Exploring the Book Problem:

Text Design, Mental Representations of Space, and Spatial Presence in Readers

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Abstract

Based on the MEC model of Spatial Presence, an experiment (N = 34) was conducted that explores the development of Spatial Presence in readers of text. Two techniques for text writing that may facilitate Spatial Presence were derived from the model and implemented in the stimulus production: the number of verbal spatial descriptions (cues) was varied (low versus high), and one text version included repeated instructions to imagine the portrayed space as vividly as possible. Findings indicate that the mental representation of described spaces is more vivid if much space-related information is presented by the text, but Spatial Presence is higher if less spatial cues are provided. These partially surprising results are discussed with respect to the MEC model and future directions of cross-media theorizing about Spatial Presence.

Keywords--- **Spatial Presence, Book Problem, Experiment, Measurement, Questionnaire**.

1. Introduction: The Book Problem

Historically, research on Spatial Presence has focused on powerful new media technologies that are very obviously capable to create an illusion of "being there", such as virtual environments or IMAX theaters. More recently, the emergence of Presence has also been hypothesized in the context of less immersive media, such as television [1]. Even books have been assumed to elicit the experience of Presence in their readers [2]. One argument for the capacity of books to induce a sense of Presence is the amazing aesthetic experience of literary texts that often include detailed and vivid portrayals of spatial configurations. If Spatial Presence can occur in users of non-immersive media such as books, however, direct sensory experience cannot be the only mechanism of Presence. For readers, perceptual processes are apparently less important for the facilitation of Spatial Presence than higher-order mental activities such as cognitive involvement and imagination. By stimulating those higher-order processes, text and small-screen media may be capable to compensate for their lack of power in terms of creating an illusion of "being there". The goal of this study was to investigate readers in order to explore those mechanisms of Spatial Presence that do not rely on sensory experience, but on imaginary processes. As a theoretical framework, we employed the MEC Model of Spatial Presence, as it predicts the emergence of Presence under conditions of low immersion and the absence of direct sensory input (see section 2.). Hypotheses derived from this model were experimentally tested (3.). The obtained results (4.) allow for some interesting progress in the explanation of the book problem (5.).

2. Spatial Presence in Readers: The MEC Model

The conceptual model of Spatial Presence advanced by Vorderer et al. [3] explains the occurrence of Presence as a two-step process (see figure 1). It explicitly covers Presence phenomena across different media and is applicable to information processing and Presence experiences during reading. According to the model, readers generate a mental representation of the spatial environment portrayed in the text. They do so by processing the space-related information included in the text (bottom-up component) and by adding spatial images and space-related knowledge that was already available to their mind before exposure to the text (top-down component). Readers combine text-based and knowledge-based information to create a so-called spatial situation model (SSM) of the described environment. For example, readers of a travelogue form a

mental representation of how the beautiful valley the author has written about would look like. This mental imagination is the first step in the formation of Spatial Presence.

However, the mere existence of an SSM is not the same as the experience of Presence. According to Vorderer et al. [3], Spatial Presence occurs only if the individual considers him/herself to actually be located within the space that is represented in the SSM (and does no longer believe to be part of the non-mediated, real environment). Spatial Presence means to accept the mediated environment as personal reality or "primary ego-reference frame" (PERF; [4]), to which one's thinking and (imagined or factual) actions are directed. Just imagining how the nice valley would look like is not enough to feel Spatial Presence, then; rather, people have to regard themselves to be located in that valley.

