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Measuring Spatial Presence: Introducing and Validating the Pictorial Presence SAM

Abstract

The aim of the present study was to develop a pictorial presence scale using self-assessment-manikins (SAM). The instrument assesses presence sub-dimensions (self-location and possible actions) as well as presence determinants (attention allocation, spatial situation model, higher cognitive involvement, and suspension of disbelief). To qualitatively validate the scale, think-aloud protocols and interviews ($n = 12$) were conducted. The results reveal that the SAM items are quickly filled out as well as easily, intuitively, and unambiguously understood. Furthermore, the instrument's validity and sensitivity was quantitatively examined in a two-factorial design ($n = 317$). Factors were medium (written story, audio book, video, and computer game) and distraction (non-distraction vs. distraction). Factor analyses reveal that the SAM presence dimensions and determinants closely correspond to those of the MEC Spatial Presence Questionnaire, which was used as a comparison measure. The findings of the qualitative and quantitative validation procedures show that the Pictorial Presence SAM successfully assesses spatial presence. In contrast to the verbal questionnaire data (MEC), the significant distraction–effect suggests that the new scale is even more sensitive. This points out that the scale can be a useful alternative to existing verbal presence self-report measures.

1 Introduction

During the last decades, the experience of immersion in media caught the attention of researchers in various fields. The concept of presence (also referred to as telepresence or spatial presence) gives a comprehensive description of this phenomenon. It describes the processes that are taking place when someone is fully immersed in mediated environments and thereby forgets about the "real" world. A vast body of research within different fields such as computer science, media studies, psychology, engineering, and philosophy underlines the concept's academic and practical relevance. Studies found presence to be relevant in various contexts such as teleoperations (e.g., piloting an unmanned aerial vehicle: Ruff, Narayanan, & Draper, 2002), online gaming (Weibel, Wissmath, Habegger, Steiner, & Groner, 2008), reading (Weibel, Wissmath, & Mast, 2011a), watching television (Weibel, Wissmath, & Mast, 2011b), video conferencing (Anderson, Ashraf, Douther, & Jack, 2001), and IMAX movies (Lombard & Ditton, 1997). In addition, it is assumed that presence is a precondition

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for successful cybertherapy (Price & Anderson, 2007). Furthermore, the concept is important for media producers: It has been found that it is an explicit or implicit goal of game designers, film makers, and writers to enhance presence experiences of the users (cf. Kim & Biocca, 1997; Bracken & Skalski, 2010; Tamborini & Skalski, 2006). We therefore argue that the concept of presence is highly relevant to understand, describe, and predict user experiences.

Since the advent of the presence concept in 1980, a plethora of different assessment techniques and instruments have been suggested. Even though questionnaires are the most widely used measurements, a consensus about how to assess presence is still missing. Existing questionnaires capturing the subjective experience of presence usually include the evaluation of verbal statements. These questionnaires are widely used, but various drawbacks and flaws of verbal measures have been identified in the past. In this study, we therefore aim to develop a pictorial presence scale. The instrument should measure spatial presence dimensions and its determinants that have been identified by previous research. The measure should be easy and fast to respond to. In addition, the sensations of presence should be assessed in a highly reliable, valid, and sensitive way. Taken together, our aim is to develop an alternative to existing presence scales that overcomes the drawbacks of verbal questionnaires.

2 Theoretical Considerations

2.1 The Concept of Presence

The term *presence* was first introduced by Minsky (1980). It describes a state of consciousness that gives the impression of being physically present in an environment portrayed by media. According to Steuer (1992), presence is the extent to which one feels present in the mediated environment rather than in the immediate physical environment. Thus, presence describes a subjective feeling of immersion into a virtual environment: Mediated contents become real and one's self-awareness is immersed into another world (Draper, Kaber, & Usher, 1998). Thus, commonly, the broad definition of *being there* or *being present* is used (Steuer, 1992; Witmer & Singer, 1998), whereas Lombard and Ditton (1997) underline the perceptual illusion of non-mediation. This illusion occurs when a person fails to perceive the mediated environment as being displayed by a media device.

A more recent approach was proposed by Wirth et al. (2007). According to the authors, two critical steps account for the sensation of presence. The first step refers to the construction of a mental model of the mediated environment. This in turn is assumed to be a necessary precondition for the emergence of spatial presence. Yet, presence will occur only through a second step: The mediated environment has to constitute the user's primary egocentric frame of reference (PERF). This means that the user must confirm the "medium-as-PERF-hypothesis" in a sense that the subjective frame of reference is captured and controlled by the mediated environment. In sum, Wirth et al. define presence as a two-dimensional construct with the dimensions of self-location and perceived possible actions. According to Wirth et al., these two dimensions are in turn influenced by the four determinants: attention allocation, spatial situation model, higher cognitive involvement, and suspension of disbelief.

1. *Attention allocation*. A fundamental precondition to experience spatial presence is the attention allocation towards the medium. Only users who pay attention to the mediated environment can experience presence. Attention allocation can be involuntary (i.e., the medium automatically triggers attention) or voluntary (i.e., the user wants to pay attention, because media contents seem enjoyable or interesting).
2. *Spatial situation model*. The second precondition is the establishment of a mental spatial situation model (SSM). This model can differ in terms of accuracy and logical consistency as well as in terms of richness or quantity of the spatial elements. If the SSM is vivid, spatial presence is more likely to occur.
3. *Spatial presence: self-location*. Spatial presence has often been referred to as experience of *being there* in a mediated environment (e.g., Heeter, 1992). Thus, the sensation of presence gives the user the impression of being located in the mediated environment. The subjective frame of reference is cap-

tured and controlled by the mediated environment. This leads to feeling located inside the mediated environment rather than in the immediate physical environment.

