Personality-related differences in subjective presence

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Abstract

Even though user-related variables are important determinants of presence, quite little is known about their role. The main aim of the present study was to examine differences in presence experience as a function of personality. Participants navigated through a multimedia presentation on a desktop computer. Half of them had the opportunity to navigate through the stimulus without interruptions, the other half were asked to generate random numbers whenever an audio signal occurred. Personality-related differences were shown to be an important determinant of presence. Especially, extraversion, impulsivity and self-transcendence were positively associated with presence ratings.

Keywords--- **Spatial Presence, personality, emotions, attention.**

1. Introduction

As complex media environments and virtual reality systems are becoming more popular, it is important to identify those people who are likely successful users of these systems [1,2]. Since there is evidence that feelings of presence are positively associated with performance in complex media environments, the task is to identify those people who are able to experience a higher sense of presence.

In fact, people seem to differ in their ability to experience presence, and characteristics of the media users are apparently important in determining the degree of presence feelings. However, as Lombard and Ditton [3] noted in their 1998 paper, very little research has been conducted on the question.

Several user-related variables are typically thought to have an impact on presence experiences, such as the user's willingness to suspend disbelief, her/his knowledge of and prior experience with the medium and adaptability to new circumstances [3,4]. For example, Slater and Usoh [5] found that quick adapters take greater notice of their environment and experience a greater sense of presence than slower adapters. Other possible characteristics of media users that may influence their presence feelings are personality type, domain specific interest, cognitive capabilities, mood, age, gender, social class and culture [1,3,4,6].

There is a lot of evidence that dimensions of personality, such as extraversion-introversion and anxiety-calmness, are related to different components of neural functions, information processing skills, knowledge and real-world adaptation [7]. Personality factors may thereby also exert influence on complex mental states such as perceived workload [8], situation awareness [9], flow experience [10], reality judgment [11] and presence.

Since presence experiences are typically related to the use of complex computer technologies, it can also be asked whether personality characteristics exert impact on the use of information technology. There is controversial evidence regarding this issue. On the one hand, there is evidence that personality factors are not important, and they are, for example, not able to predict computer performance [12]. On the other hand, personality traits, such as introversion-extraversion, are related to many aspects of human-computer interaction (for a review, see [13]). And as Stanney et al. [6] have noted, personality may become more important during more complex interactions such as those experienced in virtual environments.

1.1. Personality-related differences in sense of presence

What is common to most definitions of presence is that, first, presence is related to 'being there' in one environment, and second, presence is related to the 'perceptual illusion of nonmediation' [14]. Lessiter et al. [15] and Schubert et al. [16] found three factors that were related to the state of presence: 1) Spatial presence which means a sense of physical placement in the mediated environment, interaction and control over different parts of the environment; 2) engagement which consists of a tendency to feel psychologically involved and to enjoy the content; and 3) naturalness which means a tendency to perceive the mediated environment as lifelike or real. Wirth et al. [17] have recently presented a two-stage model of the formation of spatial presence experiences. According to their model, presence experience is based, on the one hand, on the feeling of being physically present in the mediated environment, and, on the other hand, on the ability to act in this environment.

People differ in their ability to get involved and immersed and to feel present in the mediated world [18].

For example, people differ in their ability to orient towards motivationally significant stimuli [19] and to divide attention between different stimuli [20]. Witmer and Singer [18] have presented evidence that these differences exert influence on people's presence feelings.

Several models of personality have been proposed that could potentially explain the differences in attentional engagement and presence experiences. Gray's [21,22] three-arousal model proposes the existence of three independent systems, the Behavioural Approach System (BAS), the Behavioural Inhibition System (BIS) and the Nonspecific Arousal System (NAS), each of which has a neurophysiological substrate of its own. The BAS is responsive to conditioned signals of reward and conditioned stimuli associated with the cessation of punishment fostering approach behavior towards motivationally significant stimuli [22,23]. The typical emotions are positive emotions such as hope and happiness. The BIS is responsive to secondary aversive stimuli, and it is also activated by extreme novelty [22,23]. Typical behaviors related to the BIS are stopping actions, scrutinizing the environment, passive avoidance and giving up behaviors that are not readily reinforced. The typical emotion is anxiety.

