EDINBURGH NAPIER
UNIVERSITY

ISPR 2011:

THE INTERNATIONAL SOCIETY FOR PRESENCE RESEARCH ANNUAL CONFERENCE

EDINBURGH, 26-28 OCTOBER 2011

EDITED BY PHIL TURNER

Measuring Telepresence: The Validity of The Temple Presence Inventory (TPI) in a Gaming Context

Matthew Lombard, Lisa Weinstein, & Theresa Ditton

Temple University, USA
{lombard@temple.edu; lew0405@gmail.com; tbditton@comcast.net}

Abstract

This paper describes a study that tested the validity of the Temple Presence Inventory (TPI), including correlations with several other prominent presence questionnaires, in the context of an interactive gaming environment (SimCity Classic and The Sims 3). The TPI questionnaire is a multidimensional, literature-based measure of telepresence that has demonstrated sensitivity to media form and content in several studies but until now hadn't been evaluated in an interactive media environment.

1. Introduction

The phenomenon of telepresence (hereafter, presence), in which users of advanced media technologies such as virtual reality as well as traditional media such as television, experience a sense of connection with real or fictional environments and the objects and people in them, has become increasingly important to those who study and create mediated experiences.

Systematic research on a number of important research fronts has been hindered by the absence of a presence measure or measures that incorporate all of the dimensions of presence [1, 2, 3], and that would permit comparisons across media systems, formats, and contents. Since the first calls for the development of a standardized measure of presence [4, 5, 6, 7], researchers have taken a number of different (although not necessarily mutually exclusive) approaches to creating standard measures of presence, but the most common tool used is the questionnaire.

The Temple Presence Inventory (TPI) was created as a literature-based measurement tool that could provide a standardized, flexible, multi-dimensional instrument and has passed several tests of reliability and validity in different contexts [8]. But all of these tests have been performed with passive rather than interactive media and haven't allowed direct comparisons with other well-known presence measures. This paper describes a recent experiment conducted to provide such a test. The background, hypotheses, methods and results of the study are presented, followed by recommendations regarding further testing and use of the TPI.

2. Evaluation of questionnaires measuring presence

Although every type of measurement tool has its strengths and weaknesses and it is ideal for researchers to employ multiple types, presence questionnaires are the most widely used measures of presence. These self-report measures of presence are potentially very useful as the quantification of users' presence experiences allow for statistical comparisons across different media, stimuli, and subject groups. However, currently different researchers use different items to test different hypotheses in a variety of different contexts, making comparisons across studies difficult. While there is no currently accepted standard presence questionnaire, a handful are used most commonly (see Table 1).

Presence (and other) questionnaires are evaluated on (at least) five key criteria. First a valuable questionnaire must be *reliable*, both externally and internally consistent (internal consistency is typically assessed by computing Cronbach's alpha). It must also be demonstrated to be *valid*, which requires an ongoing process of "accumulating evidence to provide a sound scientific basis for the proposed score interpretations… and their relevance to the proposed use" [9, p. 9]. Common approaches include confirmatory factor analysis, correlation with other known presence measures, correlation analyses of interrelationships among items, convergent correlational studies of relationships between the presence measure and variables that are theoretically related to presence, and known group comparison studies [10].

The third criterion, *sensitivity*, also supports validity claims by demonstrating that the questionnaire can "detect any change in the construct being measured, in other words, it can measure an effect caused by manipulating a

variable known to influence that construct" [11, p. 3]. A sensitive measure of presence distinguishes between multiple levels of presence.