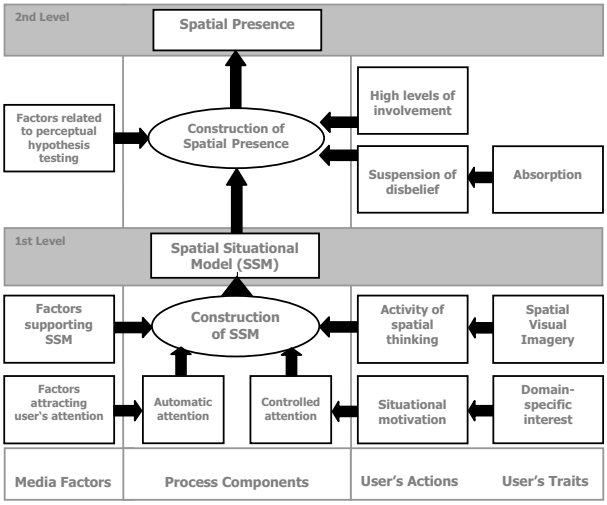

Figure 1 MEC Model of Spatial Presence

The transition from the SSM to the actual experience of Presence is explained through the theory of perceptual hypotheses [5]. Once the processing of mediated information has allowed for the creation of a rich, consistent and enduring SSM, people test the perceptual hypothesis that the space represented in the SSM is their actual surrounding (the so-called medium-as-PERF-hypothesis). If they accept this hypothesis, Spatial Presence emerges; if they reject it, they remain at the stage of having a vivid spatial impression in the mind's eye but still perceiving themselves as part of their real surrounding. Both media and personological factors determine whether in a given situation the medium-as-PERF-hypothesis is accepted (=formation of Spatial Presence) or rejected (= failure to reach the stage of Spatial Presence).

One of the most prominent stimulus characteristics related to spatial perception and Presence is spatial cues [6]. They allow users to identify boundaries and other spatial structures in the stimulus field. Most spatial cues address the visual (e. g. [7]) or the auditory [8] modality. Spatial cues may be inserted in written language as well. Verbal descriptions of spatial structures do not trigger perceptual processes such as the visual identification of an edge, but rather stimulate space-related cognitions based on existing knowledge structures. Textual spatial cues do not provide direct information on the spatial attributes of the portrayed environment, but inform the readers about which (class of) spatial cognitions they should retrieve from their memory to complete their SSM [3]. The quantity and quality (e. g., comprehensibility) of verbal spatial cues should therefore influence the richness and vividness of readers' SSM, which consequently would also affect the outcome of the readers' test of the medium-as-PERF-hypothesis, because a rich and vivid SSM increases the probability that the individual will perceive him-/herself to be located in the environment represented in the SSM. The way in which a text describes spatial structures would then have an indirect impact on the emergence of Spatial Presence.

As higher-order processes such as imaginations are presumed to be most important in the development of Presence during the consumption of text-based media [3], the inclusion of verbal spatial cues is not the only technique of message design relevant to the 'book problem'. The individual's motivation to be absorbed in a book's world and to have intense experiences during reading may affect those higher-order processes [9]. Interested, open-minded readers may engage more actively in imagining the book's world and thus insert more and very vivid spatio-visual information from their memory to the SSM [3]. From the perspective of text design, this assumption would suggest to insert phrases that animate readers to engage in (spatial) imagination as actively as possible. Such appeals may increase readers' attention to the text's spatial cues (which is a pre-condition of the development of an SSM, see [3]), would motivate them to make more active-cognitive contributions to the top-down processes involved in the formation of the SSM, and, most importantly, could make readers actively directing the test of the medium-as-PERF-hypothesis towards the acceptance of the mediated space as PERF (i. e., Spatial Presence) by actively searching for information confirming the hypothesis and suppressing contradicting information. Because of these multi-level effects, imagination instructions in a text are hypothesized to cause a higher probability of Spatial Presence in readers.

In sum, the MEC model allows to elaborate two cognitive processes which specify the "reader imagination" that leads to Spatial Presence. One is the construction of a mental representation of space (SSM) that partly builds on spatial descriptions in the text, and the other is the motivated active imagination of the portrayed space that benefits from vivid spatial memories and a less critical evaluation of the text's spatial description (support of the medium-as-PERF-hypothesis). According strategies of text design can create Spatial Presence in readers: One such strategy is the inclusion of a sufficient *amount and quality of spatial-verbal descriptions (cues)*, and the other is the

repeated invitation to engage in spatial imagination as actively as possible.

