Theoretical and Empirical Support for Distinctions Between Components and Conditions of Spatial Presence

Saskia Böcking, Andre Gysbers, Werner Wirth, Christoph Klimmt, Tilo Hartmann, Holger Schramm, Jari Laarni, Ana Sacau, & Peter Vorderer
University of Zurich, Hanover University of Music and Drama (HMT), University of Zurich, Hanover University of Music and Drama (HMT), Hanover University of Music and Drama (HMT), University of Zurich, Helsinki School of Economics and Business Administration (HKKK), University Fernando Pessoa (UFP) Porto, University of Southern California (USC) Los Angeles
{s.boecking@ipmz.unizh.ch, andre.gysbers@ijk.hmt-hannover.de, w.wirth@ipmz.unizh.ch, christoph.klimmt@ijk.hmt-hannover.de, tilo.hartmann@ijk.hmt-hannover.de, h.schramm@ipmz.unizh.ch, jari.laarni@hkkk.fi, pssacau@ufp.pt, vorderer@usc.edu}

Abstract

One of the most important measures of Presence is the questionnaire. Different instruments have been introduced; however, they are based on different and partly implicit theoretical assumptions. The MEC model of Spatial Presence has been proposed as a theoretical framework for the unification and simplification of the existing Presence research. Based on a short explication of this model, the definitions and operationalization of selected constructs (i.e. involvement and presence) within the MEC Spatial Presence Questionnaire (MEC SPQ) will be explained and distinguished from their former use in presence research. Finally, we will present some findings from pretest studies that were conducted with 290 students from three different countries (U.S., Portugal, Finland) to demonstrate the differences between presence and involvement. Testing four different media (linear text, hypertext, film, virtual environment) the data not only supported the constructs' validity but also allowed to create highly consistent and homogeneous scale versions for these constructs.

Keywords--- **Spatial Presence, Components, Theory, Measurement, Questionnaire**

1. Introduction

One important contribution of social-scientific approaches to Presence research is the development of robust and valid measures of the construct. To be able to generate reliable and valid data on Spatial Presence is a crucial condition for successful basic research, application development, service evaluation and product optimization. Consequently, the demand for usable and effective measures of Presence is strong both in academic and industrial contexts.

So far, a lot of different approaches have been used for measuring presence. Usually, subjective and objective measures are differentiated [1]. Even if it is questionable whether objective measures assess presence well – presence is mostly assumed to be a subjective sensation that it is not so amenable to objective physiological measurement [2] – the main problem of existing measurement tools is the lack of a solid theoretical foundation. This point is critical as by which way presence is measured depends on the theory used [3]. MEC's model of Spatial Presence [4] has been introduced to close the theoretical gap in presence research. However, due to the theoretical framework developed within this model, some constructs (i.e. presence, involvement) have been defined somewhat different to their former use in presence research. Because of the close connection between presence theory and the way of measuring presence, it was necessary to develop new measurement tools that fit the theoretical framework of the MEC model.

In the following sections we will report the development of this new measurement tool[1]. We start with a short summary of MEC's model of Spatial Presence which was used as a theoretical framework (section 2). We then explain in more detail MEC's definitions of presence and involvement (section 3). In doing so, we will explicate our understanding of these constructs in comparison to existing understandings in presence research. At the same time, the conceptual clarification is the basis for the operationalization and thus the development of the scales for measuring these two constructs. Finally, we present empirical findings on the reliability and validity of the scales developed for measuring presence, and involvement (section 4).

2. The MEC model of Spatial Presence

[1] As we consider presence to be a subjective experience, we developed a questionnaire that encompasses the different constructs of the MEC model, i.e. the MEC Spatial Presence Questionnaire (MEC SPQ).

The MEC model of Spatial Presence [4] has been proposed to serve as a unifying theoretical approach in explicating the development of feeling physical – or as it is named in the model – spatial present in a mediated environment. Integrating both media and user factors, it is applicable not only to virtual environments, but to less interactive and immersive media settings as well. Moreover, by introducing processes of attention and perception it integrates mental mechanisms which enable humans to feel spatially present.