Fourth, a presence questionnaire must be *conceptually comprehensive*, capturing and operationalizing the key dimensions of presence that have been identified in the literature. Lombard and Ditton [1] identified six conceptualizations: Presence as Transportation, Realism, Immersion, Social Richness, Social Actor within a Medium and Medium as Social

Table 1. Comparison of Presence questionnaire attributes

Questionnaire	N Items	(N) Presence Subscales	Intended Applicability
Slater Usoh Steed Questionnaire (SUS) [13]	6	No Separate Subscales	Virtual environments
Presence Questionnaire (PQ) [14]	32	+(2) Involvement/Control; Natural	Virtual environments
Igroup Presence Questionnaire (IPQ) [15]	14	(3) Spatial Presence Involvement; Realness	Virtual environments
MEC Spatial Presence Questionnaire (MEC-SPQ) [16, 17]	L: 8 M: 6 S: 4	+(3) Spatial Presence: Self-Location; Spatial Presence: Possible Actions; Cognitive Involvement	Cross-media
ITC Sense of Presence Inventory (ITC-SOPI) [18]	44	+(3) Sense of Physical Space; Engagement; Naturalness (Ecological Validity)	Cross-media
Temple Presence Inventory (TPI)	42	(8) Spatial Presence; Social Actor within Medium; Passive Social Presence; Active Social Presence; Engagement; Social Richness; Social Realism; Perceptual Realism	Cross-media

+ Questionnaire contains additional subscale(s) assessing constructs other than dimensions of presence

Actor. Others have proposed a variety of dimensions of presence, but most are captured in these six [3]. Finally, a standardized measure of presence must have high *applicability*, meaning that the instrument "can be used in different conditions and environments" [12, p. 5]. The last two criteria are particularly difficult to meet in the case of presence because it is arguable whether any measure could capture all types of presence in all contexts.

Each of the first five questionnaires in Table 1, the SUS, PQ, IPQ, MEC-SPQ, and the ITC-SOPI, are strong on a different subset of these criteria (e.g., the PQ has been shown to be highly reliable, the ITC-SOPI has passed a careful series of validity analyses); as of yet, however, none of these questionnaires meets all of the criteria described here.

3. Development and validation of the Temple Presence Inventory (TPI): A review of previous studies

3.1. Development of the TPI and testing validity based on the manipulation of media form

The Temple Presence Inventory (TPI) was created as a standardized, cross-media measure of presence based on a wide literature that extends beyond the study of virtual environments and relatively narrow conceptualizations of presence. The items are based specifically on literature and conceptualizations within the literature; that is, nearly every item included has been used in research in the past. Furthermore, recent presence research emphasizes social presence and the factors that contribute to it. The TPI includes the dimensions that address parasocial interactions and social richness (as conceived by Short, Williams, and Christie [19]) as well as the dimensions measured by all of the other existing scales (e.g., spatial presence/transportation, psychological and physical immersion, perceptual realism/naturalness and plausibility or social realism, and engagement/attention).

The TPI was created from 114 potentially appropriate measures collected from the studies identified by Lombard and Ditton [1] and other studies along with new items created by the researchers so that each of five conceptualizations of presence was well represented (the sixth dimension, medium as social actor, was excluded because of its arguably distinct nature and the practical limitations of testing the large number of potential items that would be required).

Following a series of pilot tests, 72 refined items were tested in a between subject experiment with a

Table 2. Factor Structure of the TPI

Factor	Label	N Items*	Cronbach's Alpha (α)
1	Spatial presence	7	.91
2	Social presence-actor within medium	7	.90
3	Passive social presence	4	.88
4	Active social presence	3	.77
5	Presence as engagement	6	.90
6	Presence as social richness	7	.93
7	Presence as social realism	3	.75
8	Presence as perceptual realism	5	.78

* Complete list of items available online at http://tinyurl/TemplePresenceInventory

Table 3. Results of Independent Samples T-Tests

Subscale	High Presence M (N)	Low Presence M (N)	T-Value
Spatial	**5.05** (307)	2.12 (162)	28.27***
Social-actor	**3.34** (304)	2.00 (162)	10.52***
Passive social	5.33 (306)	**5.42** (162)	0.62
Active social	3.16 (304)	**3.46** (162)	1.69
Engagement	**5.19** (307)	3.53 (162)	14.26***
Social richness	**4.87** (302)	3.22 (162)	12.50***
Social realism	**3.41** (303)	3.10 (159)	20.03*
Perceptual realism	**3.79** (307)	2.41 (162)	11.27***

