

The Impact of Personality Factors on the Experience of Spatial Presence

Ana Sacau, Jari Laarni, Niklas Ravaja, Tilo Hartmann

University Fernando Pessoa (Portugal), Helsinki School of Economics (Finland), Helsinki School of Economics (Finland), Hannover University of Music and Drama (Germany)
 pssacau@ufp.pt, jari.laarni@hkkk.fi, niklas.ravaja@hkkk.fi, Tilo.Hartmann@ijk.hmt-hannover.de

Abstract

The aim of this paper is to present an experimental investigation conducted to assess the impact of personality factors on the formation of Spatial Presence. Four different media -linear text, hypertext, film and virtual environment- and eight different experimental manipulations were applied. Spatial Presence was measured using the MEC-SPQ questionnaire. Personality was measured using the NEO-FFI personality questionnaire. Other personality traits such absorption, domain-specific interest and spatial visual imagery were also measured. Our findings suggest that absorption, domain-specific interest and agreeableness are good predictors of Spatial Presence. Experimental manipulations, however, had a quite small effect on Spatial Presence.

Keywords---Presence, Spatial Presence, personality factors, traits, Big Five

1. Introduction

Sensations of nonmediation have received a growing attention of researchers in the last decades. Among all phenomena of non-mediation, one of the most prominent concepts probably is the construct of “Spatial Presence” (also called “Telepresence”, [1], or “Virtual Presence”, [2]).

Spatial Presence can be defined as the subjective experience of a user or onlooker to be physically located in a mediated space (although it is just an illusion; for reviews, see [3]; [4]; [5]; [6]; [7]). It has been described as “a sense of being there” that occurs “when part or all of a person’s perception fails to accurately acknowledge the role of technology that makes it appear that s/he is in a physical location and environment different from her/his actual location and environment in the physical world” [8].

As a subjective experience, Spatial Presence is supposed to be heavily influenced by individual factors [9] [1], either situation-specific states or more enduring stable dispositions (traits). However, research on the influence of personality factors on the formation of Spatial Presence is

rare [10]. As Sas and O’Hare ([11], p. 527) put it “[a] large amount of work has been carried out in the area of technological factors affecting presence. [...] Comparatively, the amount of studies trying to delineate the associated human factors determinant on presence is significantly less”. Therefore, in this paper, we elaborate links between stable individual factors and Spatial Presence and report the results of an empirical study in order to illuminate Spatial Presence as a subjective phenomenon.

2. User factors and the formation of Spatial Presence

According to the two-level-model of Spatial Presence [6] [12], the sensation of Spatial Presence can be construed as a two-step process (see figure 1) that emerges from the interplay of media factors on the one side and user factors on the other side. In a first step, the model regards the formation of a spatial situation model (SSM), which is a subjective mental model of the perceived spatial (media) environment (e.g. the user mentally reconstructs the size, shape, depth, etc. of a depicted environment). The second level, in turn, regards the transition from an SSM to Spatial Presence (i.e. the user’s feeling to be situated in the mentally constructed spatial scenery).

The model argues that traits influence the formation process at both stages. On the first level, the construction of a SSM is supposed to be influenced by the user’s domain specific interest and spatial ability. A high *domain-specific interest* should lead to a controlled continuously persistent attention allocation onto the media stimulus. Thus, the perception and mental reconstruction of spatial cues provided by the media environment is triggered that in turn should ease the formation of a SSM. The model argues that missing ‘building blocks’ of spatial information can be derived in a top-down process from memory, and inserted into the construction of a SSM. The more ‘talented’ the user is in terms of adding and integrating spatial information into the mental model (*‘spatial visual imagery’*), the greater the probability of a well-defined SSM.

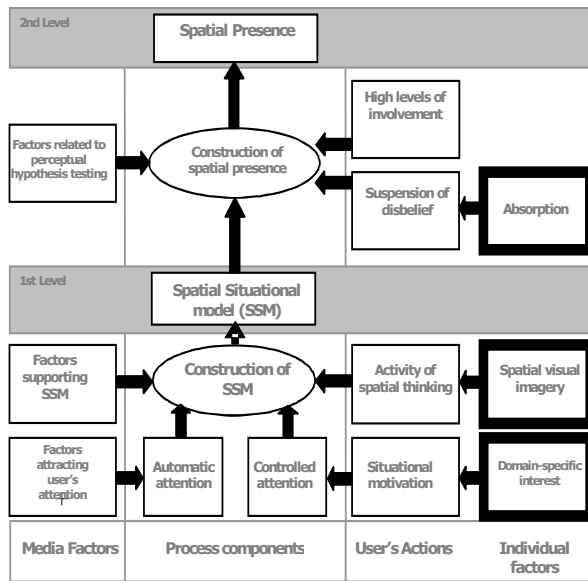


Figure 1. The two-level-model of Spatial Presence [traits are marked by thick boxes]