According to the MEC model, Spatial Presence is considered to be a specific part of the experience of presence. It arises when media users think that they are put in an environment offered by the medium. The model suggests that spatial presence emerges in two steps (cf. figure 1). In the first step, the user constructs a spatial situational model (SSM) of the mediated environment (cf. [5]). Decisive for the construction of the SSM are automatic and controlled attention processes. They result in the user's fading out of environmental stimuli and his focusing of the mediated environment. The user perceives the spatial cues of the mediated environment and constructs a mental model out of them. It is assumed that individual user characteristics such as spatial ability [6] influence the form of the SSM. The second step of the model comprises perceptional processes that are based on the SSM and guided by hypotheses [7]. In the course of hypothesis testing, the user scrutinizes the assumption that the mediated spatial environment is the primary egocentric-reference frame [8] [9]. If this assumption is affirmed, the user feels Spatial Presence. Within this process of hypothesis testing different user characteristics are considered to be important. The model here concentrates on processes of cognitive involvement [9], and suspension of disbelief [10], which is affected by trait variables, such as absorption [11].

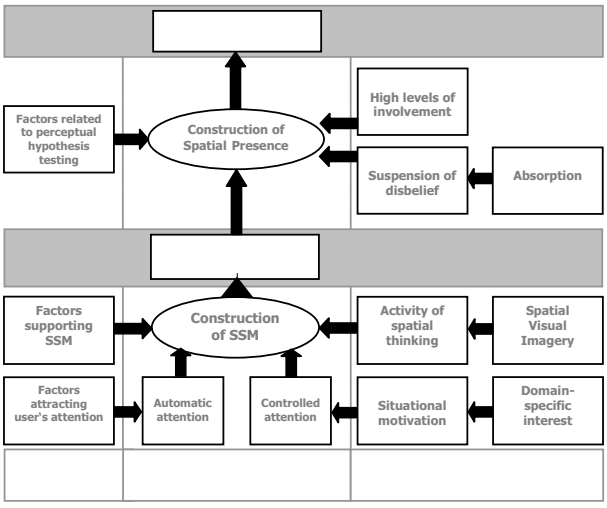

Figure 1 MEC's two-level-model of Spatial Presence

3. Conceptual clarifications of MEC's understanding of Spatial Presence and involvement

In contrast to existing theoretical and empirical modellings of presence experiences, the MEC model explicitly distinguishes presence, involvement, and attention by definition. This distinction and the integration of mental mechanisms allow for empirically testable predictions about the formation of Spatial Presence experiences. However, MEC's understanding of presence, involvement, and attention is in some way different to existing definitions and usage. Therefore, we intend to clarify these differences.

3.1. The presence concept in the existing presence literature

In general, the origin of the presence concept is seen in the term telepresence that was first introduced by Minsky [12]. In its original formulation it meant the illusion of being transported via telecommunication systems to a real, physical location experienced synchronously. Since the introduction by Minski, however, this term has been generalized to a sense of transportation to any "space" created by media [13] and finally has been broadened to the shorter and more common term "presence". Recently, presence has been generalized to the illusion of "being there" or, to name it more precisely, the "perceptual illusion of nonmediation" [14]. Lee [15] has presented the latest review of existing definitions of presence and came up with a similar definition which concentrates on aspects of perception and thus on subjective experiences.

Although most presence researchers agree in regarding presence as a subjective experience and although the broad definition of Lombard and Ditton [14] is widely accepted, there is still some confusion regarding the components of presence. Several subtypes of presence are defined which are not labelled uniformly.

When analyzing the use of the general term presence, Lombard and Ditton [14], for example, identified two broad theoretical categories: physical and social presence. While physical presence refers to the sense of being physically located in a mediated environment, social presence refers to the feeling of being together (and communicating) with a mediated person. In addition, Lombard and Ditton [14] report presence being linked to media or stimuli factors as social richness, realism, immersion, or link this concept to user's reactions to media (such as parasocial interaction). Draper, Kaber, and Usher [16] distinguish three different types of presence: simple, cybernetic, and experiental. While the first is *qua definition* simply the ability to operate in virtual environments, the second is concerned with aspects of the human-computer interface. The third, finally, is the one most scholars think of when talking of presence by using the general term: a mental state in which a user feels physically present within a computer-mediated environment. Heeter [17] again, splits the general term presence in three subdimensions: personal, social and environmental

presence. While the first is defined as the sense of being in a virtual world – including the reasons why one feels like being there (e.g. a dynamic, artificial representation of some part of oneself) –, social presence is seen as a subset of personal presence with the user being together with others in the mediated world, too, and interacting with them. Environmental presence refers to the extent to which the environment itself appears to know that the user is there and to react to him/ her. Biocca [18], finally, distinguishes theoretically between physical, social and self presence. While his understanding of social and physical presence is almost identical with its use by Lombard and Ditton [14], he defines self presence as the users' mental model of himself inside the virtual world.

Consequently, different authors define the general term presence differently. Nonetheless, most of them agree on the basis of theoretical considerations that presence is a subjective experience of which the feeling of being physically located in a mediated environment is one main component.