Note. Boldface indicates the higher sample mean.
$*p < .05$. $**p < .01$. $***p < .001$.

diverse sample (see Tables 2 and 3 for results). Subjects in the high presence condition (n=307) were exposed to large, high resolution, three-dimensional, color images, and full spectrum surround sound audio as they watched the 45-minute film *T-Rex: Back to the Cretaceous* at a 3D IMAX film presentation before completing the questionnaire. Subjects in the low presence mediated environment (n=162) were exposed to small, black and white images and monaural sound as they watched an old episode of the American situation comedy *Three's Company* in a brightly lit office and then completed the questionnaire.

A series of factor analyses of the collected data revealed 8 factors across 42 items (see Table 2): Factor 1 was Spatial Presence (e.g., presence as transportation). The 2 items that loaded the highest on the factor were "How much did it seem as if the objects and people you saw/heard had come to the place you were?" (.88) and "How much did it seem as if you could reach out and touch the objects or people you saw/heard?" (.88).

The items loading highest on factor 2 were "How often did you have the sensation that people you saw/heard could see/hear you?" (.83) and "To what extent did you feel you could interact with the person or people you saw/heard?" (.82). This factor was labeled Social Presence-Actor Within Medium (e.g., parasocial interaction).

Factor 3 was defined as Passive Social Presence; its highest loading items were "During the media experience how well were you able to observe the facial expressions of the people you saw/heard?" (.89) and "During the media experience how well were you able to observe changes in the tone of voice of the people you saw/heard?" (.85). The highest loading items on the fourth factor, Active Social Presence, were "How often did you make a sound out loud (e.g., laugh, speak) in response to someone you saw/heard in the media environment?" (.78) and "How often did you smile in response to someone you saw/heard in the media environment?" (.78).

The items loading highest on factor 5, defined as Presence as Engagement (e.g., presence as immersion), were "To what extent did you feel mentally immersed in the experience?" (.86) and "How involving was the media experience?" (.80). Factor 6 was labeled Presence as Social Richness; all items loading on this factor are measured on a semantic differential scale [19] in which participants are asked to rate their media experience in terms of bipolar word pairs. The highest loading items were "The media experience was remote-immediate" (.85) and "The media experience was unemotional-emotional" (.83).

Factor 7 was named Presence as Social Realism. The items loading on this factor asked participants to indicate their level of agreement with statements. Items loading highest on this factor were "It is likely that the events I saw/heard would occur in the real world" (.87) and "The events I saw/heard could occur in the real world" (.76). The items loading highest on the last factor, Presence as Perceptual Realism, were "Overall, how much did

touching the things and people in the environment you saw/heard feel like it would if you had experienced them directly?" (.73) and "How much did the heat or coolness (the temperature) of the environment you saw/heard feel like it would if you had experienced it directly?" (.63).

Indices built from each factor demonstrated adequate to high reliability via Cronbach's alpha and t-tests demonstrated sensitivity to the presence manipulation as predicted (see Table 3) with two exceptions that were logical in retrospect (see [20] for details).

3.2. Testing the TPI's validity based on the manipulation of media content

The next study tested the validity and reliability of the TPI through the manipulation of media content. In a repeated-measures experimental design, each participant (*N*=46) was separately exposed to three different short media stimuli, each representing a distinct media genre/content type (science fantasy – *Lord of the Rings*;