4. *Spatial presence: possible actions.* The occurrence of spatial presence not only refers to the sensation of being located inside the mediated environment, but also to the sensation of being able to take action in the mediated environment (e.g., moving objects). This dimension is termed possible actions. It is assumed to especially occur in the context of videogames or virtual reality environments, but to a lesser degree within books or films (cf. Wirth et al., 2007).
5. *Higher cognitive involvement.* Here, involvement is described as a motivation-related meta-concept. It reflects the degree to which the mediated stimulus is mentally processed. Higher cognitive involvement emerges through active and intensive processing of the mediated world. Wirth et al. assume therefore that higher cognitive involvement is related to stronger experiences of presence.
6. *Suspension of disbelief.* Suspending one's disbelief allows the user to avoid features that might contradict the medium-as-PERF-hypothesis. Suspension of disbelief refers to the user's will to suppress information in the mediated environment that would contradict real-world knowledge. Since presence emerges if the medium-as-PERF-hypothesis is confirmed, suspension of disbelief fosters the sensation of presence. In the context of reading, Prentice, Gerrig, and Bailis (1997) could show that the mechanism underlying suspension of disbelief is relatively automatic.

Taken together, the conceptual two-step model of Wirth et al. provides a comprehensive explanation of the processes forming spatial presence. The authors integrate well established psychological concepts such as attention allocation or involvement and relate them to presence.

2.2 Measuring Presence

There are various subjective and objective measures to assess presence (for an overview, see van Baren & IJsselsteijn, 2004). The former category includes questionnaires, continuous ratings, qualitative measures, psychophysical measures, and subjective corroborative measures, whereas the latter category is grouped into psychophysiological measures, neural correlates, behavioral measures, and task performance measures. Recently, Wissmath, Weibel, and Mast (2010) reviewed the existing presence measures and found that subjective verbal ratings (i.e., in the first place subjective post exposure rating scales) are still the most frequently used presence indicator. For instance, Kim and Biocca (1997) developed such a post-rating questionnaire consisting of eight items (e.g., "During the broadcast, I felt I was in the world the television created"). All items are rated on a 9-point Likert scale (1 = never; 9 = always). The items can be adapted to any media (television, computer games, etc.). In contrast to the measure described earlier using verbal anchors, several measures use numerical responses (e.g., Barfield & Weghorst, 1993; Dinh, Walker, Song, Kobayashi, & Hodges, 1999; Welch, Blackmon, Liu, Mellers, & Stark, 1996). For example, Barfield and Weghorst include the following item: "If your level in the real world is 100, and your level of presence is 1 if you have no presence, rate your level of presence in this virtual world."

There are good reasons to use verbal questionnaires. Sheridan (1992) argues that the sensation of presence has to be assessed subjectively because it is in the first place a subjective experience. Other advantages of rating questionnaires are high face validity, ease to administer, the opportunity to conduct factor analyses to identify underlying dimensions and determinants of presence, low cost, sensitivity, as well as ease to analyze and interpret (van Baren & IJsselsteijn, 2004; Wissmath et al., 2010).

Although subjective, presence questionnaires bear various advantages, and most data in the field of presence were captured by means of verbal questionnaires. This assessment technique bears serious drawbacks and came under heavy criticism. One of the most vocal critics is Slater, who argues that presence questionnaires could be invalid since the phenomenon to be measured could be brought into existence merely by asking questions about it (Slater, 2004; Slater & Garau, 2007). In other words, Slater believes that suggestive questions could urge the participants to report non-existent sensations. We share Slater's concerns regarding validity to some degree, since most presence measures have not been validated in a psychometric approach and are therefore prone to various biases. However, there is no merit in abandoning presence questionnaires, because these instruments are the most direct way to assess presence. Instead of abandoning, we think that improving questionnaires is a much better response to possible biases and flaws. This is one of the main challenges Lombard (2008) identified in his evaluation of the current status quo of presence research. To achieve this, we first have to consider the actual limitations of existing presence questionnaires.

2.3 Limitations of Verbal Measures

Wissmath et al. (2010) underline a specific problem: Existing questionnaires are usually based on verbal judgments although there are frequently observed biases in verbal questionnaires such as ambiguous questions, complex-phrased questions, vague words, uncommon words, technical jargon, double negative items, or inappropriate framing (Choi & Pak, 2005). Correspondingly, empirical evidence shows that verbally based measures are prone to bias: Lang (1985) concludes that semantic constructs often fail to explain underlying subjective experiences. Sometimes these difficulties are due to imprecise or hard-to-find definitions of a given construct.

Insko (2003) identifies further disadvantages associated with verbal questionnaires such as anchoring effects, inaccurate recall, and inability to assess temporal variations in the subjective sense of presence. Furthermore, verbal questionnaires can be too abstract for children and too difficult for individuals with low education level (Lang, 1985).

2.4 Visual Scales as a Possible Substitute for Verbal Measures

Medicine is a field where valid assessment tools are literally vital. Researchers in general agree that communication with patients can be facilitated through symbols, pictures, or visual cues (Brumfitt & Sheeran, 1999; Heine & Browning, 2002). Pain assessment and medical research have been taking advantage of this approach long before particular biases such as the SNARC (Spatial-Numerical Association of Response Codes) effect were identified (Dehaene, Bossini, & Giraux, 1993). Physicians experienced that patients indicate their sensations more easily and more reliably by visual indicators than by abstract verbal and numerical indicators. Correspondingly, a broad body of research warrants for the high reliability, validity, and sensitivity of visual scales (cf., Revill, Robinson, Rosen, Bogie, & Hogg, 1976; Nielsen, Price, Vassend, Stubhag, & Harris, 2005). We consider this highly relevant since pain—like presence—is primarily a subjective experience. In addition, recent research found pain to be a multidimensional phenomenon (Victor et al., 2008), which is why presence and pain bear some similar characteristics in terms of assessment.