On the second level, the most important user trait influencing the formation of Spatial Presence is *absorption*. Trait absorption refers to an individual’s motivation and skill in dealing with an object in an elaborate manner [13] than, in turn, cognitively ‘detracts’ the individual from other aspects of the environment. High-absorption individuals display tendencies to become intensely involved with objects (such as media products), and enter the condition of being ‘fascinated’ without much effort. Therefore it is argued that high-absorption individuals tend to pay more attention to the media stimulus, and also are prone to avoid critical elaborations or evaluations of the stimulus (i.e. to show disbelief).

In sum, the two-level model assumes that a high-domain-specific interest, a strong capability of spatial visual imagery, and a high trait absorption foster Spatial Presence experiences.

3. The Big Five personality traits

The five-factor or Big Five model of personality has emerged as the predominant model for specifying personality structure [14, 15]. This model posits that five broad dimensions—Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness—adequately encompass, at a high level of generality, the full range of personality traits. The model derived foremost from studies of natural language of personality, and the most consistent support for the model comes from studies of rated trait adjectives [14]. Studies of self-report inventories have, however, been less consistent in identifying all five dimensions.

Individuals high on Neuroticism are characterized by a tendency to experience negative affect, such as anxiety, depression or sadness, hostility, and self-consciousness, as well as a tendency to be impulsive [for a review, see 14]. Those high on Extraversion tend to experience positive emotions and to be warm, gregarious, fun-loving, and assertive [14]. Those high on Openness to Experience are inclined to be curious, imaginative, creative, original, artistic, aesthetically sensitive, psychologically minded, and flexible [14]. Agreeableness refers to the tendency to be forgiving, kind, generous, trusting, sympathetic, compliant, altruistic, and trustworthy [14]. Finally, Conscientiousness refers to a tendency to be organized, efficient, reliable, self-disciplined, achievement-oriented, rational, and deliberate [14]. The Big Five personality traits have been associated with diverse outcomes such as stress vulnerability [16], coping [17], vigilance performance [18], and attention-deficit/hyperactivity disorder [19].

4. The Big Five and the formation of Spatial Presence

Given the unprecedented level of interest in personality research and practice enjoyed by the Big Five, it is warranted to focus on these five factors when examining the relationship of personality with Spatial Presence. Although this issue has not been examined before, there may be several potential links between the Big Five traits and the formation of Spatial Presence. Conceptual considerations and empirical evidence indicate that Openness to Experience is closely related to absorption [e.g., 15]. Thus, given the aforementioned important role played by absorption in the formation of Spatial Presence, it would be expected that Openness to Experience may contribute to suspension of disbelief and Spatial Presence experiences. Given the characteristics associated with Openness to Experience, such as being imaginative, creative, and artistic, it would be expected as being related to high visual spatial imagery, i.e., a user trait putatively contributing to Spatial Presence. Characteristics associated with Agreeableness, such as being trusting and compliant [14], might also contribute to Spatial Presence (perhaps through the mediating influence on suspension of disbelief).

Prior research has also shown that a depressed mood elicits self-focused attention and results in decreased involvement with media messages [20]. Given the tendency of high Neuroticism individuals to experience depression or sadness [14], they may show diminished involvement with (external) media stimuli, which may contribute to low Spatial Presence. Self-focused attention may also interfere with the construction of a SSM. Conscientiousness has, in turn, been associated with high perceptual sensitivity (i.e. an ability to detect changes in stimuli) [18]. That being so, it may potentially (a) be

related to a critical evaluation of the stimulus (resulting in low Spatial Presence) or (b) contribute to the construction of a SSM through the mediating influence on controlled attention (resulting in high Spatial Presence).

5. The present study

Given the aforementioned considerations, the aim of the present study was to examine the relationship of the Big Five personality factors and the three personality traits included in the two-level-model of Spatial Presence (i.e., absorption, spatial visual imagery, and domain-specific interest) with Spatial Presence experiences during media processing. It was hypothesized all these personality-related factors would be associated with Spatial Presence.

It was also examined how different manipulations (e.g., large visual field vs. small visual field) influence Spatial Presence when processing different types of media (i.e., linear text, hypertext, film, virtual environment).

6. Method

6.1 Participants

The sample was made up of 240 undergraduate or graduate level students (138 females, 102 males) in four countries (Finland, Germany, Portugal and Switzerland). The mean age of the participants was 24.25 with a range between 18 and 41. They were ignorant of the purpose of the study before participating. Participants were paid for their participation (total value 10-13€).