Table 4. Repeated Measures Pairwise Comparisons

Subscale	Lord of the Rings *M* (*SD*)	Daily Show *M* (*SD*)	Civil War *M* (*SD*)
Spatial	3.96_a (1.47)	2.86_b (1.39)	1.93_c (0.98)
Social-actor	2.87_a (1.34)	3.17_b (1.49)	1.86_c (0.97)
Passive social	6.02_a (0.94)	5.62_b (1.15)	2.81_c (1.51)
Active social	2.24_a (1.32)	4.53_b (1.65)	1.47_c (1.07)
Engagement	4.88_a (1.30)	4.50_a (1.28)	2.47_b (1.24)
Social richness	4.83_a (1.08)	5.05_a (1.05)	2.60_b (1.23)
Social realism	1.32_a (0.52)	5.06_b (1.34)	4.10_c (1.75)
Perceptual realism	3.39_a (1.16)	3.84_a (1.47)	2.17_b (0.90)

Note. Means in the same row that do not share subscripts differ significantly for Bonferroni's adjustment for multiple comparisons. Of the 21 significant pairwise comparisons, 18 differ at $p < .001$, 2 at $p < .01$, and 1 at $p < .05$. *N*=45 following casewise deletion for missing values.

comedy – *The Daily Show with Jon Stewart*; documentary – *Civil War*) and completed the TPI after each segment. All stimuli were viewed in the same environment, video projected on a large film screen.

The pattern of differences in the mean scores computed for each presence index across the 3 types of media content confirmed the predictions that *Lord of the Rings* would produce means indicating high Spatial Presence and Presence as Perceptual Realism, and low Presence as Social Realism; that *The Daily Show* (a satirical newscast/late night talk show) would be high on all indices, especially Social Presence-Actor within Medium and Presence as Social Richness; and that *Civil War* would be high in Presence as Social Realism, but produce low mean values on the other indices.

Repeated measure ANOVAs and post-hoc comparisons for each of the TPI subscales revealed significant differences among the three media stimuli (see Table 4).

In summary, the results from these past studies demonstrate that the TPI has been validated across media form and content; however, the measure needs to be tested on a range of media systems and environments, particularly interactive mediated environments.

4. Validation of the TPI in a gaming context

Following the validation of the TPI in previous studies that manipulated media form and content, a recent study tested the measure's validity in an interactive media environment. More specifically, this study tested the validity and reliability of the TPI through the manipulation of gaming stimuli. Additionally, validation of the TPI was further tested through the inclusion of items from other presence questionnaires in the instrument used in this study, allowing for direct comparisons with other well-known presence measures.

4.1. Design and procedures

The study used a between-subjects experimental design in which participants were randomly assigned to either a low presence condition, in which they engaged in 10 minutes of game-play with the low presence stimulus, or a high presence condition, in which they engaged in 10 minutes of game-play with the high presence stimulus. Following game-play, they completed a questionnaire that contained demographic questions, items measuring

gaming experience and use habits, and 113 items from 6 different presence questionnaires (including the TPI).

The study took place in a large lab made to appear like a comfortable living room. The lab contained two separated computer stations with identical Dell PCs with 19-inch standard LCD monitors and identical chairs. Participants, alone or with one other participant, were seated at a station and given approximately 5 minutes to acquaint themselves with whichever game they'd been assigned. When they were ready they were directed to play the game for 10 minutes. At that time the experimenter directed the participant(s) to cease game-play and opened a computer window containing one of the two differently ordered versions of the questionnaire used in this study. After reading the on-screen instructions, participants completed the questionnaire.

The experimenter stayed in the room throughout to answer any participant questions. The questionnaire took 15-30 minutes to complete and the entire procedure took 25-45 minutes.

4.2. Stimuli

4.2.1. Low presence: SimCity Classic. The computer game *SimCity Classic* was chosen as the low presence gaming stimulus. Created by game designer Will Wright, the original *SimCity* (now referred to as *SimCity Classic*) was released in 1989. According to Albert [21], Wright was inspired to design this city-building simulation game by his passion for urban planning. *SimCity* is now widely recognized as the first popular game of the simulation gaming genre. As the objective of the game is the development and planning of virtual cities, virtual objects rather than social characters and storylines are the focal point of the gaming experience. Now more than two decades old, *SimCity Classic* presents the player with very primitive graphics by today's standards.