3. Method

To test the assumptions that more spatial descriptions and imagination instructions increase Spatial Presence in readers, an experiment with three conditions was conducted. A text portraying a museum was produced and experimentally varied with respect to the number of spatial cues (very few cues versus many cues) and to the number of encouragements to imagine the museum as vividly as possible (no encouragement versus repeated encouragements). Presence was measured after reading the text with the MEC Spatial Presence Questionnaire (MEC-SPQ; [10]; see 2.2.).

3.1. Stimulus materials

A text describing a visitation of a Mozart Museum was produced in three different versions. All versions were in German language and based on the same master document. The described spatial structure contained one large entry hall and two additional stories with one hall and three exhibition rooms each. The different levels were connected by stairways. All halls and rooms were portrayed in the text. The manipulation of the independent variables *verbal spatial cues* and *imaginary encouragement* was realized by adding information to the basic text (version number 1). Version number 1 contained only a very small number of spatial cues, whereas version number 2 contained a large number of spatial cues. The following examples illustrate the differences between these two versions:

Example of version 1: *"The entrance hall with a dark, wooden floor, decorated with a dark red carpet, holds a warm atmosphere, although there are only a few objects in it."*

Corresponding example of version 2: *"The entrance hall with a dark, wooden floor, decorated with a dark red carpet, holds a warm atmosphere, although there are only a few objects in it. It is 30 meters long, 15 meters wide and five meters high."*

Version number 3 contained the same (large number of) spatial cues as version number 2, but included repeated encouragements to imagine the museum as vividly as possible.

Example of version 2: *"The second floor starts with a long and narrow hall, covered by a wooden floor, a red carpet and several paintings of young Mozart on the grey walls."*

Corresponding example of version 3: *"Try to imagine this floor as precisely as possible: The second floor starts with a long and narrow hall, covered by a wooden floor, a red carpet and several paintings of young Mozart on the grey walls."*

3.2. Dependent Measures

After reading the text, the participants completed the MEC Spatial Presence Questionnaire (MEC-SPQ; [10]). This survey tool is based on the model of Spatial Presence experiences proposed by Vorderer et al. [3] and has been developed according to standard social scientific scale development and validation processes [10]. The MEC-SPQ measures each of the following constructs which are supposed to be involved in the experience of Spatial Presence [3] by five-point Likert scales. On the whole, all scales revealed very satisfactory internal consistencies. Two items of the involvement scale and one item assessing SoD were excluded because of low item remainder coefficients. The numbers of items and Cronbach´s alpha values are reported in brackets:

- *Attention Allocation (8 items; α=.86)*
- *Spatial Situation Model (SSM) (8 items; α=.87)*
- *Spatial Presence: Self Location (SPSL) (8 items; α=.92)*
- *Spatial Presence: Possible Actions (SPPA) (8 items; α=.94)*
- *Higher Cognitive Involvement (6 items; α=.71)*
- *Suspension Of Disbelief (SoD) (7 items; α=.92)*
- *Domain Specific Interest (DSI) (8 items; α=.89)*
- *Visual Spatial Imagery (VSI) (8 items; α=.85)*

The complete questionnaire can be obtained from www.presence-research.org.

3.3. Sample and Procedure

34 students participated in the study. Each person was randomly assigned to one of the three experimental groups (between-subject design). Versions 1 and 3 of the text were read by 12 participants each, Version 2 was read by 10 subjects. The mean age of the participants in the groups was between 24 and 25 years. The groups were nearly equalized by gender.

The participants were invited individually to a quiet room with controlled lighting conditions and were asked to read the stimulus text for seven minutes at normal pace. They were told that the research was conducted to find out more about general experiences of media users during the reception of texts. They were also informed that there was no need to read the text completely in seven minutes; rather, subjects were suggested to read "just like they would do at home". After seven minutes were over, participants completed the MEC-SPQ, were informed in more detail about the research interest (the measurement of Spatial Presence), received 10 EUR as compensation, and were thanked and dismissed.

4. Results

Most participants (n=26) read four or five pages of the text, four subjects stopped their reading on the third page, and another four subjects managed to read six pages (M=4.47, SD=.86). When the amount of text increased due to additional spatial cues or instructions, the average number of pages that were read slightly decreased (few spatial cues, M=4.67; many cues, M=4.50; many cues + instructions, M=4.25). However, these differences were not significant.