But medicine is not the only field using visual scales instead of verbal measures. In emotion assessment, Lang (1985) introduced the pictorial Self-Assessment-Manikin (SAM) scale. The SAM comprises three one-dimensional pictorial items that represent pleasure, arousal, and dominance (Lang, 1985; Bradley & Lang, 1994), derived from the three-factor theory of emotion by Mehrabian and Russell (1974; 1977). Each SAM item depicts these emotional states as bipolar: Pleasure–displeasure ranges from a very happy to a very unhappy figure, arousal–non-arousal ranges from an eye-closed figure to an excited figure with open eyes, and dominance–submissiveness ranges from a very small out-of-control figure to a very large figure representing an in-control feeling. Bradley and Lang (1994) empirically found that the pictorial SAM items track personal responses to affective stimuli better than semantic differential scales. Bradley and Lang further state that SAM could be especially valid, since these items assess the subjects' feeling more directly than verbal statements. The sometimes cumbersome verbal self-report measures (Lang, 1985) are biased in a way that participants are misled to judge the features of the actual stimulus rather than their actual psychological state (Bradley & Lang, 1994). Further on, research shows that adults and children like the pictorial description of SAM (Lang, 1980) and well understand the represented emotional content (Lang, 1985). Subjects show interest and involvement with the SAM scale, whereas usual scales are described as more tedious and less likely to hold the subjects' attention (Lang, 1980; Valla, Bergeron, Bérubé, Gaudet, & St-Georges, 1994). The SAM is easy to use and understand, even for children, and for people who speak another language. It is equally suited for paper and pencil as well as computer-based responses (Bradley & Lang, 1994). In contrast to verbally anchored measures, visually oriented scales are supposed to be culture free (Lang, 1985; Bradley & Lang, 1994). Another advantage in comparison to verbal measures is that participants are able to respond more quickly (Lang, 1985). It has furthermore been suggested that SAM measures create less mental workload (Jex, 1988) than verbally anchored questionnaires.

In developmental psychology, many pictorial measurements exist as well. For example, the Koala Fear Questionnaire (KFQ) (Muris et al., 2003) was developed for children under the age of seven. Pre-school children are able to rate their fear on a pictorial scale, indicated by three koala bear smileys, whose faces expressed no fear, some fear, and a lot of fear. Testing the KFQ showed not only the possibility to assess fear in four- to six-year-old children; it also resulted in high test–retest reliability, good internal consistency, and—importantly—in good convergent validity. Valla, Bergeron, Bérubé, Gaudet, and St-Georges (1994) state that the use of pictures attracts the attention of children and stimulates their interest. Furthermore, pictorial material avoids the need to draw on children's vocabulary and additionally helps children to convey their feelings, which would be otherwise expressed only reluctantly. Dubi and Schneider (2009) were able to differentiate between children with and without an anxiety disorder by means of pictorial assessment.

Since pictorial scales do not require a certain vocabulary, they are not only useful for children, but also for individuals with a low education level or adults with low reading literacy (Maldonado, Bentley, & Mitchell, 2004). An example is the face scale, a nonverbal instrument for assessing the actual mood (Lorish & Maisiak, 2005).

Results from pictorial questioning imply important results for constructing pictorial measures. The focus needs to be drawn away from verbal material or statements. Even a difficult construct like anxiety disorder can be measured by means of pictorial material. It is an effective way to represent a complex construct by pictures, thereby avoiding complex sentences, misleading verbal material, and suggestive information. Overall, pictorial questioning renders good results and shows convergent validity with other questionnaires analyzing the same construct. Finally, pictorial assessment is possible from an early age of four years, which points to the possibility of conducting presence research in pre-school children.

To sum up, there are valid, and at the same time reliable, as well as efficient visual assessment tools in medicine, developmental psychology, and in emotion research that do not bear the limitations of verbal measures.

2.5 The Pictorial Assessment of Presence

We feel that the advantages of pictorial measures can lead to the development of a more accurate presence questionnaire. The drawbacks of verbal measures and the numerous positive features of visual instruments inspired us to develop a pictorial presence scale on the basis of Lang's SAM scale. We believe that an adaption of the original SAM into a presence SAM is promising since Weibel et al. (2011b) suggest a close link between emotion and presence.

Schneider, Lang, Shin, and Bradley (2004) already developed a single-presence SAM item representing the sensation of spatial presence in a mediated environment. This pictorially anchored presence assessment technique includes a verbal instruction. Wissmath et al. (2010) evaluated the validity of this item and empirically found that it requires less mental workload, it is administered faster, and assesses the sensation of presence more directly than verbally anchored items. Due to these advantages, the pictorial scales could be especially useful when assessing presence during exposure.

However, one central limitation of the existing pictorial presence assessment is that it is only one-dimensional. That is, the existing measure fails to tap on the sub-dimensions and determinants of presence. In our study we aim to introduce a new Pictorial Presence SAM that assesses the two presence dimensions and the four determinants as proposed by Wirth et al. (2007). Based on the spatial presence model of Wirth et al., the sub-dimensions self-location and possible action as well as the presence determinants attention allocation, spatial situation model, involvement, and suspension of disbelief will be included. In 2004, Vorderer et al. constructed a verbal questionnaire (MEC-SPQ), which is based on Wirth's two-level process model of spatial presence. The questionnaire was carefully validated in the context of different types of media and cultures. In addition, statistical analysis proved it to be a reliable and valid tool (cf. Vorderer et al., 2004). We will validate the Pictorial Presence SAM on the basis of the MEC spatial presence dimensions and determinants.

3 Instrument Development and Validation (Three Steps)

3.1 Step One: Item Generation

It is crucial that pictorial items are unambiguous and easy to understand. To achieve this, we developed presence SAM on the basis of Schneider et al. (2004), whose presence SAM item was found to be valid by Wissmath et al. (2010). We used an adaptation of Lang's item to represent the dimension *spatial presence: self-location* (SL) of the MEC-SPQ. We developed the other five dimensions and determinants based on corresponding items of the MEC-SPQ. This was accomplished in several steps. Three presence researchers and three psychologists from other fields brainstormed how the MEC sub-dimensions and determinants could be expressed in a pictorial way. Various different versions for each dimension had been generated. For each factor, the group then chose the pictorial item that they found to represent it best. The first versions were paper–pencil based. Finally, we used Adobe Photoshop to design items representing the dimensions and determinants: *attention allocation* (AA; how much someone is focused on the mediated environment), *spatial situation model* (SSM; how much a person has a mental spatial representation of the mediated world), *possible action* (PA; the feeling of perceived possible actions in the virtual world), *higher cognitive involvement* (HCI, how much the thoughts of a person are by the mediated world and not by something else that has nothing to do with the virtual world), and *suspension of disbelief* (SoD; how much a person disbelieves the objects or actions in the virtual world). Each item consists of five pictures that are used as increments of a five-point scale (see Figure 1). In a next step, we created a title for each pictorial item to further enhance the comprehensibility of the pictures.