However, what presence, i.e. the feeling of "being there", exactly is, has not been answered uniformly. Different authors have defined this experience in terms of hardware or stimulus effects [10] [13] [19] [20]. Moreover, empirical findings propose presence to be a complex, multidimensional construct. Using cluster analyses, Witmer and Singer [20], for example, identify control (i.e., perceived control of events in the VE, responsiveness of the VE to user-initiated actions, the involving power of the visual aspects and the participant's involvement – which the authors define similarly to attention – in the VE), naturalness (i.e., the extent to which interactions with the VE feel natural, the extent to which the VE is consistent with reality, and the degree of naturalness of the control of locomotion through the VE) and interface quality (i.e., interference of or distraction by control or display devices from task performance, extent to which the participant feels able to concentrate on the task) as components of presence. Lessiter, Freeman, Keogh, Davidoff [21], applying the ITC-SOPI, extract the factors sense of physical space (i.e., a sense of physical placement in the mediated environment, interaction with, and control over parts of this environment), engagement (i.e., the tendency to feel psychologically involved and to enjoy the content), naturalness (i.e., a tendency to perceive the mediated environment as life-like and real), and negative effects (i.e., adverse physiological reactions caused by the mediated environment). Similarly, Schubert, Friedmann, and Regenbrecht [22] identify a three-component structure of presence, containing the factors spatial presence (i.e., sense of "being there" and possible actions in the VE), involvement (i.e., awareness and attention processes) and realness (i.e., in how far the virtual and the real world are perceived to be similar). The authors prove them to be on the one hand different from, but on the other hand closely related to each other. Besides these three components that they regard as facets of presence, five other factors (i.e., quality of immersion, drama, interface awareness, exploration of VE, predictability and interaction) have been identified. In contrast to the presence factors, they tap descriptions of the stimuli offered by the VE and the interface, and the interaction with them. However, when taking a closer look at all these components, it has to be taken into account that factor and cluster analyses can only structure the items derived theoretically. This is problematic as both Witmer and Singer [20] as well as Lessiter et al. [21] did not base their items on a theoretical framework. Moreover, there are other problems which we address in the following section.

3.2. Problems of the existing understanding of the presence concept

At first glance, the three investigations analyzing components of presence revealed different components. However, if one examines these components more deeply, most of them turn out not to be part of the presence concept, i.e. the feeling of being in a mediated environment. Rather, they are hardware, software, subject or task variables which, when combined, will add to the sensation of presence. For example, the items of the Witmer and Singer questionnaire [20] do not directly assess subjective presence experiences, but address factors that influence involvement (which the authors defined as awareness and attention processes) and immersion. By doing so they rather measure subjective evaluations of immersive technology than presence [22]. Thus, Witmer and Singer [20] do not properly distinguish between the mere experience of presence and factors leading to this experience. The same holds true for Lessiter et al. [20] who did not clearly define what they mean by the term "presence", but used 15 different content areas deemed relevant to presence on the basis of theoretical and empirical papers instead. Thus, their components of presence – as that of many other authors – are mainly related constructs which seem to be rather perceptions of different hardware components enhancing presence or effects of presence, but not the experience of being present itself.

Altogether, the different factors mentioned above are usually regarded as being part of the presence experience. However, some scholars prove that, for example, realness is closely related to presence but at the same time is different to it [22]. According to these results, presence experiences are influenced by, but are distinct from evaluations of the immersive technology or evaluations of interaction. Therefore, it is more plausible to assume that constructs such as involvement or reality judgment are antecedents of presence experiences rather than components. In this context, it is pointed to the possibility of feeling present in a media environment without assigning reality status to it [23]. Schubert [24] highlights that the sense of presence has to be distinguished from the technological quality of the virtual environment. "The former is *subjective* experience similar to a feeling. The latter is commonly called *immersion* …, referring to objective descriptions of the technology" (p. 69). Similarly, Kalawsky [25] states: "it is clear that presence is a cognitive factor that must be treated differently than other perceptual aspects of a human-computer

interface such as brightness or contrast of an image." (p. 5) Additionally, sometimes negative effects have been considered to be one component of presence [20]. However, as the word "effects" suggests, behaviour such as becoming motion-sick may be an outcome of presence rather than an element of it.

These problems of existing conceptualizations of different presence components are due to the lack of a theoretical framework which underlies the definitions and empirical investigations. The MEC model of Spatial Presence has been proposed to close this gap (cf. section 2). However, this conceptualization defines presence and involvement differently from their former use in presence research, i.e. as conditions of presence.