6.2 Stimuli

Each participant was exposed to either linear text, virtual environment with hypertext interaction characteristics (from now Hypertext), film or virtual environment with 3D graphics (from now VE) media stimulus. Table 1 presents the distribution of participants according to stimulus type, location and gender.

In the linear-text experiment, participants read an extract from Ken Follett’s book “The Pillars of the Earth” (“Die Säulen der Erde” in German). The 12-page episode portrays how one of the main characters intrudes a cathedral, sets fire and tries to escape from the flames.

| Type of stimulus | | Gender of participant | | Total |
|------------------------|--|-----------------------|------|-------|
| | | Female | Male | |
| Linear Text (Hannover) | | 19 | 21 | 40 |
| Hypertext (Helsinki) | | 36 | 24 | 60 |
| Film (Porto) | | 30 | 30 | 60 |
| VE (Zürich) | | 53 | 27 | 80 |

| Total | 138 | 102 | 240 |
|-------|-----|-----|-----|
|-------|-----|-----|-----|

Table 1. Gender of participant by type of stimulus

In the hypertext condition, 'The Art of Singing' CD-ROM (Nothing Hill Publishing Limited 1996) based multimedia stimulus was applied (see Figure 2). It is a commercial 2-D virtual environment in which the user tours around a virtual academy of song. The academy consisted of three floors; on each floor there were several rooms in which different activities took place. The participants had no time to check all the possibilities of the academy ('navigation paths' were thus quite different), but they typically visited all the floors of the house. The field size (FoV) was either 20° or 60° in diameter.



Figure 2. A view to the first floor of the Academy of Song

In the film condition, the participant watched a film that was projected on a screen. The film stimulus was an extract from a Harry Potter and the Philosopher Stone (Warner Bros. Entertainment Inc. 2001). Sequence shows Harry Potter visiting the restricted area of the library at night, under an invisible cloak. The extract is 8 minutes and 39 seconds in length, remaining from 1:21:43 to 1:30:21. The extract was used in its Portuguese version without captions. The FoV was either 20° or 60° in diameter.

In the VE condition, a computer game was applied that was based on Doom 3’s (Id Software Inc. 2004) 3D engine (see Figure 3). The user visited a Mayan temple consisting of 17 different rooms on three floors. In this condition the FoV was either 30° or 60°. In the film, hypertext and VE stimulus conditions, the stimuli were generated with a PC computer, and the image was projected on the screen by a beamer. Sounds were presented through high-quality headphones. A standard computer mouse was used for input in the hypertext and VE condition.



Figure 3. A view to the Mayan temple

6.3 Measures

After stimulus presentation, all the participants completed several questionnaires. The MEC Spatial Presence Questionnaire (MEC-SPQ) consists of several scales that measure different dimensions of Spatial Presence [21]. It includes four process factors [Attention Allocation, Spatial Situation Model (SSM), Self Location (SPSL) and Possible Actions (SPPA)], two variables relating to states and actions [High Cognitive Involvement and Suspension of Disbelief (SoD)] and three trait variables [Domain Specific Interest, Spatial Visual Imagery and Absorption]. Since our interest was to investigate the relationship between personality characteristics and Spatial Presence, only Self Location (SPSL) and Possible Actions (SPPA) and trait variables were considered here. Spatial Presence was the mean score of SPSL and SPPA scores.

NEO-FFI is a 60-element version of the NEO-PI-R. It generates scores on five personality factors, neuroticism, extraversion, openness, agreeableness and conscientiousness [22]. The format of the questionnaire is a five-point Likert scale, ranging from “Strongly disagree” to “Strongly agree”. The Finnish, German and Portuguese versions of the NEO-FFI were used. German NEO-FFI is validated. Finnish and Portuguese NEO-FFI are based on NEO-PI-R validated versions for Finland and Portugal, respectively. Table 2 shows descriptives and reliability indices for three trait scales from MEC-SPQ and five personality dimensions from NEO-FFI.