3.2 Step Two: Qualitative Analysis

3.2.1 Sample. Six males and six females from various educational and professional backgrounds participated. Mean age was 29.33 years ($SD = 10.8$). Participants were treated in accordance with the Declaration of Helsinki (World Medical Association, 1991).

3.2.2 Method and Procedure. To qualitatively validate our new measure and to test comprehensibility of the six pictorial items, we conducted interviews. The validation procedure used was suggested by Bortz and Döring (2006). In a first step of the interview *(initial exposure phase*), each Pictorial Presence SAM item was presented without any prior instruction. The participants were told that the six items were part of a questionnaire and they were asked what they think the items would measure. The subjects had no previous knowledge and the investigator gave no feedback. The items were not developed to be used in the absence of any media stimulus. However, this phase was conducted in order to assure that the displayed objects (e.g., TV set) were correctly identified and the participants understood the general idea of the items. In a second step (*media exposure phase*), subjects watched a short movie, read a text, listened to a radio play, or played a computer game. After media exposure, participants judged their experience based on the six items of the Pictorial Presence SAM. Thereby, we asked the participants to "think aloud," to speak out what comes to their mind. Within this phase, it was evaluated whether the participants correctly inter-

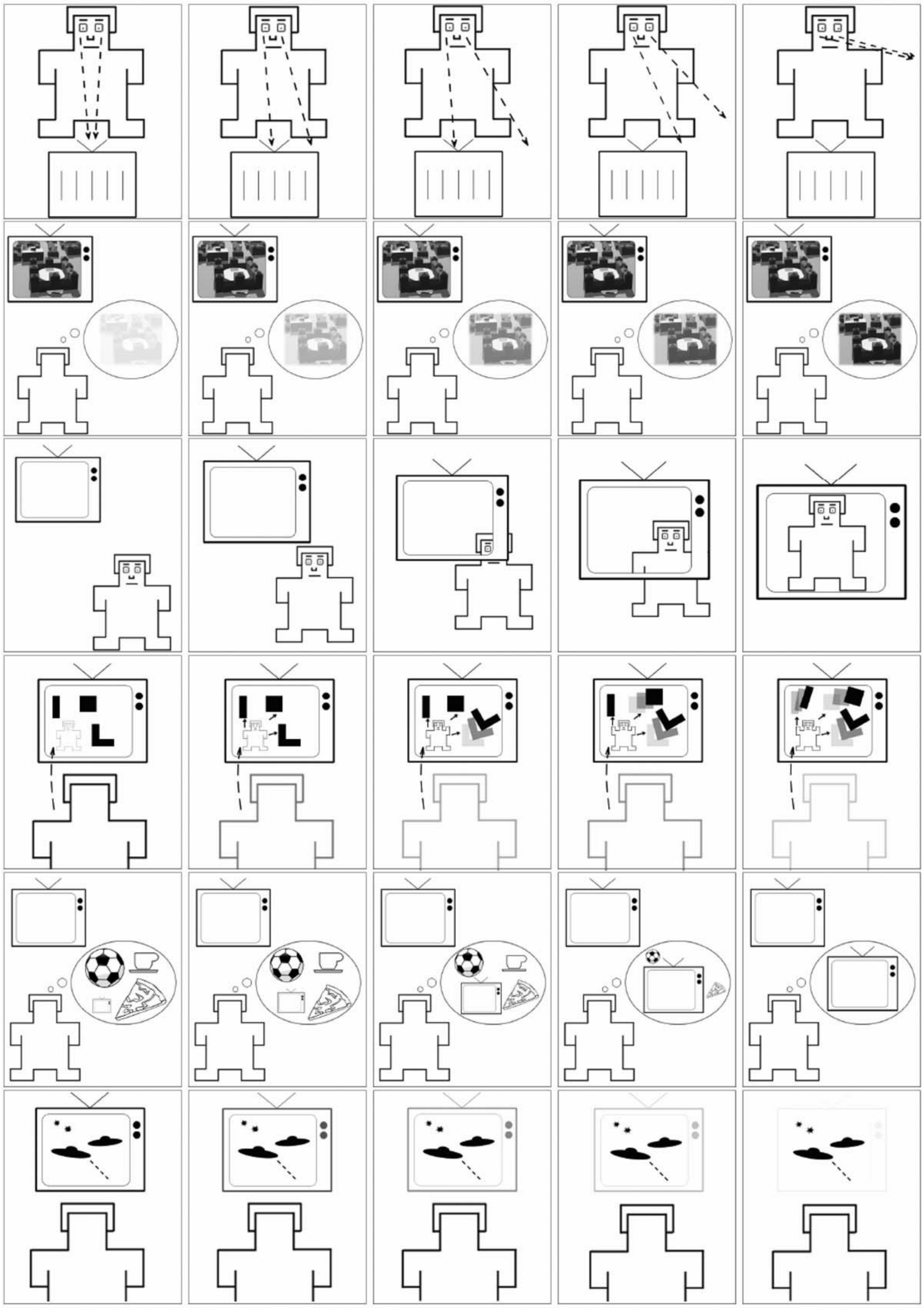

Figure 1. *The Pictorial Presence SAM representing the dimensions attention allocation, spatial situation model, self-location, possible actions, cognitive involvement, and suspension of disbelief.*

preted the items. The answers were coded as being either accurate or inaccurate. In a third step of the interview (*item evaluation phase*), the investigator explained the intended meaning for each item and asked how each item could be improved to make it more comprehensible. The interviews were audio-recorded.

3.2.3 Result. A content analysis was carried out to evaluate the interviews. The procedure suggested by Mayring (2000) was used. The results are described separately for each phase in the following sections.