3.3. Presence, and involvement within the MEC model of Spatial Presence

The feeling of being physically located in a mediated environment is considered to be a subtype of the general term presence (section 3.1.). Most scholars, however, when talking about this experience, do not define in which way the feeling of being present manifest itself. Rather, most of them mention this experience by labeling it as the feeling of "being there" or they misleadingly include different factors or perceptions leading to presence into their definitions (section 3.2.).

Schubert et al. [22] refer to cognitive processes and propose more thorough considerations when trying to explain the formation of presence experiences. According to them, two cognitive processes are involved in the emergence of presence: the construction of a mental model and attention allocation. In applying the embodied cognition framework [26], they argue that media users feel present when the mentally represented actions are bodily actions within the space depicted. Attention allocation is crucial for this process, as without attention is not possible to construct a mental model of the mediated environment. Using factor analyses Schubert et al. demonstrate that presence experiences in fact consist of spatial-constructive and attention facets.

Following these considerations, the MEC model distinguishes between attention processes, the construction of a mental model of the mediated environment, and the experience of presence itself. In contrast to other scholars, presence – which we call Spatial Presence in order to distinguish it from the general term and to emphasize the aspect of feeling physically present in the mediated environment – in a first step is defined as the subjective experience of being in the mediated environment. However, this mere verbal description does not offer any possibility for formulating concrete items – except items which directly address the feeling of being present in the mediated environment. Taking this problem into account and regarding that the embodied cognition framework suggests that mentally represented actions of the own body in the space depicted are important for experiencing Spatial Presence, we would like to widen the classical definition of Spatial Presence for this aspect. Thus, Spatial Presence consists of two dimensions: (1) the classic description of presence, i.e. the sensation of being physically situated within the spatial environment portrayed by the medium (*self-location*), and (2) perceived possibilities to act in the mediated environment (*possible actions*). Following the cognitive processes proposed by the model, a user experiences Spatial Presence, if he perceives himself to be in and connects his action possibilities to the mediated environment. The user's mental capacities are bound by the mediated environment instead of reality. He perceives only those action possibilities that are relevant to the mediated space, but will not be aware of actions that are linked to his real environment.

In doing so, we limit Spatial Presence to its core, i.e. the concrete experience. Cognitive processes as attention allocation or the construction of a mental model of the mediated environment are regarded as preconditions of this experience. Different media and user factors that can affect those preconditions of Spatial Presence experiences are integrated in the MEC model. However, they are not considered to be part of this feeling.

One of the user factors taken into account in the MEC model is involvement. So far, in presence research involvement has mainly be conceptualized as awareness and attention processes [22], immersion into the virtual environment [28] [27] or a mixture between attention and immersion [20]. However, according to our model, attention processes are assumed to take effect especially in the first stage. Thus, involvement as it is understood here implies more than just mere attention. Following conceptualizations from advertising [28] [29] and communication research [30] we therefore regard involvement as higher forms of information processing that may have cognitive, affective and conative aspects. However, as affective and conative aspects are strongly connected with cognitive processes, we consider involvement to be the intense cognitive engagement with a media environment that can be observed via processes of appraisal, elaboration, evaluations, and mental explorations. Thus, involvement is sharply distinguished from Spatial Presence. While involvement means the *active and intense processing* of the world presented by the media, Spatial Presence emphasizes the experience of being solely within the mediated world. In being conceptualized as active and intense processing of the mediated environment, involvement fosters Spatial Presence as processing the content of the media stimuli strengthens the assumption that the mediated spatial environment is the primary ego-reference frame.

Based on the proposed definitions of Spatial Presence, and involvement we now report the development of the scales measuring these constructs.

4. Development of scales measuring Spatial Presence, and involvement

A new Presence questionnaire has been developed [31] that targets both modelled dimensions of Spatial Presence

as well as other process components of the MEC model. We use data from the validation process of this questionnaire to demonstrate the empirical distinction between involvement and the two dimensions of Spatial Presence. Aiming at a final 8-item-scale for each construct and following methodological guidelines of the number of items necessary to start with when developing a scale [32] we formulated 12 items per scale, thus starting with an item pool of 36 items. The items have been measured by using a 5-point Likert scale ranging from 1 (I do not agree at all) to 5 (I fully agree).

4.1. Basic principles in item formulation

As items should be theoretically derived and valid, i.e. they should be based on a solid theoretical definition and appear consistent with the theoretical domain of the construct [33], we started the development of the Spatial Presence and involvement scales from the proposed definitions. In doing so, regarding Spatial Presence we took into account the already existing wording of the items from different presence questionnaires. These items were reviewed and updated according to our definition of Spatial Presence. i.e. referring to the dimensions self-location and possible actions.