Overall, domain specific interest (DSI) for the presented topic was rather low (M=2.35, SD=.80), but did not significantly differ between the experimental groups. Self-reported scores for visual spatial imagery (VSI) were nearly distributed normally (M=3.41, SD=.73) and very similar across all three groups.

Mean score for attention was M=3.69 (SD=.68), with none of the participants scoring lower than 2.0 on the attention scale. These results indicated that most participants focused their senses on the text (as a basic requirement for initiating spatial presence experiences). The text version with many spatial cues and additional instructions yielded the highest attention score (M=3.90), followed by the basic text version with few spatial cues

(M=3.75) and the "medium" text version (M=3.35). These differences were not significant, and no substantial influence of domain specific interest on attention was observed (r=-.01, n.s.)

With regard to building a spatial situation model (SSM), participants reported a mean score of M=2.86 (SD=.69). Obviously, the experimental manipulation of the text was successful at this pre-level of spatial presence experiences (see figure 2). Readers of the basic text version with few spatial cues scored lowest on SSM (M=2.51). A large number of spatial cues evoked a more intense SSM (M=2.88), and additional instructions to precisely imagine the described setting resulted in an even higher SSM score (M=3.19). To test for the main effect of text version, an analysis of variance was performed on the SSM scale. According to the model proposed by Vorderer et al. [3], besides media factors, attention and VSI are potential factors that could influence the creation of a SSM and therefore were entered as covariates in the analysis. Both covariates were positively correlated with SSM (attention, B=.28, p<.10; VSI, B=.38, p<.01), and the main effect of the text version was still significant after controlling for these variables (F(2,33)=5.13, p<.05). Post-hoc comparisons showed that only the difference between the "few spatial cues" and "many spatial cues + instructions" groups was significant (Bonferroni correction, p<.05), the difference between "few spatial cues" and "many spatial cues" groups was close to significance (p<.10).

The MEC-SPQ included two subscales to assess spatial presence experiences, self location (SPSL) and possible actions (SPPA). Both scales were highly intercorrelated (r=.72, p<.01). However, factor analysis with oblique rotation showed that all items had higher factor loadings on their respective component and thus could be separated correctly. Despite the descriptive, non-immersive nature of the text, a broad variety of different levels of spatial presence was reported by the readers. As expected, SPSL scores (M=2.88, SD=.88) were significantly higher than SPPA scores (M=2.10, SD=.88; t (33) = 7.02, p < .01).

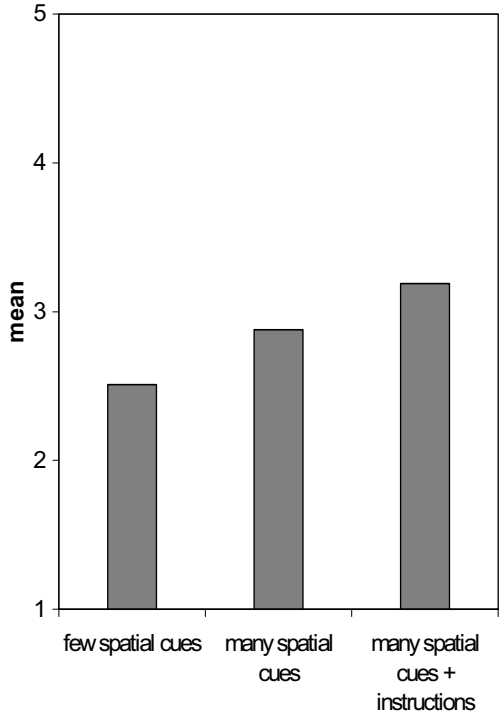

Figure 2 Mean scores of the Spatial Situation Model (SSM) scale for experimental conditions

Comparison of SPSL and SPPA scores across the experimental groups revealed a non-expected pattern, which was opposite to the SSM results. For both spatial presence subscales, highest average scores were yielded by the basic text version with few spatial cues (SPSL, M=3.10, SD=1.00; SPPA, M=2.50, SD=1.08). Additional spatial cues and instructions did not result in more, but contrarily lower values for both SPSL and SPPA (many spatial cues: SPSL, M=2.99, SD=.59; SPPA, M=1.88, SD=.52, many cues + instructions: SPSL, M=2.57, SD=92; SPPA, M=1.88, SD=.81) (see figure 3).