3.2.4 Result Initial Exposure Phase. Within this phase, it was evaluated whether the participants understood the general idea of the items and recognized the key elements. Table 1 shows how the items were interpreted without presenting any media content. The results show that the core elements and the general idea were correctly identified.

3.2.5 Result Media Exposure Phase. In a second phase, participants judged and verbalized their experience after media exposure based on the six items of the Pictorial Presence SAM. The answers were coded as being accurate or inaccurate. Table 2 shows the results, which indicate that most participants interpreted the items correctly. Moreover, participants indicated that the items were easy to answer.

3.2.6 Result Item Evaluation Phase. In a last phase, participants were asked to express suggestions in order to improve the items. In the light of the corresponding comments, we considered three modifications in order to enhance comprehension. In the SSM item, we had used a two-dimensional picture to represent the media content. According to various participants, it was not clear that this picture represents the media content. Thus, the two-dimensional map was replaced by a three-dimensional picture, which makes the idea of a mental representation of the spatial environment clearer. Furthermore, the findings suggested that to fade out of the television in the SoD is more salient and to modify the gaze direction in the AA determinant (the initial manikin was too squint-eyed).

3.2.7 Discussion. The analysis of the interviews revealed that the general understanding of the meaning of the pictorial scales was high since ten to twelve out of twelve participants indicated that they understood the items. The underlying sub-concept was evident for the participants and the meaning of the pictorial items was immediately clear. Participants responded quickly and stated that the meaning of items was intuitively clear. For example, one participant thought that the pictures representing self-location indicates "to what extent one feels located in the media world." Another participant thought that the item representing attention allocation assesses "how closely one attends the clip." Taken together, the interviews revealed that the scale is rapidly and unambiguously understood.

Figure 1 depicts the modified SAM items.

3.3 Step Three: Quantitative Analysis

3.3.1 Sample. To quantitatively validate the Pictorial Presence SAM, we conducted an online experiment. Participants could participate on standard personal computers. We invited 1021 individuals via email and personal messages on Facebook. Of those, 317 volunteered in the experiment. The sample consisted of 174 women and 143 men. Mean age was 28.11 years ($SD = 10.47$), ranging from 8 to 70 years with 17 participants being younger than 15 years. The sample consisted of a broad spectrum of educational and professional backgrounds. A majority of participants were university students (46%). The occupation of non-university participants can be classified as follows: technical profession (13%); occupation in the social field (12%); graduate occupation (11%); commercial profession (9%); high school, elementary school, or college student (6%); and unemployed or retired (3%). Participants were treated in accordance with the Declaration of Helsinki (World Medical Association, 1991).

3.3.2 Design. We used a two factorial between-subjects design (medium × distraction). The factor *medium* consisted of four levels (written story, audio book, video, and computer game) and the factor *distraction* consisted of two levels (non-distraction vs. distraction).

Table 1. *Initial Exposure Phase: The Four Most Frequently Stated Interpretations for the Six Initial Items* (n = 12)

Item	Interpretation 1	% (*n*)	Interpretation 2	% (*n*)	Interpretation 3	% (*n*)	Interpretation 4	% (*n*)
Attention Allocation	Concentration	41.6 (5)	Focus (drifting away)	33.3 (4)	Attention	33.3 (4)	Gaze direction	25.0 (3)
Spatial Situation Model	Memory	41.6 (5)	Bleariness of the mind	41.6 (5)	Intelligence	41.6 (5)	Perceived complexity of content	25.0 (3)
Spatial Presence: Self-Location	Importance of TV	50.0 (6)	Identification with TV	25.0 (3)	Coalescence of fiction and reality	33.3 (4)	Distance of self to TV / story	33.3 (4)
Spatial Presence: Possible Actions	Possibility of being active	33.3 (4)	Feeling immersed or absorbed	41.6 (5)	Relationship with objects	16.6 (2)	Quality of the story or the picture	16.6 (2)
Higher Cognitive Involvement	Cognitive or mental dominance of TV	58.3 (7)	Attention	25.0 (3)	Repression	16.6 (2)	Disappearance of needs	25.0 (3)
Suspension of Disbelief	Coalescence of fiction and reality	66.6 (8)	Believe or credibility	16.6 (2)	Engagement or involvement	16.6 (2)	Unconscious reception	16.6 (2)

NOTE. % refers to the percentage of participants giving a certain interpretation. Multiple answers were possible.

Table 2. *Media Exposure Phase: Frequency of Inaccurate and Accurate Interpretations of the SAM-Items after Media Exposure (n = 12)*

Item	Accuracy of interpretations	
	% (*n*) of participants providing *accurate* interpretations	% (*n*) of participants providing *inaccurate* interpretations
Attention Allocation	100 (12)	–
Spatial Situation Model	83.3 (10)	16.6 (2)
Spatial Presence: Self-Location	100 (12)	–
Spatial Presence: Possible Actions	91.7 (11)	8.3 (1)
Higher Cognitive Involvement	91.7 (11)	8.3 (1)
Suspension of Disbelief	83.3 (10)	16.6 (2)

NOTE. Only one interpretation could be provided per item.

We chose to implement four different media in order to validate the SAM. The chosen media environments represent different types of media that trigger presence through different features. Thus, the video could evoke presence through sensory richness, the written story could evoke presence through the power of narration, and the audio book could trigger presence through empathy with the reader, whereas the game could evoke presence through sensations of agency and flow. A presence measure should not only be valid in various contexts but also distinguish between high and low sensations of presence. Therefore, we included a distraction manipulation. Since previous findings indicate that distraction reduces sensations of presence (e.g., Lee & Kim, 2008; Wirth et al., 2007), this manipulation should result in lower sensations of presence in the distraction groups compared to the non-distraction groups.

3.3.3 Instruments. The dependent variable was presence, which was measured with the Pictorial Presence SAM as well as with the MEC items. The latter scale was designed for immediate assignment after media exposure (Vorderer et al., 2004). In a validation study carried out in different countries, all non-trait scales were sensitive for the experimental manipulation of attention (distraction and dual-task procedure) and different types of media, and inter-scale-correlations reflected theoretical assumptions of the MEC two-level model of Spatial Presence (Vorderer et al.). This questionnaire consists of 24 items, four items for each dimension or determinant of the presence. Vorderer et al. found the scales to be reliable (all Cronbach's alpha > .80). One exception is the subscale higher cognitive involvement that bears rather poor reliability (Cronbach's alpha = .66).