Two internal consistency estimates of reliability were computed for each trait MEC-SPQ scales and five personality NEO-FFI scales: coefficient alpha and split-half coefficient expressed as a Spearman-Brown corrected correlation. For the split-half coefficient, each scale was split into two equal length halves. In the splitting the items were selected by the SPSS. Spearman-Brown reliability indices indicate reasonable reliability with values between

.66 and .88.

| NEO-FFI scales | Mean | Std. deviation | Skewness | Alpha | Spearman-Brown |
|--------------------------|-------|----------------|----------|-------|----------------|
| Neuroticism | 2.833 | .683 | .079 | 0.696 | 0.868 |
| Extraversion | 3.569 | .489 | -.317 | 0.824 | 0.680 |
| Openness | 3.688 | .552 | -.186 | 0.689 | 0.763 |
| Agreeableness | 3.738 | .438 | -.083 | 0.619 | 0.663 |
| Conscientiousness | 3.538 | .615 | -.424 | 0.824 | 0.847 |
| MEC-SPQ trait scales | | | | | |
| Domain-specific interest | 2.427 | .994 | .627 | 0.921 | 0.876 |
| Spatial visual imagery | 3.763 | .690 | -.242 | 0.845 | 0.852 |
| Absorption | 3.611 | .612 | -.204 | 0.770 | 0.737 |

Table 2: Descriptives and reliability indices

6.4 Procedure

For all stimulus conditions, a 1 x 2 between-subjects design was used. In the linear text experiment, the experimental manipulation was the level of suspension of disbelief. Participants were sitting at the table and reading a text. Half of the participants were asked to read the text carefully and to look for mistakes. They were also told that, after reading, they have to report the mistakes. The other half was asked to read the text just as if they were reading a novel at home. They were told that, after reading, they would be asked how much they like the text. In the hypertext condition the participants were told to freely navigate through the environment. For the VE condition the participants’ task was to search for gold bars. For the film condition participants were told to see a film sequence.

The total duration of the presentation of each stimulus was 7-10 minutes. After the stimulus presentation, the participants were asked to fill out the above-mentioned questionnaires.

For all conditions, stimuli were presented in single experimental sessions.

Regression analysis was conducted to assess which personality factors were better predictors of Spatial Presence. Then, the General Linear Model Univariate procedure was applied in order to determine the interaction effects of personality predictors and experimental manipulations on Spatial Presence. The data of the four type of stimulus were analyzed separately. SPSS was used for all data analysis.

7. Result

7.1. Correlation between trait MEC-SPQ scales and NEO-FFI

Correlation coefficients were computed between three trait MEC-SPQ and five NEO-FFI scales. The results of the correlation analysis are presented in table 3. Results suggest that more extroverted participants scored higher on

spatial visual imagery. Participants who scored higher on neuroticism and openness also showed higher levels of absorption. Finally, those individuals who scored higher on conscientiousness showed higher domain-specific interest.

| | Domain-specific interest | Spatial visual imagery | Absorption |
|-------------------|--------------------------|------------------------|------------|
| Extraversion | .113 | .239** | -.032 |
| Neuroticism | .073 | .023 | .238** |
| Openness | -.026 | .075 | .365** |
| Agreeableness | .100 | .048 | .052 |
| Conscientiousness | .161* | .051 | .004 |

** Correlation is significant at .01; * Correlation is significant at .05

Table 3. Correlations between trait MEC-SPQ scales and NEO-FFI scales

7.2. Personality traits and Spatial Presence

Spatial Presence is represented by the mean value of “Spatial location” and “Possible actions” scales of MEC-SPQ. Spatial Presence mean is 2.681 and standard deviation equal to .852.

Correlation coefficients were computed between Spatial Presence and each trait MEC-SPQ scales and five personality factors from NEO-FFI. The results of the correlation analysis are shown in table 4.

| | Spatial Presence |
|--------------------------|------------------|
| Domain-specific interest | .310** |
| Spatial visual imagery | .116 |
| Absorption | .190** |
| Extraversion | .060 |
| Neuroticism | .052 |
| Openness | .011 |
| Agreeableness | .169** |
| Conscientiousness | -.048 |

** Correlation is significant at the 0.01

Table 4. Correlation between Spatial Presence and traits

Two multiple linear regression analysis using two unordered sets of predictors were conducted to predict Spatial Presence. One analysis included the five personality dimensions from NEO-FFI as predictors (Extraversion, Neuroticism, Agreeableness, Openness and Conscientiousness), while the second analysis included three trait factors of MEC-SPQ (Domain-specific interest, Absorption and Spatial visual imagery). The regression equation with trait factors of MEC-SPQ was significant $R^2 = .12$, adjusted $R^2 = .10$, $F(3, 236) = 10.68$, $p = .000$. However, the regression equation with five personality dimensions was not significant, $R^2 = .04$, adjusted $R^2 = .02$, $F(5, 234) = 2.22$, $p = .053$. Based on these results, trait factors of MEC-SPQ appear to be better predictors of

Spatial Presence.