Analyses of variance were performed on both Spatial Presence scales, individually. As both involvement and SoD are supposed to mediate the transition from SSM to Spatial Presence experiences [3], these variables were entered as covariates. However, the analysis exposed no significant between-group differences (SPSL, $F(2,33)=.93$, ns; SPPA, $F(2,33)=.69$, ns). Interestingly, SoD was a significant covariate for SPSL ($B=.32$, $p<.05$) and positively correlated with SPPA, as well ($B=.21$, ns), whereas involvement was a significant covariate for SPPA ($B=.40$, $p<.05$), not for SPSL ($B=-.004$, ns).

Exploring the data for involvement and suspension of disbelief (SoD) revealed similar patterns. Overall, participants showed a great variety in both constructs (involvement, M=2.87, SD=.87; SoD, M=3.17, SD=1.14). Reading the text versions with more spatial cues or instructions did not lead to higher levels of involvement or SoD. On the contrary, the basic version of the text with few spatial cues yielded highest mean scores for both involvement and SoD (see figure 4). The differences were not significant, however, and in view of the ANOVA results, especially the involvement scores have to be interpreted very carefully (involvement, $F(2,33)=.74$, ns; SoD, $F(2,33)=2.20$, ns).

5. Discussion

Based on the MEC model of Spatial Presence, an experiment was conducted to explore if and how Presence occurs in readers of texts. Two elements of message design which were derived from the model were supposed to facilitate Spatial Presence during reading: the number of spatial descriptions (cues) in the text and the integration of explicit instructions to imagine the described spatial environment as vividly as possible. It was argued that both design techniques would affect the quality of the mental representation of space (SSM), and that the imagination instructions would in addition cause motivational support for the medium-as-PERF-hypothesis. According to the theoretical model, both mechanisms would enhance the feeling of Spatial Presence.

Interestingly, the findings support our assumptions only partially. With respect to the quality or strength of the SSM, the hypothesized effect both of number of spatial cues and imagination instructions was empirically confirmed. However, the average values in Spatial Presence (both scales) were highest in the condition that was expected to display the lowest scores (few spatial cues, no instructions), whereas the condition that was supposed to hold the highest Spatial Presence scores (many spatial cues plus instructions) turned out to have the lowest values. In

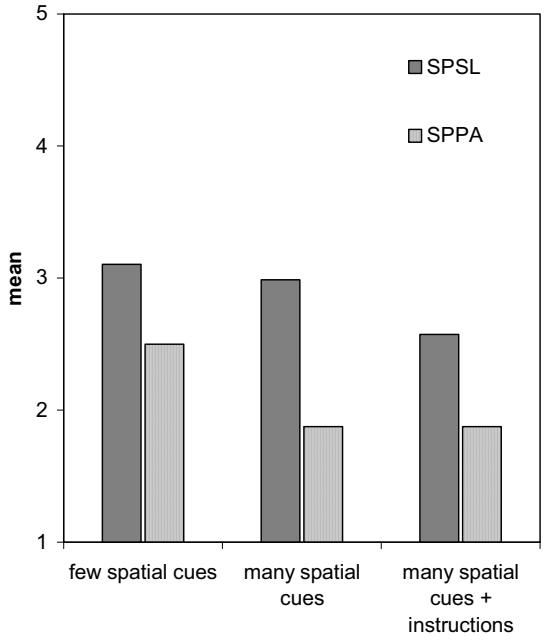

Figure 3 Mean scores of the Spatial Presence scales (self location: SPSL, and Possible Actions: SPPA) for experimental conditions