3.3.4 Procedure. After entering the web-browser-based platform, where the experiment took place, participants were randomly assigned to one of the eight experimental groups. Thereby, participants saw a movie sequence, heard an audio recording of a short story, read a written story, or played a computer game. In the distraction condition, participants were instructed to tuck a pen under each arm. Within the instructions a picture displayed an individual with a pen tucked under each arm. Participants were asked to apply pens or a similar object in the same way as shown in the picture. As a manipulation check, participants were asked whether they followed the instruction. Thereby, no one disagreed. In the non-distraction group, participants received no such instruction. We expected the distraction to disturb the media reception resulting in lower presence scores.

The duration of the media exposure lasted about four minutes in all conditions. After the presentation, presence was assessed with the pictorial SAM items and the corresponding SPQ-MEC dimensions and determinants.

Table 3. *Descriptive Statistics*

DV	*Min*	*Max*	*M*	*SD*
AA MEC	1.00	5.00	3.40	.84
AA SAM	1.00	5.00	3.79	.96
SSM MEC	1.00	5.00	3.13	.86
SSM SAM	1.00	5.00	3.21.	1.10
SL MEC	1.00	4.75	2.21	.87
SL SAM	1.00	5.00	2.99	1.00
PA MEC	1.00	5.00	2.06	1.16
PA SAM	1.00	5.00	1.94	.81
HCI MEC	1.00	5.00	2.77	.73
HCI SAM	1.00	5.00	3.45	1.07
SOD MEC	1.00	5.00	3.28	.87
SOD SAM	1.00	5.00	2.84	1.44

At the end of the study, the participants were asked to provide demographical information and were debriefed.

3.3.5 Results. First, we examined distribution parameters of the dependent variables. Table 3 displays the descriptives of the MEC and SAM dimensions and determinants showing that the means are in the mid-range of the scale. Thereby, there is considerable variation as the standard deviations suggest. One exception is the subdimension possible actions which scored low in both instruments.

In a first step of analysis, we examined the dimensionality of the MEC-SPQ by means of factor analysis (without including the SAM items). Although Vorderer et al. (2004) assessed reliabilities of the scales, factor analysis has not been conducted so far. Thereby, the measure of sampling adequacy (MSA) criterion turned out to be meritorious ($MSA = 0.84$). Congruent with the theoretical conceptualization, the Kaiser criterion (extracting as many factors as Eigenvalues over 1.0 in the initial solution) led to a six-factor solution explaining 50.9% of the variance. Thus, the solution is in line with the dimensionality proposed by Vorderer et al. (2004) and Wirth et al. (2007). Table 4 shows that the varimax rotation extracts the factors attention allocation, and spatial situation model, self-location, and possible actions, as predicted by theory. Combined, these four factors explain a substantial part of the variance (39.8 %). Also, the factors higher cognitive involvement and suspension of disbelief turned out to be in line with the a priori classification: However, these two factors were less clear and seem to consist of only two (higher cognitive involvement) or three items (suspension of disbelief). In addition, these factors explain less variance (11.1 %) than the former dimensions.

Then, following a parallel test procedure, we included the Pictorial Presence SAM items in the factor analysis to figure out whether the corresponding SAM and MEC-SPQ dimensions load on the same factors. The measure of sampling adequacy (MSA) criterion turned out to be meritorious ($MSA = 0.86$). The six-factor solution explains 48.1% of the variance. The varimax rotation consistently extracts the MEC items of the dimensions attention allocation, spatial situation model, self-location, and possible actions on the same dimensions as the corresponding SAM item (see Table 5). These factors explain 38.8 % of the variance. The solution for higher cognitive involvement and suspension of disbelief is again not distinct and explains less variance compared to the other dimensions (9.2%).

After analyzing the dimensionality of the MEC-SPQ and the Pictorial Presence SAM, we calculated bivariate correlations between the mean MEC values in each dimension and the corresponding SAM items. Thereby the correlation between the mean MEC attention allocation score and the corresponding SAM item is strong, $r(317) = .59$, $p < .01$. Additionally, strong correlations occur for the dimensions spatial situation model, $r(317) = .62$, $p < .01$, self-location, $r(317) = .61$, $p < .01$, whereas a medium correlation results for the scores representing possible actions, $r(317) = .40$, $p < .01$. In contrast and in accordance with the previous factor analyses, there are low respectively inverse relations for higher cognitive involvement, $r(317) = .37$, $p < .01$, and suspension of disbelief, $r(317) = -.12$, $p < .05$.

Finally, we conducted *t*-tests to explore whether SAM and MEC-SPQ are sensitive enough to distinguish between distraction and non-distraction groups. As expected, higher overall SAM scores resulted in the non-distraction group ($M = 3.10$, $SD = 0.59$) compared to

Table 4. *MEC-SPQ: Principal Axis Factoring**

Factor		1	2	3	4	5	6
A priori	Item						
Attention Allocation	I devoted my whole attention to the [medium].	.77					
	I concentrated on the [medium].	.76					
	The [medium] captured my senses.	.78					
	I dedicated myself completely to the [medium].	.62					
Spatial Situation Model	I was able to imagine the arrangement of the spaces presented in the [medium] very well.			.78			
	I had a precise idea of the spatial surroundings presented in the [medium].			.78			
	Even now, I still have a concrete mental image of the spatial environment.			.56			
	I was able to make a good estimate of the size of the presented space.			.62			
Self-Location	I felt as though I was physically present in the environment of the presentation.		.82				
	It seemed as though I actually took part in the action of the presentation.		.68				
	I felt like I was actually there in the environment of the presentation.		.66				
	It was as though my true location had shifted into the environment in the presentation.		.61				
Possible Actions	I had the impression that I could be active in the environment of the presentation.				.59		
	I felt like I could move around among the objects in the presentation.		.44				
	The objects in the presentation gave me the feeling that I could do things with them.				.62		
	It seemed to me that I could do whatever I wanted in the environment of the presentation.				.58		
HCI	I thought about whether the [medium] presentation could be of use to me.					.47	
	The [medium] presentation activated my thinking.						
	I thought most about things having to do with the [medium].	.66					
	I thoroughly considered what the things in the presentation had to do with one another.					.76	
SOD	I concentrated on whether there were any inconsistencies in the [medium].						.64
	I didn't really pay attention to the existence of errors or inconsistencies in the [medium].						.72
	I took a critical viewpoint of the [medium] presentation.					−.47	
	It was not important for me whether the [medium] contained errors or contradictions.						.48
% of variance explained		**12.6**	**10.7**	**10.0**	**6.5**	**5.6**	**5.5**