According to recommendations of different authors dealing with the development of scales in general, we took care of a couple of methodological guidelines in formulating single items:

- each item should express only one idea [34]
- lengthy items should be avoided [32]
- items that are not clear, not concise, ambiguous, not concrete should be avoided [34]
- use of negatives to reverse the wording of an item should be avoided [34]

Thus, we tried to make sure that the items were as easy to understand as possible in favour of the scales' reliability. Moreover, as there is no common notion for all possible media the scales might be applied to, we decided to insert a placeholder for the type of media stimulus in each single item that had to be replaced by the medium tested.

4.2. Method

In order ensure the applicability of the Spatial Presence and involvement scales to different media settings, the item pool derived from the definitions of the constructs was tested with four types of media. For each kind of medium, a typical content was selected:

- Linear text: extract out of „The pillars of the earth" by Ken Follett
- Film: sequence from „Das Boot – Director's Cut"
- Hypertext: „The Art of Singing" (2-D virtual academy of song)
- Virtual environment: Musée d'Orsy in Paris (exhibition of art of the 19th century)

As the scales were intended to be applicable to international samples, the questionnaire was developed in English and tested in both Europe and the U.S. Participants were recruited at international schools and universities in Porto (Portugal), Helsinki (Finland), and Los Angeles (USA). The investigation was indicated as a study relating to the field of media psychology dealing with how people experience the different media used, thus guaranteeing the participant's ignorance of the actual purpose. As the scales should be applicable for adults only, participants had to be at least 15 years old.

Experiments with the text and film stimuli in L.A. were conducted in group sessions with 6-7 participants per session. Hypertext (Helsinki) and VR (Porto) were tested in single sessions due to technical restrictions. Subjects spent 10 minutes time receiving their media stimulus.

At each location a dual-task paradigm was implemented to validate the sensitivity of the scales. Half of the participants were distracted several times during media usage and had to perform a secondary task, the other participants were not distracted. Participants were randomly assigned to either the distracted or the non-distracted condition.

The basic idea of this experimental manipulation was to produce different intensities of Spatial Presence experiences systematically in order to test the scales' sensitivity for this variation. If the scales respond to the variation, this would be an empirical demonstration of their validity. According to MEC's model of Spatial Presence, attention allocation is the origin of the process that leads to the experience of Presence. The employed secondary task (random number generation) was intended to reduce subjects' attention for the medium they were exposed to and thus "slow down" or "interrupt" the formation of Spatial Presence repeatedly by affecting the starting point of this process. It was therefore considered as a strong, theory-based tool to manipulate the subjects' experience of Spatial Presence. As cognitive involvement is presumed to be affected by situational factors, differences in involvement were also assumed.

The questionnaire started with welcoming the participants, instructions how to fill out the questionnaire, and assuring anonymity. Then the inital item pool was assigned.[2] Items were presented in randomly mixed order. Finally, participants had to answer some sociodemographical questions (age, gender, education) and were asked for their English skills, if they were non-native speakers.

5. Results

Altogether, 291 participants took part in the investigation. One subject had to be excluded from further analysis due to too many missing data. 80 participants read the linear text, 81 in each case watched the film or attended the hypertext, and 49 tested the virtual environment. The participants' mean age was 21.4 years (SD=5.2), ranging from 15 to 54 years. The samples for hypertext and virtual envi-

[2] Besides the Spatial Presence and involvement scales items measuring the other constructs of the MEC model have been applied.

ronment were significantly older than those in LA (see table 1).

Applied medium	Statistical values		
	n	M	SD
Linear text	80	19.7	3.9
Film	81	19.5	1.4
Hypertext	81	24.4	3.7
VE	49	22.9	9.5
all 4 media	290	21.4	5.2

Table 1 Age of participants by medium tested

Almost three-fourths of participants were female, with female proportion significantly differing between Helsinki (63.8 %) and Porto (49.0 %) on the one hand, and L.A. on the other hand (text: 88.5 %, film: 84.0 %).

5.1. Basic principles for item analysis and item selection

Examination of data showed that item distributions were very similar across the four locations. Thus, to form a larger sample, reliability analyses were performed on the scales using the combined data from all four experiments. We used an iterative approach to eliminate items for the final version of the three scales. The analysis was intended to result in a final 8-item version of each scale. Although shorter versions (with 6 or 4 items per scale) have been developed as well, throughout this paper we will concentrate on the 8-item version only, for this version is recommended for future research.