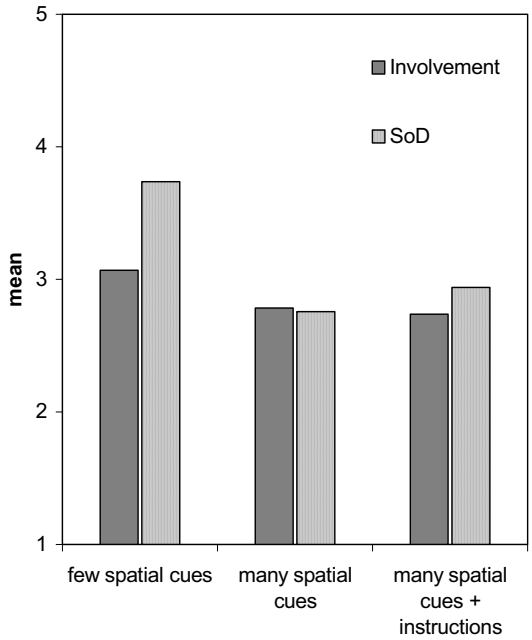

Figure 4 Mean scores of Involvement and Suspension of Disbelief (SoD) for experimental conditions

other words, the strength of the SSM was no important factor in determining the confirmation of the medium-as-PERF-hypothesis (and consequently, no determinant of Spatial Presence). Rather, Spatial Presence values were higher if the vividness of the SSM was *lower*. At first sight, this empirical relation is contradicting the assumptions of the MEC model.

However, the findings on the internal processes (user variables) shed some light on how this relationship might be explained. As books are especially low-immersive media, the importance of user factors (involvement and suspension of disbelief) for the emergence of Spatial Presence had been hypothesized beforehand. The results indicate that SoD was most intense in the experimental condition with a few spatial cues and no imagination instructions, whereas involvement displayed only marginal differences across conditions. One plausible interpretation of these data is that detailed spatial descriptions and imagination instructions in the text facilitated the construction of strong, vivid SSMs in readers, but at the same time, those text elements limited readers' imagination and fantasy regarding their 'active illusion' to be located in the museum. Readers have a better impression of how a described space looks like if they receive more information, but their transportation [11] into the text world is inhibited, because this process obviously requires more degrees of freedom for imagination. The high SoD value in the "low spatial cues + no instruction" condition supports this interpretation, because it points at more active imagination processes in the readers of this experimental group.

Of course, methodological limitations have to be mentioned when this interpretation is considered. First, the number of subjects is small, and variance in most investigated variables was quite large. Technically, these circumstances increase the importance of chance and suggest being rather conservative in interpreting the findings. Second, the text stimulus employed in this study had not been written by a professional author, but was our own creation that might have led to unexpected (and undetected) effects of non-typicality in (some) readers. The differences found between the groups may therefore in part be caused by other variables than those discussed here. Third, reading time was limited to only seven minutes, which may have been not sufficient to allow readers to accommodate to the laboratory context and to enter a typical reading condition in which imaginations of Spatial Presence normally would occur.

These limitations and the partly surprising results suggest an extension or replication of the study, which should employ other genres of text (from professional writers, such as a travelogue or a novel) and expand the number of subjects to allow for a more reliable data analysis. But the findings reported here already foreshadow that the formation of Spatial Presence may have to be modeled differently than predicted by the applied theory. A solid SSM is perhaps not the key determinant of Spatial Presence, as the precise description of space forces the readers to adjust their mental representation to many details, which would hinder them from generating the illusion to be located within the described space. According to this preliminary study, readers will more likely succeed in imagining self-location in the text's world if they are given more freedom to picture the spatial arrangements in their mind's eye. Whereas mental representations of space depend on external information, the feeling of Spatial Presence would rather be facilitated if the text leaves the specific spatial configuration of the portrayed environment open to the individual reader's spatial imagination. The present study has shed some light on the book problem, then, but has raised some questions about necessary distinctions in the modeling of Spatial Presence between the consumption of texts and other (immersive and/or audiovisual) media. With respect to existing theories of Spatial Presence [3], specifications for different media or modalities addressed by a medium may be required if our findings can be confirmed by further research.

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