Next, a multiple regression analysis was conducted with all eight trait scales as predictors. The linear combination of the eight measures was significantly related with Spatial Presence, $R^2 = .15$, adjusted $R^2 = .12$, $F(8, 231) = 5.23$, $p = .000$. Trait factors from MEC-SPQ predicted significantly over and above the personality dimensions of NEO-FFI, R^2 change = .11, $F(3, 231) = 9.83$, $p = .000$, but the five personality dimensions of NEO-FFI did not predict significantly over and above the trait factors of MEC-SPQ, R^2 change = .03, $F(5, 231) = 1.84$, $p = .105$.

Standardized Beta coefficients showed three factors for the predicting equation: domain-specific interest (Beta = .28, $t = 4.42$, $p = .000$), agreeableness (Beta = .15, $t = 2.34$, $p = .02$) and absorption (Beta = .14, $t = 2.04$, $p = .042$). Regression model is graphically represented in figure 4.

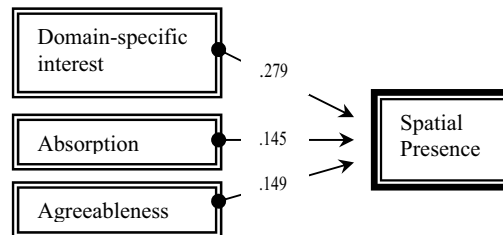


Figure 4: Regression model for Spatial Presence

Diagnoses of collinearity using tolerance coefficients showed that the scales are independent from each other, minimizing standard error (tolerance coefficients from .72 to .92).

7.3. Experimental manipulations and traits interactions on Spatial Presence

Four four-way analyses of variance (ANOVA) were conducted to analyze the effects of each four experimental manipulation on Spatial Presence. In any case, the dependent variable was the Spatial Presence and domain-specific interest, absorption, and agreeableness were recoded into three levels (low, medium and high) and included as factors.

Experimental manipulations for four type of stimulus are represented in table 5.

The first four-way ANOVA was conducted to evaluate the effects of three levels of domain-specific interest, absorption and agreeableness and two levels of text experimental manipulation (with vs. without SoD) on Spatial Presence. The ANOVA indicated no significant interactions between factors but significant main effects for text manipulation, $F(1,25) = 4.34$, $p < .05$, partial $\eta^2 = .15$. The text manipulation main effect indicated that participants who were encouraged to simply enjoy the text

without checking it for errors (with SoD) reported higher levels of Spatial Presence than those who were encouraged to make a critic reading (without SoD).

| Type of stimulus | Experimental condition | Spatial Presence mean | Standard deviation |
|------------------|------------------------|-----------------------|--------------------|
| Text | Without SoD | 2.087 | .74 |
| | With SoD | 2.400 | .56 |
| Hypertext | Small FoV | 2.654 | .65 |
| | Large FoV | 2.900 | .68 |
| Film | Small FoV | 2.534 | .91 |
| | Large FoV | 2.670 | .93 |
| VE | Small FoV | 2.865 | .95 |
| | Large FoV | 2.915 | .91 |

Table 5: Spatial Presence mean values per experimental condition

The second four-way ANOVA was conducted to evaluate the effects of three levels of domain-specific interest, absorption and agreeableness and two levels of hypertext experimental manipulation (large FoV vs. small FoV) on Spatial Presence. The ANOVA indicated no significant interactions between factors but significant main effects for domain-specific interest, $F(2,38) = 7.58, p < .005$, partial $\eta^2 = .28$. Follow-up analysis to the main effect for domain-specific interest examined all pairwise comparisons among three levels of domain-specific interest. The Tukey HSD procedure was used to control for Type I error across pairwise comparisons. The results of the analysis (see table 6) indicate that the group with low domain-specific interest (DSI) reported significantly less sense of Spatial Presence than people who report medium and high levels of domain-specific interest. There was no significant difference between medium and high levels of domain-specific interest.

The third four-way ANOVA was conducted to evaluate the effects of three levels of domain-specific interest, absorption and agreeableness and two levels of film experimental manipulation (large FoV vs. small FoV) on Spatial Presence. The ANOVA indicated three significant main effects for domain-specific interest, $F(2,38) = 6.42, p < .005$, partial $\eta^2 = .25$, absorption, $F(2,38) = 17.67, p < .001$, partial $\eta^2 = .48$ and agreeableness, $F(2,38) = 6.34, p < .05$, partial $\eta^2 = .14$. The ANOVA also indicated two two-level and one three-level significant interactions between factors, domain-specific interest*absorption interaction, $F(2,38) = 11.04, p < .001$, partial $\eta^2 = .37$, domain-specific interest*agreeableness interaction, $F(2,38) = 5.23, p < .05$, partial $\eta^2 = .22$, and domain-specific interest*absorption*agreeableness interaction, $F(2,38) = 6.39, p < .05$, partial $\eta^2 = .14$. Because a three-level interaction was significant, we choose to ignore low-level interactions and main effects. Follow-up tests were conducted to evaluate the eighteen pairwise comparisons (3x3x2). The Tukey HSD procedure

