher than MMOG players on *proto self-presence* while MMOG players should score higher than FPS players on *extended self-presence*.

In addition to testing for these correlates of each dimension of *self-presence*, various causes of *self-presence* should also be examined. Regarding *proto self-presence*, physical tools that are integrated into body schema, such as a rake, tend to extend the reach of the arm and require similar movements as would be used without the tool [34-35]. Thus, media interfaces that require more natural movements and give more natural (haptic) feedback (e.g., Wii mote) should cause more *proto self-presence*. Regarding *core self-presence*, Armel, & Ramachandran [14] found that when people have associated a faux body part with their body schema, they respond emotionally (measured by EDA) to false injuries to that body part. However, certain facets of the body part's presentation, such as realism of appearance and orientation, limit the extent of this phenomenon [10, 36]. Thus, virtual self-representations that appear and are oriented more like real body parts should cause more *core self-presence*. Lastly, regarding *extended self-presence*, the importance of a mediated identity is likely to be related to the potential for this identity to be used. Identities are used to connect with other people, and thus the number and significance of potential connections with others should positively contribute to *extended self-presence*. Experiments should be designed to test for all of these potential relationships. Independent variables should include manipulations of the control interface, the on screen self-representation, and expectations for social uses of mediated identity.

If the findings from these experiments support the expectations, then the SPQ can be treated as a valid measure of self-presence. However, this would not mean that the theory of self-presence itself has been validated or proven to be useful. In order to accomplish this, the concept of self-presence must be used to provide an understanding of some noteworthy phenomena to a greater extent than other theories are presently able. Some topics that may be appropriate for such inquiries include interpersonal relationship development in virtual environments and serious games (e.g., educational and health-oriented gaming), but other potentially interesting areas may be discovered as the SPQ is explored further. The present paper has initiated this exploration by establishing that the SPQ is a promising standard measurement of *self-presence*. The first author is currently working on addressing some of these suggestions in his

dissertation work with the hope that a growing body of researcher will begin to utilize and contribute to this concept.

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Appendix

Self-Presence Questionnaire

(note: these questions are subject to change. Updates on the project can be found here: <http://self-presence.com>)

Proto Self-Presence

1. When using your avatar, do you feel physically close to the objects and other avatars in the game/virtual environment?
Example response prompt: When using my avatar, I feel [not at all/somewhat/moderately/very much/a great deal] physically close to the objects and other avatars in the game/virtual environment.
2. When playing the game/using the virtual environment, how much do you feel like your avatar is an extension of your body within the game/virtual environment?
3. When something happens to your avatar's body, to what extent does it feel like it is happening to any part of your body?
4. When using your avatar, to what extent do you feel like your arm is elongated into the game/virtual environment through your avatar?
5. When using your avatar, to what extent do you feel like you can reach into the game/virtual environment through your avatar?
6. When playing the game/using the virtual environment, to what extent do you feel like your hand is inside of the game/virtual environment?
7. When playing the game/using the virtual environment, how much do you feel your avatar is a part of your body?

Core Self-Presence

1. When happy events happen to your avatar, to what extent do you feel happy?
2. When surprising events happen to your avatar, to what extent do you feel surprised?
3. When sad events happen to your avatar, to what extent do you feel sad?
4. When upsetting events happen to your avatar, to what extent do you feel angry?
5. When arousing events happen to your avatar, to what extent do you feel aroused?

Extended Self-Presence

1. How much effort did you put into making your avatar's sex clear to others?
2. How much effort did you put into making your avatar's race clear to others?
3. How important is it for your profile to portray a specific identity for your avatar?
4. How much do you care about the age of your avatar?
5. How much do you care about the race of your avatar?
6. To what extent has the experience of using your avatar helped you learn more about your own identity?
7. To what extent have you customized your avatar to make it look the way it does?
8. To what extent does your avatar's appearance represent some aspect of your identity?
9. How much do you care about the sex of your avatar?
10. How much effort did you put into making your avatar's age clear to others?
11. How much do you care about how your avatar looks?