Once the participants in the low presence condition indicated that they had finished reading *the SimCity Classic* instructions, they were ready to engage in game-play. When starting a new game, the player is presented with the edit window; this window contains the terrain on which the player will build the simulated city. During the game-play participants were given complete freedom regarding the creation of their city. There is no winner or loser in this game; rather, the objective is to build whatever type of city the player may desire.

4.2.2. High presence: The Sims 3. The computer game *The Sims 3* was chosen as the high presence gaming stimulus. Released in 2009, *The Sims 3* is a "virtual life

simulator. In it, you take control of a character called a sim, or an entire household of them… It's real life boiled down to simple mechanics, but within these mechanics lies an entire universe of possibilities" [22, p. 1]. Furthermore, according to one review, "the free-to-explore town makes you feel like part of an entire virtual society" [22, p. 1]. *The Sims 3* provides the player with an immersive, social, and interactive virtual environment.

Prior to engaging in game-play, *The Sims 3* provides players with step-by-step instructions on everything from how to personalize the player's avatar (or "sim") to how to move about and modify the virtual town (which is named "Sunset Valley") to how to interact with the other virtual Sunset Valley citizens. During game-play, participants were given free reign to design their personal avatars, explore Sunset Valley, and interact with the virtual members of the simulated society.

4.3. Participants

Participants (N=85) were recruited from Communications courses at Temple University, and in most cases given extra credit. The sample was 58 percent (n=49) female, with an average age of 20.4 years (*SD*=3.04). Approximately 62 percent of participants (n=53) reported their race as White, 25 percent (n=21) African American, 7 percent (n=6) Asian, 1 percent (n=1) Hispanic, and 5 percent (n=4) identified their race as Other.

4.4. Measurement instrument

The questionnaire designed for this study included 135 items. Four of these items were demographic questions, 18 regarded subjects' gaming habits/experience, and 113 items measured each subject's experience of presence. To control for possible order effects, 2 versions of the questionnaire were created, each with the presence items arranged differently; one of the two questionnaire versions was randomly assigned to each participant.

The 113 presence items were drawn from the 6 established presence questionnaires in Table 1: the TPI, the Slater-Usoh-Steed Questionnaire (SUS) [13], the Witmer-Singer Presence Questionnaire (PQ) [14], the Igroup Presence Questionnaire (IPQ) [15], the MEC Spatial Presence Questionnaire (short version) (MEC-SPQ) [16; 17], and the ITC Sense of Presence Inventory (ITC-SOPI) [18].

More specifically, the 113 items measuring the experience of presence included all items from the TPI

and SUS along with the items from particular corresponding subscales of the other questionnaires (see below for details). The items were selected to allow tests of the convergent validity of the TPI, with convergent validity defined as "the extent to which different measures that are designed to tap the same construct correlate with each other" [23, p. 164].

4.5. Hypotheses and statistical methods

Beyond tests of the reliability (inter-item correlations) of the TPI subscales, two primary sets of hypotheses were tested, utilizing two statistical techniques. First, in order to establish that the TPI could distinguish between high and low presence stimuli (i.e., meet the sensitivity criterion) in an interactive media environment ("gaming environment"), independent samples t-tests were performed on each of the TPI subscales. Second, intercorrelational analyses among the TPI subscales and the related presence questionnaire subscales were conducted to establish the convergent validity of the TPI.

4.5.1. Sensitivity. Independent samples t-tests were conducted for each of the 8 TPI subscales in order to assess the differences in means between the low presence (*SimCity Classic*) and high presence (*The Sims 3*) conditions. It was hypothesized that the mean scores for all but one TPI subscale would be higher for participants in the high presence condition than for those in the low presence condition.

More specifically, based on the social nature and personalization of avatars that characterize *The Sims 3* and the complete lack of social interaction in *SimCity Classic*, it was postulated that mean scores on each of the Social Presence subscales (Social-Actor within Medium, Passive Social Presence, Active Social Presence, and Social Richness) would be significantly higher for the high presence condition than for the low presence condition. As stated in Section 4.2.2, *The Sims 3* provides the player with an immersive, social, and interactive virtual environment; based on this, it was postulated that the mean scores on the Engagement subscale would be significantly higher for the high presence condition than for the low presence condition.