was used across pairwise comparisons. The results of the analysis indicate that the group with high domain-specific interest, high level of absorption and medium level of agreeableness reported significantly high sense of Spatial Presence (Mean = 4.75; S. Error = .47). The fourth four-way ANOVA was conducted to evaluate the effects of three levels of domain-specific interest, absorption and agreeableness and two levels of virtual environment experimental manipulation (large FoV vs. small FoV) on Spatial Presence. The ANOVA indicated no significant interactions between factors but significant main effects for domain-specific interest, $F(2,59) = 4.69, p < .05$, partial $\eta^2 = .14$. Follow-up analysis to the main effect for domain-specific interest examined all pairwise comparisons among three levels of domain-specific interest. The Tukey HSD procedure was used to control for Type I error across pairwise comparisons. The results of the analysis indicate that the group with low domain-specific interest reported significantly less sense of Spatial Presence than people who reported medium levels of domain-specific interest (see table 6). There was no significant difference between low and high levels and medium and high levels of domain-specific interest (DSI).

| Type of stimulus | Personality factor(s) main effects | Levels of factor | Spatial Presence means | Standard deviation |
|------------------|------------------------------------|------------------|------------------------|--------------------|
| Hypertext | DSI | Low | 2.25 | .48 |
| | | Médium | 2.91 | .60 |
| | | High | 3.17 | .69 |
| VE | DSI | Low | 2.59 | .82 |
| | | Médium | 3.57 | .84 |

Table 6: Spatial Presence mean values for personality main effects on hypertext and VE conditions

8. Discussion

Our results showed that three personality variables (i.e., domain specific interest, absorption and agreeableness) were associated with Spatial Presence. There was a positive correlation between Spatial Presence and domain specific interest for three of the four conditions. Even though all the differences between groups with low, medium and high level of domain specific interest were not significant in the hypertext, film and VE conditions, there was some indication that subjective sense of Spatial Presence increases with increasing domain specific interest. Results of the film experiment also indicate that higher levels of absorption and agreeableness are associated with higher levels of Spatial Presence.

Two of the three trait factors of the MEC-SPQ (i.e., domain specific interest and absorption) were significantly associated with Spatial Presence. Visuo-spatial imagery

was not correlated with presence reflecting perhaps the fact that questionnaires are not a sensitive enough method to detect differences in visualization abilities.

The results suggest that when users are interested in the topic of the media stimulus, they are more motivated to pay attention to the stimulus, and thus as a result, experience higher levels of Spatial Presence. It was reasonable to hypothesize that domain specific interest would play a more prominent role when using low-immersive media stimuli such as linear text. Surprisingly, the effect was significant only for the hypertext, film and VE stimuli, not for the linear text stimulus. The role of domain specific interest might be the larger the more specific the topic of the stimulus. Since the media stimuli we used here were commercial products and of general interest, its role was perhaps smaller than if we had used stimuli that are of less general interest.

Absorption was significantly associated with Spatial Presence, and in the film-stimulus condition the group with high level of absorption experienced higher levels of Spatial Presence. The finding that those people who have a higher tendency to dwell on the experiences and on the media objects themselves experience higher levels of Spatial Presence in the film-stimulus condition is consistent with previous studies. Recently, Sas [23] found a significant association between absorption and presence, and Laarni et al. [24] showed that presence correlated significantly with self-transcendence which, in turn, has shown to be related to absorption [25].

Only one factor of the Big Five (i.e., agreeableness) was associated with Spatial Presence. Those people who get high scores on agreeableness are typically altruistic, helpful, friendly, tenderminded, credulous and empathetic; those people who get low scores are, in turn, typically selfish, distrustful, competitive and antagonistic. It is possible that those users who get high scores on this scale are more eager to suspend of disbelief and adapt to the media world. Empathy is typically characterized as a state in which a person is able to perceive accurately the internal reference frame of another person and be in-tune with him/her. Even though empathy is then normally considered when talking about interpersonal relations, it is also possible to feel empathetic to non-living objects such as different types of media stimuli. Empathy has shown to be typical to those who get high scores on agreeableness [26], and it is possible that this ability is crucial for experiences of presence. Interestingly, Sas [23] found that empathy was positively associated with presence.