BIS activity is, thus, associated with negative affect and BAS activity with positive affect [24]. According to Gray [25], individual differences in the activity and responsiveness of the BIS and BAS systems determine two major personality dimensions. Because of higher impulsivity, high BAS people presumably concentrate less on low-immersive media stimuli such as hypertext. They may rush quickly through the site in the pursuit of new possibilities and thus experience a lower level of presence than low BAS individuals. Also, they may engage more in distracting stimuli, and thus attentional distraction and a secondary task may have a larger effect on their feelings of presence.

In fear of punishment, people who have high BIS activity may concentrate more on low-immersive media stimuli, and thus they may experience a higher state of presence than those who have lower BIS activity. On the other hand, attentional distraction and a secondary task may have a larger effect on their sense of presence.

Eysenck [26] differentiated three traits, extraversion-introversion, neuroticism-stability and psychoticism-superego, and considered them as the basic dimensions of individual differences. Extraverts engage in many external activities, because they are able to process many stimuli at the same time. They, thus, possess more processing resources or they are better in allocating their resources than introverts [27]. Because of this, it is possible that extraverts experience higher sense of presence than more introverted individuals. In addition, if extraverts have more processing resources available than introverts, attentional distraction and the need to divide attention between two stimuli may have a smaller effect on their sense of presence.

Also neuroticism-stability may contribute to presence feelings. In Avila's [28] study neurotics had more problems in shifting attention from new locations to previously revised locations. Neurotic introverts also had more problems in disengaging attention away from motivationally significant stimuli; neurotic extroverts, in turn, had more problems in disengaging attention away from positive stimuli. In general, neurotic people may thus experience a lower level of presence than those who are less neurotic, and a secondary task may have a larger detrimental effect on their sense of presence.

Zuckerman [29] defined sensation seeking as a trait defined by the seeking of novel and intense sensations and experiences and the willingness to take different kinds of risks for the sake of such experiences. Individuals who are high/low in sensation seeking may process information differently because of differences in arousal and attention. Those who score high on sensation seeking have better focused attention than low sensation seekers [31]. High sensation seekers may thus do better in a selective attention task for which certain stimuli must be attended to and others ignored; low sensation seekers, in turn, may do better in tasks that require them to divide their attention to several stimuli [30,31]. Overall, if high sensation seekers are better able to focus their attention to a particular media stimulus than low sensation seekers, they may experience a higher level of presence. Attentional distraction and a secondary task may also have a smaller effect on their sense of presence.

Impulsive individuals, in turn, are better able to shift attention throughout space [32]. Avila and Parcet [33], for example, have found that impulsive participants focused more on reward/expected targets than low impulsive individuals. Therefore, impulsive people may concentrate less on low-immersive media stimuli such as hypertext. Since they may rapidly navigate through the site in the pursuit of new possibilities, they may experience lower states of presence than those who are less impulsive. They may also pay more attention to distracting stimuli and allocate more attention to a secondary task than less impulsive people. As a result, the secondary task may have a larger detrimental effect on their sense of presence.

According to Cloninger et al. [34], self-transcendence refers generally to identification with everything considered as essential parts of a unified whole. This unitive perspective is described as acceptance, identification, or spiritual union with nature and its source. Self-transcendence has multiple aspects or stages: self-forgetfulness, transpersonal identification and spiritual acceptance. Self-transcendence, particularly self-forgetfulness, should be positively associated with dimensions of presence.

1.2. Aims of the present study

The main aim of the present study was to examine differences in presence experience as a function of personality. Another aim of the study was to investigate the relationships between different personality traits and the tendency to get involved and immersed in the mediated world.

It is possible that people who are more prone to experience positive or negative emotions have a tendency to focus attention more tightly to a stimulus that they are inclined to engage in, and then as a result, they will experience a higher level of presence. We hypothesized that experiences of presence, i.e. spatial presence and attentional engagement, are positively associated with high BIS activity, extraversion, sensation seeking and self-transcendence.. Presence would, in turn, be negatively associated with high BAS activity and impulsivity. We also expected that the secondary task would have a larger detrimental effect on presence for high BIS and BAS individuals, introverts, impulsive people and high sensation seekers.

In order to experimentally induce different levels of presence a dual-task method was used. We assumed that the secondary task will reduce the amount of attentional resources that subjects can allocate to the processing of the media stimulus, which will then reduce the level of presence they experience.

2. Method

2.1. Participants

Eighty volunteers participated in the experiment (51 females, 29 males). The mean age of the participants was 24 with a range between 18 and 39. They were ignorant of the purpose of the study before participating. Participants were selected in the order of their announcement to an email message. They were paid for their participation (each one received two movie tickets, total value about 13€).