Also, considering the graphic sophistication of *The Sims 3* and taking into account the graphically primitive style characterizing *SimCity Classic*, it was hypothesized

that mean scores on the Perceptual Realism subscale would be significantly higher for the high presence condition than the low presence condition. The Social Realism subscale, however, was not predicted to significantly differ between the high and low presence conditions. This is because both games provide players with scenarios and objectives that are consistent with real-life activities.

4.5.2. Convergent validity. Intercorrelational analyses were used to test the hypotheses that related subscales from the different presence questionnaires measuring Spatial Presence, Presence as Engagement and Presence as Perceptual Realism would each be intercorrelated.

The first set of subscales all purport to measure the construct of Spatial Presence (e.g., Presence as Transportation): the TPI's Spatial Presence subscale, the IPQ's Spatial Presence subscale, the SUS in its entirety (all six items measure a single dimension of presence), the MEC-SPQ's Spatial Presence: Self Location subscale, and the Spatial Presence subscale of the ITC-SOPI.

The subscales measuring Presence as Engagement (e.g., Presence as Immersion) and expected to be correlated are: Engagement on the TPI, Involvement on the IPQ, Attention Allocation on the MEC-SPQ, Involvement on the PQ, and the ITC-SOPI's Engagement subscale.

The final set of related subscales are all designed to measure the construct of Presence as Perceptual Realism: Perceptual Realism on the TPI, Experience Realism on the IPQ, the PQ's Natural subscale, and the Ecological Validity subscale on the ITC-SOPI.

5. Results

5.1. Internal consistency and reliability

Cronbach's Alphas were computed for each subscale to assess the internal consistency and reliability of the TPI (see Table 5). The results of these analyses demonstrate that every subscale of the TPI is highly reliable. The lowest Cronbach's Alpha value (α= .860) was for the Active Social Presence subscale, while Presence as Social Richness had the highest Cronbach's Alpha value (α= .919).

Table 6. Independent Samples T-Tests: TPI Subscales

TPI Subscale	High Presence M(SE) (n=40)	Low Presence M(SE) (n=45)	T-statistic t(df)	Sig. Level (p-value)
Spatial	**2.692** (.224)	2.222 (.172)	1.664 (75.5)	.100
Social-Actor	**3.000** (.200)	2.006 (.181)	3.689 (83)	<.001
Passive Social	**3.819** (.216)	1.711 (.213)	6.934 (83)	<.001
Active Social	**2.800** (.226)	1.696 (.192)	3.714 (83)	<.001
Engagement	**3.938** (.219)	3.315 (.205)	2.075 (83)	<.050
Social Richness	**4.343** (.177)	3.213 (.243)	3.759 (78.3)	<.001
Social Realism	**3.850** (.257)	3.570 (.252)	.776 (83)	.440
Perceptual Realism	**3.025** (.200)	2.182 (.201)	2.957(83)	<.010

Note. Boldface indicates the higher sample mean.

5.1.1. Validity: Sensitivity in the context of interactive stimuli. The overall hypothesis that the mean scores on the TPI subscales would be higher for the high presence condition than the means for the low presence condition was supported by the results of the independent samples t-tests (see Table 6).

As predicted, means for all of the Social Presence subscales, for the Engagement subscale, and for the Perceptual Realism subscale were significantly higher for the high presence condition than for the low presence condition. Also as predicted, the difference between high and low presence means for Social Realism was not statistically distinct.