It is also possible that demand characteristics play a differential role for those who get high scores on agreeableness and for those who get low scores. Demand characteristics are a problem caused when participants can predict the response that is expected and they respond either in accord to or against those expectations. It is possible that high scorers on agreeableness are more

willing to respond in accord to expectations than those who get low scores. For example, when high scorers discovered the aim of the study, they tried to be helpful and gave higher presence ratings to the stimuli.

Contrary to our hypothesis, there was no association between openness to experience and Spatial Presence. This negative finding may reflect the fact that the Big Five's openness to experience is factorially complex [27]. For example, such aspects of the Openness to experience as intellectual curiosity and willingness to try new things are not necessarily associated with Spatial Presence, and they are not included into the absorption scale.

Overall, the Big Five personality factors seemed to contribute quite little to Spatial Presence. It is possible that personality factors, and user-related factors in general, play a minor role in Spatial Presence. Formal characteristics of the media and situational factors are much more important and can explain most of the variance in ratings. Another possibility is that our measures are not sensitive enough to show the effects of user-related factors on Spatial Presence. Especially, if personality factors exert their influence on the first stage of the construction of Spatial Presence, their effect is not easily seen if we measure the products of the second stage (i.e., Spatial Presence itself). A better approach would then be to study their effect on the first stage constructs (i.e., on attentional engagement and construction of spatial situation model).

We have recently suggested that the effect of user-related factors may interact in a complex way with the properties of media stimulus. For example, in case of low-immersive media such as radio and TV, the role of user-related factors may be larger than in case of complex interactive virtual environments [10]. The present results, however, do not provide much support to the claim that different aspects of personality would be important for different types of media stimuli. For example, it might be assumed that the effect of personality would be more prominent when using low-immersive media stimuli such as linear text, but this hypothesis was not supported. Different media properties such as FoV had not any effect on Spatial Presence. It may be possible that the difference between small and large FoVs (20° vs. 60°) was not large enough in the present study.

If state of presence is something that is worth to be gained, it might be a good idea to try to identify those people that are better able to experience presence and those who are not able to experience it at all [10]. For example, training in simulators or virtual therapy services could be directed to those people who are better able to get absorbed to experiences and who are more friendly and empathetic. However, much research has to be done before people can be chosen for these services on the basis of personality test results.

9. Conclusion

We have shown that some personality factors are important determinants of Spatial Presence. Especially, it was found that domain specific interest, absorption and agreeableness are positively associated with Spatial Presence. Users who are more interested in the topic of the stimulus, who are more prone to dwell on the experiences and who are more empathetic gave higher Spatial Presence ratings than those who had lower scores on these scales. The effect of domain specific interest was prominent for the hypertext, film and VE stimulus; the effect of absorption and agreeableness was the clearest for the film stimulus.

Overall, the present results provide some support for the underlying theoretical model of Spatial Presence which argues that domain specific interest and absorption have an impact on the formation of presence experiences

However, better empirical evidence is needed to show whether cognitive abilities (i.e. spatial visual imagery) play any role in the formation of presence.

Acknowledgements

This work has been supported by the European Community, Information, Society and Technology Program, within the research project "Presence: Measurement, Effects, Conditions (MEC)", IST-2001-37661 (<http://www.ijk.hmt-hannover.de/presence>). We thankfully acknowledge the European Community's support.