*NOTE.** Rotation method: Varimax with Kaiser Normalization. Values less than .5 are suppressed.

Table 5. *MEC-SPQ and SAM: Principal Axis Factoring**

Factor		1	2	3	4	5	6
A priori	Item						
Attention	AA 1	.74					
Allocation	AA 2	.78					
	AA 3	.77					
	AA 4	.61					
	SAM AA	.67					
Spatial	SSM 1			.79			
Situation	SSM 2			.77			
Model	SSM. 3			55			
	SSM 4			.63			
	SAM SSM			.63			
Self-Location	SL 1		.76				
	SL		.69				
	SL		.67				
	SL		.63				
	SAM SL		.56				
Possible	PA 1				.64		
Actions	PA 2		.42				
	PA 3				.57		
	PA 4				.58		
	SAM PA				.48		
HCI	HCI 1					.46	
	HCI 2						
	HCI 3	.67					
	HCI 4					.72	
	SAM HCI	.64					
SOD	SOD 1						.67
	SOD 2					−.41	.67
	SOD 3					−.49	
	SOD 4						.47
	SAM SOD						
% of variance explained		**13.1**	**9.7**	**9.7**	**6.3**	**4.8**	**4.4**

*NOTE.** Rotation method: Varimax with Kaiser Normalization. Values less than .5 are suppressed.

the distraction group ($M = 2.97$, $SD = 0.64$), $t(315) = 1.74$, $p < .05$ (one-tailed), $d = .21$. In contrast, the MEC-SPQ was not sensitive enough to distinguish between the distraction ($M = 2.77$, $SD = 0.51$) and non-distraction groups ($M = 2.84$, $SD = 0.49$), $t(315) = 1.32$, $p = 0.9$ (one-tailed), $d = .13$.

4 Discussion

Our aim was to introduce a pictorial presence measure that overcomes the drawbacks of existing verbal measures. The results of qualitative and quantitative validation procedures show that the Pictorial Presence SAM developed here successfully assesses spatial presence. The qualitative approach revealed that the SAM items are quickly filled out as well as easily, intuitively, and unambiguously understood. The quantitative validation is pointing to high validity as well: Factor analyses reveal that the SAM presence dimensions and determinants closely correspond to those of the MEC-SPQ. Congruently with the MEC model and the consideration of Wirth et al. (2007), our findings suggest that spatial presence consists of six factors. This study is the first to conduct factor analyses on the MEC-SPQ. Due to the results, we conclude that factorial structure of attention allocation, spatial situation model, self-location, and possible actions, is distinct and explains a substantial part of the variance. In contrast, the structure is less clear for the higher cognitive involvement and suspension of disbelief. Moreover, these determinants are not as important as the former in terms of variance explained. In the original validation of the MEC-SPQ (Vorderer et al., 2004), the reliability of the determinant higher cognitive involvement was poor. The low relations of SAM and MEC-dimensions in terms higher cognitive involvement and suspension of disbelief are plausible considering that these MEC dimensions failed to result in a distinct factorial solution. Thus, self-location and possible actions seem to form core dimensions of spatial presence, whereas attention allocation and spatial situation model seem to be the most important determinants. Most noteworthy, Wirth et al. did not clarify whether the relevance of all factors is similar. There are other studies suggesting that presence consists of fewer factors (e.g., Kim & Biocca, 1997; Schubert, Friedrich, & Regenbrecht, 2001). Here, we do not want to argue that suspension of disbelief is not required to experience spatial presence, which would be fully in line with Slater et al. (2006). Also, we do not claim that many media contents do not appeal for "higher" cognitive involvement.

Yet, the factorial solutions of the combined SAM and MEC-SPQ items for attention allocation, spatial situation model, self-location, and possible actions are almost ideal (the only exception is the second MEC item representing possible actions that loads on self-location). There are strong correlations between these SAM items and the corresponding MEC dimensions and determinants. This suggests that these SAM items are highly valid. In addition, given the advantages of pictorial measures presented in the introduction, such as assessing the participants' state instead of features of the stimulus, the non-shared variance could also indicate that the SAM items are more valid than the MEC-SPQ items since the construct is assessed in a more direct way. In other words, systematic and random errors in the MEC-SPQ could be greater than in the SAM, translating in a strong but non-perfect relation. Based on qualitative interviews, content analysis, and factor analysis, we found that the Pictorial Presence SAM is a valid tool to assess spatial presence.

Another important quality criterion for psychometrical measures besides validity and reliability is sensitivity (i.e., the measure should distinguish between different levels of presence). As expected, SAM presence levels were significantly lower in distraction conditions compared to non-distraction groups. This result is a clear indicator for the measure's validity and sensitivity. In contrast, the MEC-SPQ failed to distinguish between the distraction and the non-distraction group. This is surprising since Vorderer et al. (2004) found the MEC-SPQ to be sensitive. However, these authors used not only distraction (there were four distractions during the reception) but also a dual task. Therefore, the distraction in their study interfered more strongly with the sensation of presence. Due to our results, we conclude that the SAM is more sensitive than the MEC-SPQ. This indicates that the scale is useful whenever someone aims to detect small effects. This underlines the potential of our visual and language-free presence measure. We assume that the presence SAM is more sensitive because it measures the experience of presence more directly than verbal items. This in turn points out a clear advantage of the presence SAM over other existing presence questionnaires. Semantic constructs often fail to explain underlying subjective experiences: It is therefore a common disadvantage of verbal self-report instruments that their items force individuals to report sensations that probably do not even exist (e.g., Barker, Pistrang, & Elliott, 2002; Choi & Pak, 2005; Ghiassi, Murphy, Cummin, & Patridge, 2011). As a consequence, Slater (2004) doubts that verbal presence questionnaires are valid. He argues that it could be that the phenomenon is brought into existence merely by asking questions about it. We believe using visual presence items is one possibility to overcome or at least diminish this limitation.