Lastly, while the high presence mean for the Spatial Presence subscale was higher than the low presence mean score for this subscale, the difference between the two means did not reach statistical significance. Of all 8 subscales, the high presence condition had the lowest mean score on the Spatial Presence subscale, which measures the dimension of presence that Lombard and Ditton [1] refer to as "presence as transportation." This result is not surprising considering the limited amount of time (10 minutes) that participants engaged in game-play. Because of this time limitation, the majority of

Table 7. Measurement of Spatial Presence: Inter-Correlations Among Related Scales (N=85)

Scale	1	2	3	4
1 TPI-Spatial Presence	1			
2 IPQ-Spatial Presence	.584**	1		
3 SUS Questionnaire	.708**	.778**	1	
4 MEC-SPQ-Spatial Presence: Self-Location	.706**	.720**	.861**	1
5 ITC-SOPI-Sense of Physical Space	.693**	.647**	.795**	.860**

**p<.01

participants playing *The Sims 3* (those in the high presence condition) spent all 10 minutes designing their personal avatars (or "sims") and did not get the opportunity to travel through *The Sims 3* universe. Because of this limitation, testing convergent validity through correlational analyses was a particularly important step in establishing the validity of the Spatial Presence subscale in the context of an interactive (gaming) environment.

5.1.2. Validity: Intercorrelations among presence subscales. The hypothesis that all intercorrelations among the subscales that measure the construct of Spatial Presence would be highly significant, was confirmed by the results of the correlational analyses (see Table 7). Correlations among all of the related subscales did demonstrate significance (*p*<.01) with correlation coefficients ranging from *r*=.584 to *r*=.861.

The second prediction, that all intercorrelations among the subscales measuring the construct of Presence as Engagement would be highly significant, was also confirmed by the results of the correlational analyses (see Table 8). Correlations among all of the related subscales were significant (*p*<.01) with correlation coefficients ranging from *r*=.334 to *r*=.774.

Lastly, the hypothesis that all intercorrelations among the subscales measuring the construct of Presence as Perceptual Realism will be highly significant was confirmed by the results of the correlational analyses (see Table 9). Correlations among all of the related subscales

Table 8. Measurement of Presence as Engagement: Inter-Correlations Among Related Scales (N=85)

Scale	1	2	3	4
1 TPI-Engagement	1			
2 PQ- Involvement	.731**	1		
3 IPQ-Involvement	.449**	.337**	1	
4 MEC-SPQ-Attention Allocation	.475**	.489**	.334**	1
5 ITC-SOPI-Engagement	.774**	.691**	.463**	.637**

**p<.01

were significant (*p*<.01) with correlation coefficients ranging from *r*=.563 to *r*=.786.

Conclusions

In addition to the previous studies in which the 42-item Temple Presence Inventory demonstrated reliability, validity and sensitivity across media form and content, the TPI has now established its reliability, validity and sensitivity in an interactive media environment.

The results of this study have also confirmed the convergent validity of the TPI, which supports the use of this questionnaire in the measurement of Spatial Presence, Presence as Engagement, and Presence as Perceptual Realism. What sets the TPI apart from the other measures involved in the correlational analyses, however, is that the TPI not only measures these three presence constructs, it also measures the various dimensions of social presence (i.e., Social-Actor within Medium, Passive Social Presence, Active Social Presence, and Social Richness). The multidimensional TPI (available at http://tinyurl/TemplePresenceInventory) captures nearly all aspects of presence (as conceptualized in [1]), and this

Table 9. Measurement of Presence as Perceptual Realism: Inter-Correlations Among Related Scales (N=85)

Scale	1	2	3
1 TPI-Perceptual Realism	1		
2 IPQ-Experienced Realism	.640**	1	
3 ITC-SOPI-Ecological Validity	.660**	.724**	1
4 PQ- Natural	.563**	.669**	.786**

**p<.01

comprehensive questionnaire has been shown to be highly reliable and valid across a number of different studies.

Based on all of the evidence thus far, there is strong support for advocating the use of the TPI for the measurement of presence in a variety of empirical settings. That being said, the TPI still needs to be tested in fully immersive virtual environments and with advanced virtual technologies. Additionally, the convergent validity of the Social Presence subscales on the TPI must be established by correlating these subscales with other established presence scales that purportedly measure the same constructs of social presence. In conclusion, while the TPI must still undergo more rigorous testing, the future of this multidimensional measure of presence is promising.