2.2. Stimulus

'The Art of Singing' CD-ROM (Nothing Hill Publishing Limited 1996) based multimedia stimulus was applied. It is a commercial multimedia presentation 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 stimuli were generated on the face of Apple Multiple Scan CRT (17' in diameter) with a Power MacIntosh 7200/90 computer. The number of color was set to 256, and the screen resolution was set to 800 x 600. Sounds were presented through Multimedia Speakers (SP-628). A standard computer mouse was used for input.

In the dual-task condition, the distracting audio signals were presented through loudspeakers that were located behind a participant. Five different signals (e.g., alarm, train and school bell) were used. They were presented in a random order with random intervals between the single signals. There were 12 signals in a 10-minute test session.

2.3. Procedure

A between-subjects design was used; half of the participants had the opportunity to navigate through the hypertext presentation without interruptions, the other half of the participants were asked to generate 3-digit random numbers whenever a defined signal occurred during the reception of the media stimulus. This task reduced the amount of attentional resources that participants could devote to the processing of the stimulus.

2.4. Presence measures

2.4.1. MEC-SPQ The MEC Spatial Presence Questionnaire (MEC-SPQ) consists of nine scales that measure the different concepts integrated in Wirth et al.'s [17] theoretical model. It includes process factors (Attention Allocation, Spatial Situation Model, Self Location and Possible Actions), variables relating to states and actions (Higher Cognitive Involvement and Suspension of Disbelief) and trait variables (Domain Specific Interest, Visual Spatial Imagery and Absorption). The items related to spatial presence experiences, i.e., Self Location and Possible Actions, were analyzed, and their scores were summed before they were entered into the analysis. Two of the three trait variables (Domain Specific Interest and Visual Spatial Imagery) were also entered into an analysis that considered the possible relationships between attributes of immersive tendency and other individual traits.

2.4.2. ITC-SOPI Since the initial English version of MEC-SPQ was used in this study, the participants also filled out another presence questionnaire, the Independent Television Commission Sense of Presence Inventory (ITC-SOPI), which has been widely applied in presence studies [15]. The ITC-SOPI measures four dimensions of presence: 1) Sense of physical space which means a sense of physical placement in the mediated environment, interaction and control over different parts of the environment; 2) Engagement which consists of a tendency to feel psychologically involved and to enjoy the content; 3) Naturalness which means a tendency to perceive the mediated environment as lifelike or real; and 4) Negative effects, that is, a tendency to have adverse physiological reactions [15]. The ITC-SOPI consists of 43 items. It is recommended that each scale is analyzed separately, since each scale is differentially sensitive to manipulations of particular determinants of presence. Only Sense of physical space, Engagement and Naturalness subscales were used in this study.

2.5. Trait measures

2.5.1. Immersive Tendencies Questionnaire (ITQ) Witmer and Singer's [18] Immersive Tendencies Questionnaire (ITQ) is aimed to examine individual differences in the ability to experience presence. It thus

concentrates on the user characteristics. For example, it aims to measure the capability or tendency to be involved or immersed, and the ability to focus on a particular activity. It consists of three subscales, Focus, Involvement and Games. According to Witmer and Singer [18], the Focus items are related to mental alertness, participants' ability to concentrate on enjoyable activities and their ability to block out distractors. Involvement items, in turn, are related to the participants' propensity to get involved passively in some activity; and the Games items are asking how frequently participants play video games and whether they get involved to the extent that they feel they are inside the game. Some studies have found a significant correlation between presence ratings and ITQ scores [18].

2.5.2. BIS/BAS scales The BIS/BAS Scales are a 20 item self-report questionnaire assessing individual reactivity to reward and punishment [35]. It includes four subscales: 1) BIS (fearfulness and reactivity to negative events), 2) Drive (the persistent pursuit of goals), 3) Fun Seeking (the desire for novel rewards and the inclination to eagerly approach such rewards), and 4) Reward Responsiveness (the positive reaction to reward and its anticipation). The global BAS score was the sum of Drive, Fun Seeking and Reward Responsiveness scores. BIS items are aimed to reflect the experience of anxiety in situations in which there are signs of possible punishment. BAS items tap a strong pursuit of goals, responsiveness to rewards, a tendency to seek out new potentially rewarding experiences and to act quickly in the pursuit of desired goals.