There are several additional reasons that lead us to the conclusion that the presence SAM bears great potential. Bradley and Lang (1994) empirically found that the original pictorial SAM tracks personal responses to affective stimuli better than semantic scales. Since Weibel et al. (2011b) found a close link between presence and emotions, we suggest that the advantages of the SAM scale also account for the presence SAM. Thus, the use of a visually oriented presence scale should eliminate a majority of problems related to verbal presence measures. One main advantage is brevity: It takes only a few seconds to respond to the whole presence SAM. This again can lead to a lower respondent fatigue compared to verbal instruments. This could, for example, be beneficial within web studies. It is a problem of web surveys that verbal items often lead to high drop-out rates (e.g., Tourangeau, Conrad, & Couper, 2013). Since response times of our scale turned out to be short, the presence SAM would be ideal for web surveys or web experiments. Furthermore, brevity allows repeated measurements and testing numerous stimuli in a short amount of time. Like the original SAM scale by Lang (1985) that has previously been used to examine emotional responses toward advertisement (cf. Morris, 1995), the presence SAM could be a meaningful and efficient way to evaluate immersive capabilities of mediated stimuli. This appears promising given that media producers attempt to enhance presence experiences in audiences (cf. Kim & Biocca, 1997; Bracken & Skalski, 2010; Tamborini & Skalski, 2006).

A plethora of previous studies on pictorial measurements conclude that individuals show more interest in pictorial ratings (e.g., Bradley & Lang, 1994; Lang, 1985; LeBlanc, Chang Jin, Simpson, Stamou, & McCrary, 1998; Morris, 1995; Schneider et al., 2004). This accounts for children as well as for adults (Valla et al., 1994). Thus, the presence SAM is more likely to keep the respondents focused, compared to existing verbal presence measures. The visual modus combined with the brevity of the scale should prevent boredom in participants when filling out the questionnaire. This could translate into increased validity since the response to the items is more timely and directly related to the stimulus.

A further advantage is that the presence SAM items are easily understood. The presence SAM is culture free and language free. It has been shown in various studies that the SAM scale is suitable for use in different countries and cultures and for different age groups such as children (cf. Bradley, Greenwald, & Hamm, 1994). Since presence and emotion are closely related constructs (Weibel et al., 2011b), we believe that the presence SAM could be used for different cultures, age groups, and educational levels as well. In our study, we tested a diverse sample, which also contained different educational levels and children. Based on our data we can assume that the scale works out for these groups. Since a majority of the sample were university students (46%) and the sample size of young participants was low ($n = 17$), more research would be needed to ensure usability for children and different educational levels. However, many existing studies on pictorial scales including the SAM scale could prove their usefulness for children (e.g., Dubi & Schneider, 2009; Muris et al., 2001; Pianosi, Smith, Almudevar, & McGrath, 2006; Robertson et al., 2006; Valla et al., 1994), different educational levels and adult non-readers (e.g., Lang, 1985; Lorish & Maisiak, 2005; Maldonado et al., 2004). The same accounts for the possible use for different cultures: Existing literature (e.g., Bradley & Lang, 1994) suggests that pictorial scales bear great potential. Our data do not allow drawing conclusions concerning this issue. Therefore, additional validation would be needed.

In addition, pictorial presence items require less mental workload than verbal items (Wissmath et al., 2010). These features seem ideal for presence assessment during media exposure. Whenever someone does not want to measure presence ex-post, but online (during exposure), the presence SAM is clearly to be preferred over a verbal presence questionnaire with plenty of items: It is not feasible that a participant in a virtual environment has to respond to a verbal 20-item questionnaire without being pulled out of the immersive experience. In contrast, Wissmath et al. (2010) could show that using the presence SAM makes it possible to test presence during media exposure or within an ongoing task. This again allows assessing temporal variations in the subjective sense of presence. Therefore, the pictorial measure of presence could be of prospective importance within the fast-growing field of e-therapy and the development of new technologies such as the ocular rift. Thinking of e-therapies, for example phobia, it would be beneficial to measure presence during and not after exposure. The pictorial presence SAM could be easier to embed into the virtual reality settings than verbal questionnaire items. Furthermore, embedding verbal multi-item measures (such as the MEC-SPQ) are more likely to interfere with the users' presence experiences during VR exposure.

Taken together, the advantages of the presence SAM described here point out that the scale can be a useful alternative to existing verbal presence self-report measures. We claim that the use of the presence SAM is promising in various contexts.

We have to point out that conducting an online experiment allowed us to gather a large and diverse sample. However, the fact that conducting an online experiment also raises some concerns (cf. Reips, 2000). Besides the problem of self-selection and drop out, there was a lack of experimental control. We cannot fully guarantee validation of the distraction task. Also, we could not control the monitor size of the participants' computers. Thus, the perception of the SAM items could have been different between participants. It could be a matter of future research, whether this may influence the application of the scale. Within our study, we used different media. Additionally, it would be promising to also evaluate presence using the presence SAM in a virtual reality setting. Future research should focus on this issue. Our careful examination of the psychometric criteria revealed that the validity and reliability of the Pictorial Presence SAM are even higher than in the case of established verbal measures. These performance features, combined with the practical advantages, clearly suggest the use of the SAM. We validated the instrument in the context of conceptually different media. Therefore, no matter whether an HD-television set is evaluated or a new computer game is to be examined, the Pictorial Presence SAM could be the most useful presence indicator.

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