In a first step, principal component analyses (PCA) were conducted to test the scales' reliability and validity. The involvement scale was analysed separately, the two Spatial Presence scales were analysed conjointly using PCA with varimax rotation. This is due to theoretical considerations as Spatial Presence is considered to exist of the dimensions self-location and possible actions. In case of homogeneity, a one-factor-solution for involvement and a two-factor-structure for Spatial Presence should emerge. Factor loadings were then used as first indicators for fits of single items. Items with small factor loadings or double loadings (regarding the scales self-location and possible actions) were considered for exclusion.

Furthermore, difficulties of all items were computed. For dichotomous (e.g., right/wrong) items, the difficulty is the proportion of right answers, ranging from 0 to 1. In our case (Likert-scales from 1-5), it reflects the item's arithmetic mean, i.e. a difficulty of 0 corresponds with a mean of 1 and a difficulty of 1 is equivalent to a mean of 5. Item difficulties should range from .20 to .80 and ideally come close to .50 [37]. We used variability of item difficulties within this range as one criterion for excluding and retaining items.

Because internal consistency and homogeneity of the final scales were a major concern of this study, we ranked each scale's items considering the following (corresponding) measures:

- Cronbach's alpha if item deleted indicates to what extent dropping one item would elevate or decrease Cronbach's alpha for the remaining scale. Cronbach's alpha of the resulting scale should be at least .70 [34].
- Item-remainder coefficients (corrected item-total correlation; item-scale correlation) are computed as correlation of each item and the sum of remaining items. This value should be as high as possible, but not fall below .30, as a rule of thumb [37]. Correlations with other scales should be lower than item-total correlations. These correlations were computed tentatively by using the original scales with 12 items.
- Item homogeneity (average inter-item correlation) of an item should also be high, indicating that these items assess similar information. However, moderate homogeneity coefficients comply with higher validity [37].

Preliminary analysis showed that all scales were highly internally consistent even in the original version with 12 items. However, if the statistical criteria mentioned above were applied, merely very similar worded items were selected. Although redundancy can be useful in terms of repeated measures [32], it is possible to derive a scale with high internal consistency by writing the same items in different ways [33]. Therefore, during each step of item selection, two items that normally could have been dropped were retained, if they accounted for more variability in the scale's wording. This procedure only marginally decreased internal consistencies.

5.2. Reliability and validity of Spatial Presence and involvement scales

5.2.1. Reliability

The reliability of the three scales was tested by computing PCA (see section 5.1.) and computing Cronbachs Alpha for each scale. Having conducted a PCA with varimax rotation by entering all items of the two Spatial Presence scales, the screeplot suggested two components explaining 35.8 % (self-location) and 23.6 % of the variance (possible actions). The factor solution gives support for two separate subscales, as most of Self Location items clearly loaded on the first component, and most Possible Action items constituted component two[3]. Alternative analyses were performed (principal axis analyses, oblique rotations), but did not reveal any significant difference in the ranking of the items.

PCA for involvement items initially suggested a three factor solution, explaining 52.8 % of variance. However, this solution did not allow for a reasonable interpretation. Screeplot of eigenvalues (3.89, 1.36, 1.10, .93, .85, .70, .66,

[3] We realize that it would be desirable to provide the full loading structure in a table. Due to space constraints, however, we restrict ourselves to the verbal description of the loadings. The complete matrices for the factor analysis are documented by Vorderer et al. [31].

.61, .59, .56, .43, .32) suggested the appropriateness of a single factor solution, explaining 32.4% of variance, which pointed at the unidimensionality of the scale.

The initial scales yielded high internal consistencies which only marginally decreased after dropping items for the 8-item scale (see table 2).

Scale	Statistical values		
	Cronbach's α	M	SD
Spatial Presence Self Location	.94	2.38	.91
Spatial Presence Possible Actions	.88	2.32	.81
Cognitive Involvement	.78	2.85	.76

Table 2 Statistical values of the 8-item-scales

5.2.2. Validity

A core aim of scale development is the establishment of a valid method of measurement [36]. Validity indicates whether a measure properly captures the meaning of the concept or construct it represents [37]. In contrast to reliability, validity is much more difficult to establish with certainty. Usually, it is distinguished between face or content validity (does the measure appear to measure what is aimed to measure), criterion validity (predictive and concurrent validity, i.e. does the measure allow to predict a future event or is it associated with another indicator that has already been shown to be valid), and construct validity (convergent and discriminative validity, i.e. to what degree does a scale measure a theoretical construct or trait). Although face validity offers a basic level of judgement [37], it is no objective specific value [37]. Nonetheless, we ensured face validity in theoretically deriving the items from the definitions of each construct and at the same time reverting to already existing items for each construct. Criterion validity, however, could be assessed in testing the scales' sensitivity for the experimental manipulation, i.e. the secondary task participants had to fulfil when using the media environment. For if the scales are sensitive to the distraction, they can be used to measure different intensities of presence (cf. section 4.2.). All scales did respond to the manipulation, which supported their validity (see table 3).