2.5.3. Eysenck Personality Questionnaire-Revised, Short Form (EPQ-R Short) The EPQ-R Short [36] is a 48 item self-report questionnaire assessing extraversion (E), neuroticism (N) and psychoticism (P). The EPQ's scales have been revised several times while attempting to produce scales that assess orthogonal and reliable personality dimensions [37].

2.5.4. Zuckerman-Kuhlman Personality Questionnaire-ImpSS (ZKPQ-ImpSS) The original Zuckerman-Kuhlman Personality Questionnaire (ZKPQ) is a 99-item questionnaire aimed at the evaluation of the five-factor model [29]. The impulsivity and sensation seeking scales comprise 19 items. The impulsivity items describe a lack of planning and a tendency to act impulsively without thinking; the sensation seeking items describe a general need for thrilling and exciting experiences, a preference for unpredictable situations and friends and the need for change and novelty.

2.5.5. Self-Forgetful vs. Self-Conscious Experience scale The self-forgetfulness trait was measured with the 11-item Self-Forgetful vs. Self-Conscious Experience subscale of the Self-Transcendence scale included in the Temperament and Character Inventory (TCI) [34]. The TCI is a self-report personality questionnaire based on Cloninger's psychobiological model of personality [34].

2.6. Data analysis

Since there were both categorical and continuous independent variables, the data were analyzed using the General Linear Model Univariate/Multivariate procedure in SPSS (Statistical Package for the Social Sciences).

Continuous independent variables were used as covariates while Condition was used as a between-subjects variable. MEC-SPQ's Spatial presence and ITC-SOPI's Sense of Physical Space, Engagement and Naturalness scales were used as dependent measures. Multiple regression analyses were used to investigate the relationships between the Immersion Tendency Questionnaire and different individual traits.

3. Results

To investigate the relationship between presence scales and different personality-related scales a series of multivariate ANOVAs was carried out. The mean scores, standard deviations and Cronbach alpha coefficients for all the predictor and outcome variables are presented in Table 1. The scores for those who participated in the single-task and dual-task condition are presented separately. Except for the Psychoticism subscale (Cronbach's alpha = 0.43), the alpha coefficients for all predictor variables were high ranking from 0.74 to 0.84. The alpha coefficients for outcome variables were also high ranking from 0.77 to 0.95.

3.1. BIS/BAS scales

BAS had a significant main effect in predicting Engagement, $F(1,75) = 5.3$, $p < 0.05$. BAS was negatively associated with Engagement: the participants who had high BAS scores felt less engaged than those who had lower scores. The Condition x BAS interaction was significant for all scales, Spatial Presence (MEC-SPQ): $F(1,75) = 5.4$, $p < 0.05$; Sense of Physical Space (ITC-SOPI): $F(1,75) = 6.4$, $p < 0.05$; Engagement: $F(1,75) = 12.6$, $p < 0.001$; Naturalness: $F(1,75) = 9.9$, $p < 0.01$. The secondary task had a different effect on high and low BAS participants. For low BAS participants the sense of spatial presence, engagement and naturalness were higher in the dual-task condition, while for high BAS participants feelings of presence, engagement and naturalness were higher in the single-task condition.

BIS had no significant effect in predicting presence, $p > 0.1$. The Condition x BIS interaction was, however, significant for the three scales of the ITC-SOPI, Sense of Physical Space: $F(1,75) = 5.0$, $p < 0.05$; Engagement: $F(1,75) = 11.6$, $p < 0.001$; Naturalness: $F(1,75) = 9.1$, $p < 0.01$. This interaction approached significance for MEC-SPQ's Spatial Presence scale: $F(1,75) = 3.7$, $0.05 < p < 0.1$. For high BIS participants, the secondary task had

Table 1. The mean scores, standard deviations and Cronbach alpha coefficients for the predictor and outcome variables.