References

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

[2] Lombard, M., & Jones, M. T. (in press). Defining presence. In F. Biocca, W.A. Ijsselsteijn, and J. Freeman (Eds.) *Handbook of Presence Research*. Hillsdale, NJ: Lawrence Erlbaum Associates.

[3] International Society for Presence Research. (2000). *The concept of presence: Explication statement*. Retrieved June, 2009 from http://ispr.info/

[4] Prothero, J. D., Parker, D. E., Furness III, T. A., & Wells, M. J. (1995). Towards a robust, quantitative measure for presence. In *Proceedings of the Conference on Experimental Analysis and Measurement of Situation Awareness,* 359-366.

[5] Sheridan, T. B. (1992). Musings on telepresence and virtual presence. *Presence, 1*(1), 120-126.

[6] Barfield, W., & Weghorst, S. (1993). *The sense of presence within virtual environments: A conceptual framework.* Proceedings of the fifth International Conference of Human-Computer Interaction, 699 - 704.

[7] Barfield, W., Zeltzer, D., Sheridan, T., & Slater, M. (1995). Presence and performance within virtual environments. In W. Barfield and T. A. Furness, III (Eds.), *Virtual environments and advanced interface design* (pp. 473-541). New York: Oxford University Press.

[8] Kline, P. (2000). *The handbook of psychological testing*. London; New York: Routledge.

[9] American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (1999). *Standards for educational and psychological testing*. Washington, DC: American Educational Research Association.

[10] Goodwin, L. & Leech, N. (2003, October). Assessment in action: The meaning of validity in the *New Standards for Educational and Psychological Testing*: Implications for measurement courses. *Measurement and Evaluation in Counseling and Development, 36,* 181-191.

[11] Youngblut, C. (2003). *Experience of presence in virtual environments* (IDA Document D-2960). Alexandria, VA: Institute for Defense Analysis.

[12] Laarni, J., Ravaja, N., Saari, T., Böcking, S., Hartmann, T. & Schramm, H. (in press). Ways to measure presence. Review and future directions. In F. Biocca, W. IJsselsteijn & J. Freeman (Eds.), *Immersed in media experiences: Handbook of the psychology and design of presence in virtual environments*. Mahwah, NJ: Lawrence Erlbaum Associates.

[13] Slater, M., Usoh, M., & Steed, A. (1994). Depth of presence in virtual environments. *Presence: Teleoperators and Virtual Environments, 3,* 130-144.

[14] Witmer, B., & Singer, M. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence, 7*(3), 225-240.

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

[16] 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.

[17] 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.

[18] 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*(3), 282-297.

[19] Short, J. Williams, E., and Christie, B. (1976). *The social psychology of telecommunications*. London: Wiley.

[20] Lombard, M., Ditton, T., & Weinstein, L. (2009). Measuring telepresence: The Temple Presence Inventory. In *Proceedings of Twelfth International Workshop on Presence* (Los Angeles California, USA).

[21] Albert, E. (2001, February). *SimCity Classic: History and Review*. Retrieved June, 2011 from http://www.stanford.edu/group/htgg/cgibin/drupal/sites/default/files2/ealbert_2001_1.pdf

[22] VanOrd, K. (2009, June 1). The sims 3 review. *Gamespot*. Retrieved June, 2011 from http://www.gamespot.com/pc/strategy/the-sims-3/review.html

[23] Cunningham, W., Preacher, K., & Banaji, M. (2001, March). Implicit attitude measures: Consistency, stability, and convergent validity. *Psychological Science, 12*(2), 163-170.

[24] de Greef, P., & IJsselsteijn, W. A. (2001). Social presence in a home tele-application. *CyberPsychology & Behavior, 4*, 307-316.