	Not distracted		Distracted	
Scale	M	SD	M	SD
	n = 146		n = 144	
Self-location**	2.55	.89	2.21	.91
Possible actions*	2.44	.75	2.20	.86
Involvement**	2.97	.71	2.72	.79

* p < .05 **p < .00

Table 3 Scale means of distracted and not distracted participants

Inter-scale-correlations supported the constructs' validity, too: The two Spatial Presence scales are highly intercorrelated (r = .76, p < .01), the involvement scale correlates significantly positive with the self-location scale (r = .38, p <. 01) and the possible actions scale (r = .45, p <. 01). These findings are in line with theoretical assumptions, as involvement is substantial connected with Spatial Presence, but at the same time is distinct from it.

6. Conclusions

Altogether, Spatial Presence and involvement have been demonstrated to be theoretically and empirically differentiable. All scales developed were sensitive for distraction during exposure, thus indicating criterion validity. Construct validity has been supported by inter-scale correlations. Moreover, the three scales yielded very satisfactory reliability estimates. In contrast to former conceptualizations of presence and involvement the distinction of the different concepts and the scales developed allow to investigate the formation of Spatial Presence experiences theoretically based and in more detail than former research. Although the MEC model here concentrates on user factors, media factors can be integrated as well.

Acknowledgements

The work presented here was conducted within the Information Society Technologies program of the European Commission (EC), project no. IST-2001-37661, and has been granted by the European Commission and the Federal Office for Education and Science of Switzerland. We thankfully acknowledge the support of the European Commission and the Federal Office for Education and Science of Switzerland.

References

[1] IJsselsteijn, W. A., & Riva, G. (2003). Being there: The experience of presence in mediated environments. In G. Riva, F. Davide & W. A. IJsselsteijn (Eds.), *Being there: Concepts, effects, and measurement of user presence in synthetic environments* (pp. 3-16). Amsterdam: IOS Press.

[2] Stanney, K., & Salvendy, G. (1998). Aftereffects and sense of presence in virtual environments: Formulation of a research and development agenda. *International Journal of Human-Computer Interaction, 10*, 135-187.

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

[4] Vorderer, P, Wirth, W., Saari, T., Gouveia, F. R., Biocca, F., Jäncke, F., Böcking, S., Hartmann, T., Klimmt, C., Schramm, H., Laarni, J., Ravaja, N., Gouveia, L. B., Rebeiro, N., Sacau, A., Baumgartner, T., & Jäncke , P. (2003). *Constructing Presence: Towards a two-level model of the formation of Spatial Presence*. Unpublished report to the European Community, Project Presence: MEC (IST-2001-37661). Hannover, Munich, Helsinki, Porto, Zurich.

[5] McNamara, T. P. (1986). Mental representations of spatial relations. *Cognitive Psychology, 18*, 87-121.

[6] Maier, P. H. (1994). *Raeumliches Vorstellungsvermögen. Komponenten, geschlechtsspezifische Differenzen, Relevanz, Entwicklung und Realisierung in der Realschule* [Spatial sense. Components, sex differences, relevance, development and realization in high school]. Frankfurt: Lang.

[7] Gregory, R. L. (1980). Perceptions as hypotheses. *Philosophical Transactions of the Royal Society of London Series B, 290*, 181-197.

[8] Prothero J. D., Parker, D. E., Furness, T. A., & Wells, M. J. (1995). *Towards a robust, quantitative measure for presence* [On-line]. Available: http://www.hitl.washington.edu/publications/p-95-8/ [29.03.2004].

[9] Greenwald, A.G. & Leavitt, C. (1984). Audience involvement in advertising: Four levels. *Journal of Consumer Research, 11*, 581-592.

[10] Slater M., & Usoh, M. (1993). Representations systems, perceptual position, and presence in immersive virtual environments. *Presence: Teleoperators and Virtual Environments, 2*, 221-233.

[11] Wild, T. C., Kuiken, D., & Schopflocher, D. (1995). The role of absorption in experiential involvement. Journal of Personality *and Social Psychology, 69* (3), 569-579.

[12] Minsky M. (1980). Telepresence. *Omni, 2*, 44-52.

[13] Steuer, J. (1992). Defining virtual reality: Dimensions determining telepresence. *Journal of Communication, 42* (4), 73-93.