	Single Task		Dual Task		Cronbach's
	Mean	SD	Mean	SD	Alpha
BIS/BAS Scale					
BIS	2.10	0.54	2.10	0.54	0.76
BAS	1.97	0.38	1.93	0.35	0.74
EPQ					
Psychoticism	2.40	1.72	2.40	1.63	0.43
Extraversion	7.58	3.05	7.68	3.35	0.83
Neuroticism	5.68	3.19	5.10	2.65	0.76
ImpSS					
Impulsivity	2.99	0.76	2.85	0.78	0.84
Sensation Seeking	3.16	0.77	3.23	0.65	0.84
Self-Transcendence	3.18	0.77	3.00	0.68	0.84
ITQ					
Focus	4.91	0.73	4.64	0.66	0.80
Involvement	4.80	1.08	4.60	0.97	0.77
Games	3.89	6.11	2.96	1.45	0.78
MEC-SPQ					
Spatial Presence	2.56	0.73	2.39	0.81	0.95
ITC-SOPI					
Spatial Presence	2.35	0.67	2.21	0.61	0.92
Engagement	3.13	0.75	2.78	0.75	0.92
Naturalness	2.57	0.81	2.51	0.69	0.77

a large detrimental effect on the sense of spatial presence, engagement and naturalness; for low BIS participants, the effect was much smaller, however.

3.2. EPQ scales

Extraversion was positively associated with Spatial Presence, Spatial Presence (MEC-SPQ): $F(1,76) = 5.9$, $p < 0.05$; Sense of Physical Space (ITC-SOPI): $F(1,76) = 7.2$, $p < 0.01$. That is, the extraverts had higher scores on presence scales than those who were more introverted. The association between Extraversion and Engagement and between Extraversion and Naturalness approached significance, Engagement: $F(1,76) = 4.0$, $0.05 < p < 0.1$; Naturalness: $F(1,76) = 3.4$, $0.05 < p < 0.1$. Neuroticism and Psychoticism had no significant effects in predicting presence, all p's > 0.1.

3.3. ImpSS scale

Impulsivity had a significant main effect in predicting Engagement, $F(1,73) = 4.1$, $p < 0.05$, and the association between impulsivity and engagement was positive in nature. The effect of Impulsivity on Spatial Presence (MEC-SPQ) approached significance, $F(1,73) = 3.6$, $0.05 < p < 0.1$. None of the other effects were significant, all p's > 0.1.

3.4. Self-forgetfulness scale

Self-forgetfulness had a significant main effect in predicting Spatial Presence and Engagement, Spatial Presence (MEC-SPQ): $F(1,75) = 8.9$, $p < 0.01$. Sense of Physical Space (ITC-SOPI): $F(1,75) = 7.7$, $p < 0.01$; Engagement: $F(1,75) = 15.2$, $p < 0.001$. Self-forgetfulness was positively associated with Spatial Presence and Engagement.

3.5. ITQ scales

Focus had a significant main effect on Spatial Presence and Engagement, Spatial Presence (MEC-SPQ): $F(1,76) = 16.4$, $p < 0.001$; Sense of Physical Space (ITC-SOPI): $F(1,76) = 11.7$, $p < 0.001$; Engagement: $F(1,76) = 14.4$, $p < 0.001$. The correlation between Focus and presence scales was positive. Involvement had a marginally significant effect in predicting Engagement, $F(1,76) = 3.2$, $0.05 < p < 0.1$.

3.6. Relationships of personality measures with the Immersive Tendency Questionnaire (ITQ)

Multiple regression analyses were carried out separately for the three dependent variables (Focus, Involvement and Games). A stepwise approach that

enters the variables into the equation according to the strength of their association with each primary dependent variable was used. Predictor variables included BIS, BAS, Extraversion, Neuroticism, Psychoticism, Impulsivity, Sensation Seeking, and Self-Forgetfulness. Also, Domain Specific Interest and Spatial Imagery Ability from the MEC-SPQ were entered into the analysis.

The multiple regression analysis showed that the predictor variables together explained 31% of the variance in the Focus, $F(3,74) = 11.0$, $p < 0.001$ (adjusted $R^2 = 28\%$). Three variables contributed statistically significantly to the equation, Self-Forgetfulness ($\beta = 0.40$, $p < 0.001$), BIS ($\beta = 0.22$, $p < 0.05$) and Extraversion ($\beta = 0.22$, $p < 0.05$).

The predictor variables together explained 33% of the variance in the Involvement, $F(3,74) = 12.3$, $p < 0.001$ (adjusted $R^2 = 31\%$). Again, the same three variables met the inclusion criteria and contributed significantly to the regression equation, Self-Forgetfulness ($\beta = 0.40$, $p < 0.001$), BIS ($\beta = -0.35$, $p < 0.001$) and Extraversion ($\beta = 0.21$, $p < 0.05$).