References

- [1] Steuer, J. (1992). Defining Virtual Reality: Dimension determining Telepresence. *Journal of Communication*, 42(4), 73-93.
- [2] Sheridan, T.B. (1992). Musings on telepresence and virtual presence. *Presence: Teleoperators and Virtual Environments*, 1(1), 120-125.
- [3] Draper, J.V., Kaber, D.B., & Usher, J.M. (1998). Telepresence. *Human Factors*, 40(3), 354-375.
- [4] Barfield, W., Zeltzer, D., Sheridan, T.B., & Slater, M., (1995). Presence and performance within virtual environments. In W. Barfield & T.A. Furness III (Eds.). *Virtual environments and advanced interface design* (pp. 473-513). Oxford: Oxford University Press.
- [5] Riva, G., Davide, F., & Ijsselstein, W.A. (2003). (Eds.), *Being there: concepts, effects and measurement of user presence in synthetic environments*. Amsterdam: Ios Press.
- [6] Wirth, W., Hartmann, T., Böcking, S., Vorderer, P., Klimmt, C., Schramm, H., Saari, T., Laarni, J., Ravaja, N., Gouveia, F. R., Biocca, F., Sacau, A., Jäncke, L., Baumgartner, T., & Jäncke, P. (submitted for publication). *A Process Model of the Formation of Spatial Presence Experiences*.
- [7] Lee, K.M. (2004). Presence, explicated. *Communication Theory*, 14, 27-50
- [8] ISPR (2001). *What is Presence?* [Online]. Available: <http://www.temple.edu/mmc/explicat.htm> [9.10.2002].
- [9] Heeter, C. (1992). Being there: The subjective experience of presence. *Presence*, 1(2), 262-271.
- [10] Sacau, A., Laarni, J., & Hartmann, T. (submitted for publication). *Influence of individual factors on Presence*.
- [11] Sas, C., & O'Hare, G.M.P. (2003). Presence equation: An investigation into cognitive factors underlying presence. *Presence: Teleoperators and Virtual Environments*, 12(5), 523-537.
- [12] Hartmann, T., Böcking, S., Schramm, H., Wirth, W., Klimmt, C., & Vorderer, P. (2005). Räumliche Präsenz als Rezeptionsmodalität: Ein theoretisches Modell zur Entstehung von Präsenzerleben [Spatial presence as modus of reception: A theoretical model]. In V. Gehrau, H. Bilandzic & J. Woelke (Eds.), *Rezeptionsstrategien und Rezeptionsmodalitäten* (pp. 21-37). München: R. Fischer.
- [13] 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.
- [14] McCrae, R.R. (Ed.). (1992). The five-factor model: Issues and applications [Special issue]. *Journal of Personality*, 60 (2).
- [15] Church, A. T. (1994). Relating the Tellegen and Five-Factor Models of personality structure. *Journal of Personality and Social Psychology*, 67, 898-909.
- [16] Bolger, N. & Zuckerman, A. (1995). A framework for studying personality in the stress process. *Journal of Personality and Social Psychology*, 69, 890-902.
- [17] Penley, J.A., & Tomaka, J. (2002). Associations among the Big Five, emotional responses, and coping with acute stress. *Personality and Individual Differences*, 32, 1215-1228.
- [18] Rose, C. L., Murphy, L. B., Byard, L., & Nikzad, K. (2002). The role of the Big Five personality factors in vigilance performance and workload. *European Journal of Personality*, 16, 185-200.
- [19] Nigg, J. T., John, O. P., Blaskey, L. G., Huang-Pollock, C.L., Willcutt, E, G. Henshaw, S. P., & Pennington, B. (2002). Big Five dimensions and ADHD symptoms: Links between personality traits and clinical symptoms. *Journal of Personality & Social Psychology*, 83, 451-469.
- [20] Ravaja, N., Saari, T., Kallinen, K., & Laarni, J. (in press). The role of mood in the processing of media messages from a small screen: Effects on subjective and physiological responses. *Media Psychology*.
- [21] Vorderer, P., Wirth, W., Saari, T., Gouveia, F. R., Biocca, F., Jäncke, L., Böcking, S., Schramm, H., Gysbers, A., Hartmann, T., Klimmt, C., Laarni, J., Ravaja, N., Sacau, A., Baumgartner, T., and Jäncke, P. (2004). *Development of the MEC Spatial Presence Questionnaire (MEC-SPQ)*. Unpublished report to the European Community, Project Presence: MEC (IST-2001-37661).
- [22] Costa, P. T. Jr., & McCrae, R. R. (1992). *Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) professional manual*. Odessa, FL: Psychological Assessment Resources.
- [23] Sas, C. (2004) Individual differences in virtual environments. In M. Bubak, G. Dick van Albada, P. Sloot

- & J. Dongarra (Eds.). *Computational Science - ICCS 2004, 4th International Conference, Kraków, Poland, June 6-9, 2004, Proceedings, Part III. Lecture Notes in Computer Science 3038* (pp. 1017-1024). Springer-Verlag.
- [24] Laarni, J., Ravaja, N., Saari, T., & Hartmann, T. (2004). Personality-related differences in subjective presence. In M. Alcañiz & B. Rey (Eds.). *Proceedings of the Seventh Annual International Workshop Presence 2004* (pp.88-95). Valencia: Ed.UPV.
- [25] Laidlaw, T.M., Dwivedi, P., Naito, A., & Gruzelier, J.H. (2005). Low self-directedness (TCI), mood, schizotypy and hypnotic susceptibility. *Personality and Individual Differences*, in press.
- [26] Ashton, M.C., Paunonen, S.V., Helmes, E., & Jackson, D.N. (1998). Kin altruism, reciprocal altruism, and the Big Five personality factors. *Evolution and Human Behavior*, *19*, 243–255.
- [27] Glisky, M.L., Tataryn, D.J., Tobias, B.A., Kihlstrom, J.F., & McConkey, K.M. (1991) Absorption, openness to experience, and hypnotizability. *Journal of Personality & Social Psychology*, *60*, 263-272.