[14] Lombard M., & Ditton, T. (1997). At the heart of it all: The concept of presence. *Journal of Computer-Mediated Communication, 3* (2) [On-line]. Available: http://www.ascusc.org/jcmc/vol3/issue2/lombard.html.

[15] Lee, K. M. (2004). Presence, Explicated. *Communication Theory, 14*, 27-50.

[16] Draper, J. V., Kaber, D. B., & Usher, J. M. (1998). Telepresence. *Human Factors, 40*, 354-375.

[17] Heeter, C. (1992). Being there: The subjective experience of presence. *Presence: Teleoperators and Virtual Environments, 1*, 262-271.

[18] Biocca, F. (1997). *The cyborg's dilemma: Progressive embodiment in virtual environments* [On-line]. Available: http://www.ascusc.org/jcmc/vol3)issue2/biocca2.html [08.04.2004].

[19] Sheridan, T. B. (1992). Musings on telepresence and virtual presence. *Presence: Teleoperators and Virtual Environments, 1*, 120-126.

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

[21] 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.

[22] Schubert, T. W., Friedmann, F., & Regenbrecht, H. (2001). The experience of presence: Factor analytic insights. *Presence: Teleoperators and Virtual Environments, 10*, 266-281.

[23] Banos, R. M., Botella, C., Barcia-Palacios, A., Villa, H., Perpina, C., & Alcaniz, M. (2000). Presence and reality judgement in virtual environments: A unitary construct?. *Cyberpsychology & Behavior, 3* (3), 327-333.

[24] Schubert, T. W. (2003). The sense of presence in virtual environments. A three-component scale measuring spatial presence, involvement, and realness. Zeitschrift für Medienpsychologie, *15* (2), 69-71.

[25] Kalawsky, R. S. (2000). *The validity of presence as a reliable human performance metric in immersive environments* [On-line]. Invited paper presented at PRESENCE 2000 – 3rd International Workshop on Presence, Delft, The Netherlands, 27-28 March 2000. Available: http://www.presence-research.org/Kalawsky.pdf [20.04.2004].

[26] Glenberg, A. M. & Kaschak, M. P. (1997). What memory is for. *Behavioral and Brain Sciences, 20* (1), 1-55.

[27] Freeman, J., Avons, S. E., Pearson, D. E., & IJsselsteijn, W. A. (1999). Effects of sensory information and prior experience on direct subjective ratings of presence. *Presence: Teleoperators and Virtual Environments, 8* (1), 1-13

[28] Krugman, H. E. (1965). The impact of television advertising: learning without involvement. *Public Opinion Quarterly, 29*, 349-356.

[29] Rothschild, M. (1983). Perspectives on involvement. Current problems and future direction. In T. Kinnear (Ed.), *Advances in Consumer Research* (Vol. 11, pp. 216-217). Provo, UT: Association for Consumer Research.

[30] Roser, C. (1990). Involvement, attention, and perceptions of message relevance in the response to persuasive appeals. *Communication Research, 15,* 571– 600.

[31] Vorderer, P, Wirth, W., Gouveia, F. R., Biocca, F., Saari, T., Jäncke, F., Böcking, S., Schramm, H., Gysbers, A., Hartmann, T., Klimmt, C., Laarni, J., Ravaja, N., Sacau, A., Baumgartner, T., & Jäncke, P. (2004). *Development of the MEC Spatial Presence Questionnaire (MEC SPQ)*. Unpublished report to the European Community, Project Presence: MEC (IST-2001-37661). Hannover, Munich, Helsinki, Porto, Zurich.

[32] DeVellis R. F. (2003). *Scale Development. Theory and Applications* (2nd ed.). Thousand Oaks, CA: Sage.

[33] Bearden, W. O., Netemeyer, R. G., & M. F. Mobley (1993). *Handbook of Marketing Scales. Multi-Item Measures for Marketing and Consumer Behavior Research*. Newbury Park: Sage.

[34] Spector, P.E. (1992). *Summated Rating Scale Construction*. Newbury Park: Sage.

[37] Bortz, J., & Döring, N. (2002). *Forschungsmethoden und Evaluation für Human- und Sozialwissenschaftler* [Research methods and evaluation for human and social scientists]. Berlin: Springer.

[36] Fishman, J. A., & Galguera, T. (2003). *Introduction to test construction in the social and behavioral sciences. A practical guide.* Lanham, MD: Rowman & Littlefield Publishers.

[37] Gunter, B. (2002). The quantitative research process. In K. Bruhn Jensen (Ed.), *A Handbook of Media and Communication Research* (pp. 209-234). London: Routledge.