Regression analyses predicting the Games dimension showed that the predictor variables together explained 7% of the variance, $F(1,74) = 5.1$, $p < 0.05$ (adjusted $R^2 = 5\%$). The only variable that met the inclusion criteria was Impulsivity, $\beta = -0.26$, $p < 0.05$.

4. Discussion

Our results suggest that personality-related variables influence subjective presence. Especially, BIS/BAS scales were quite successful in predicting presence ratings. In accordance with the hypotheses, the BAS scores were negatively correlated with Engagement. That is, those who had higher scores on BAS felt less engaged than those who had lower scores. It was also found that those who had high BAS activity were more engaged in the single-task condition than in the dual-task condition, and the secondary task had a large detrimental effect on their sense of engagement. Contrary to that, those who had lower BAS activity were even more engaged in the media stimulus in the dual-task condition than in the single-task condition. Perhaps, in order to keep the performance at the same level in the divided attention condition, the low BAS participants tried to attend more tightly to the media stimulus and allocated more attentional resources to the task. They were presumably also more worried about their performance than those who had higher BAS activity.

Even though BIS had not a significant main effect in predicting presence, the interaction between BIS and Condition was significant, however. The difference in presence feelings between conditions was larger for those who had a higher BIS activity. Since the high BIS participants presumably felt themselves more anxious when the demands of the task were increased, they reported considerably lower levels of spatial presence and engagement in the dual-task condition.

As hypothesized, extraverts had higher scores on presence scales than those who felt themselves more introverted. If extraverts have more processing resources than introverts, they may process more information per time unit and thus feel more present in a mediated environment. Contrary to the hypotheses, neurotics did not experience a lower level of presence than those who are less neurotic.

Overall, the EPQ scales were not very successful in predicting presence. Impulsivity was, however, positively associated with presence. It is possible that the positive effect of impulsivity is related to the amount of processing resources available. As in case of extraverts, impulsive individuals may have more processing resources than less-impulsive people, and thus, they may be able to engage more deeply in a mediated environment.

The effect of self-transcendence is quite clearcut. Self-forgetfulness and transpersonal identification seem to be important determinants of subjective presence. Those who get high scores on these scales are better able to identify themselves with a media stimulus.

Witmer and Singer's [18] ITQ has been developed to examine individual differences in state of presence. If higher scores on these scales reflect a greater tendency to become involved or immersed, then those participants who score high on these scales should report more presence. In fact, Witmer and Singer [18] have found a positive correlation between ITQ and presence. Both the Focus and the Involvement subscales of the ITQ were positively associated with Extraversion and Self-Transcendence. In general, extraversion and some kind of self-forgetfulness seem to be associated with the ability to focus one's attention to the mediated environment and the ability to get involved with media stimuli.

There are two types of breaks in presence: First, our attention may be shifted away from the mediated environment towards the real world; second, attention may be shifted away from media stimuli to internal thoughts [38]. In the present study, the participants, thus, had to assign a priority to responding, on the one hand, either to stimuli from the real world or to stimuli from the hypertext, and on the other hand, either to environmental stimuli or to those stimuli that seem to be internal. How much they at every moment paid attention to these different types of stimuli may, at least in part, depend on personality factors. For example, both anxious and impulsive participants may have had difficulties in focusing attention on hypertext stimuli because of greater distractability by audio signals and peripheral stimuli. Moreover, since it was necessary to succeed in the secondary task, they were perhaps less eager to focus on neutral hypertext stimuli, and instead paid more attention to distracting audio signals.

Attentional processes thus seem, at least in part, play a mediating role between personality and presence: People differ in their ability and willingness to pay attention to the mediated world, and these differences exert influence on people's presence feelings. The

results, however, do not give a definitive answer to the question by which way the effect of personality factors is mediated. For example, according to the two-stage model of Wirth et al., there are several possible mediated factors that exert influence on the sense of presence [17]. More information can be gathered by investigating the relationship between more objective indicators of presence and personality. In the future, we will more systematically study the effect of personality variables on different dimensions of the MEC-SPQ. Our aim is also to investigate the impact of personality on presence experiences in different types of media environments.

Conclusions

Since presence is a subjective phenomenon, characteristics of individuals apparently influence presence [18]. Our study is one of the first ones to show that personality-related factors are an important determinant of presence. Especially, extraversion, impulsivity and self-transcendence were positively associated with presence. Attentional processes seemed to play a mediating role. People who got high scores on these scales paid more attention to the media stimulus and were also more deeply involved in the mediated environment.

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