Presence as External Versus Internal Experience: How Form, User, Style, and Content Factors Produce Presence from the Inside

Matthew T. Jones
Temple University
matjones@temple.edu

Abstract

This paper describes and explores two major opposing perspectives in presence theory. The external/perceptual perspective recognizes presence exclusively as a response to the external environment while the internal/conceptual perspective allows for the influence of mental models in constructing the environment one feels present within. Form, user, style, and content factors are discussed in terms of their relationship to these perspectives and with regard to their function in evoking presence.

Keywords--- **Book Problem, Cognitive Priming, Content Factors, Flow, Form Factors, Mental Model, Mental Simulation, Style Factors, Suspension of Disbelief, User Factors**

1. Introduction

One major distinction among presence definitions concerns whether presence is seen as an exclusively external/perceptual phenomenon or an internal/conceptual phenomenon that is based on perception. For example, Waterworth and Waterworth's [1] definition of presence as "a conscious emphasis on direct perception of currently present stimuli rather than on conceptual processing" (p. 211) takes a clear stance on the side of external perception, whereas Biocca, Harms, and Burgoon's [2] definition of presence as "the phenomenal sense of 'being there' including automatic responses to spatial cues and the mental models of mediated spaces that create the illusion of place" (p. 459) takes the opposing internal/conceptual view.

In this paper, I proceed by first distinguishing among categories of user, form, style, and content characteristics because these are easily confused and/or conflated in discussions concerning the causes of presence experiences. From there, I describe *The Book Problem*, because it is a primary source of contention between the external/perceptual and internal/conceptual perspectives. Next, a description of the external/perceptual perspective and review of the experimental evidence demonstrating the role of form factors is presented and followed up by a critique of this perspective and an explanation of the internal/conceptual perspective, which includes (in addition to form factors) user, style, and content factors in the presence experience. Finally, the application value of these assertions is discussed.

2. User, Form, Style, and Content Factors

In a popular concept explication, Lombard and Ditton (1997) [3] attribute the causes of presence to form, content, and media user variables. Additionally, Slater (2003) [4] distinguishes Immersion from Presence, noting that "presence is a human reaction to immersion" (Form and Content). The "human reaction" is a quality of the user of the medium whereas the "immersion" is a quality of the form of the medium. Further, Slater distinguishes form from content and attributes the experience of presence to form, regardless of the nature of the content (e.g. boring or compelling). Although the following sections will debate against the notion that presence is strictly a response to form, the divisions between user versus form factors and form versus content factors prove valuable.

Additionally, style characteristics should be considered in terms of their contribution to the presence experience. The Russian Formalists made the separation between "fabula" (story), which can be generalized to include the content of the medium, and "syuzhet" (plot), which is the stylistic reorganization of the fabula. This stylistic reorganization of content likely carries implications for the experience of presence since it determines the nature of how content is presented. This will be discussed further in section 5.7.

Based on these divisions, there are four sets of factors that interact to produce a sense of presence in the individual:

1. User Factors: the physical and psychological makeup of the user, including sensorimotor and cognitive functions.
2. Form Factors: the capabilities and limitations of the medium, including level of immersion, interactivity, and display fidelity.
3. Style Factors: the techniques and conventions germane to the medium that are used in the presentation of content.
4. Content Factors: the subject matter.

In the sections that follow, these factors will be considered in light of two major (opposing) perspectives on presence. I turn now to the book problem to highlight the differences between these perspectives.

3. The Book Problem

Within the presence research community, the subject commonly referred to as "the book problem" encapsulates two opposing perspectives (external/perceptual vs. internal/conceptual) concerning the nature of the presence phenomenon. At the heart of the debate is the question of whether less immersive media (such as books) are capable of providing a telepresence experience. Biocca [5] articulates the book problem in the following way:

> If sensorimotor immersion is the key variable that causes presence, then how do we explain the high levels of presence people report when reading books? Books are very low fidelity, non-iconic media and are extremely low on all sensorimotor variables identified as causing presence: extent of sensory data, control of sensors, and ability to modify the environment. (p. 4)

A number of other theorists and researchers also recognize this incongruity [e.g. 6, 7, 8, 9, 10], and even outside the domain of presence research, Phillips [11] has argued that "[l]ow resolution media does not mean a low-resolution experience" (p. 82).

In an initial effort to supply a resolution to the paradox, Schubert and Crusius [10] propose a theory that acknowledges a "cognitive layer" to the experience of presence wherein all incoming perceptual stimuli do not give way directly to the sense of presence, but rather apply toward the construction of a mental model which may or may not induce presence depending upon its level of detail.

Expanding beyond this root concept, Biocca [5] points out that the heart of the book problem rests with the "sensorimotor immersion assumption," which posits a direct correlation between the level of immersion of the medium and the level of telepresence experienced by the user. He goes on to detail a "three pole model" which accounts for the role of mental imagery space in addition to physical and virtual space. This mental imagery space, central to mental model development, explains why media of low immersion are capable of fostering a sense of telepresence in users. The reason is that a mental model can be constructed based on cues from media (e.g. novels, comic books, etc.) that depend upon the user's imagination.

Supporting this internal/conceptual view of the book problem, Pinchbeck and Stevens [9] claim "the book problem should come as no surprise and rather than being an issue, should be taken as demonstrating that virtual environments and other media share the capacity to influence an organism's representation of its surroundings" (p. 223). In stark contrast to this, Waterworth and Waterworth [12] strongly assert the external/perceptual view by completely dismissing the book problem as "a confusion between sense of presence and emotional and/or intellectual engagement in internal, imagined space" (Introduction).

The oppositional quality that these perspectives on "the book problem" have with respect to each other reflects a fundamental difference in the understanding of what presence is and how it is constituted. However, beyond gaining insight into the debate about the physical/psychological mechanisms responsible for presence, studying the book problem provides an opportunity to learn the alternative techniques used in nonimmersive media to induce the experience of presence. But before this is explored, it is necessary to take a look at the two major (opposing) perspectives on presence, since only one of them recognizes value in exploring nonimmersive media.

4. The External/Perceptual View of Presence

Describing the philosophical roots of the external/perceptual view of presence, Biocca [13] has observed that "[m]any immersive virtual reality designers tend to be implicitly or explicitly Gibsonian" (The Senses as Channels to the Mind) in the sense that they start from the assumption that no preexisting knowledge of the world is necessary in order to make sense of it because presence within the environment is constituted through direct perception.

Waterworth and Waterworth [1, 12, 14]; Waterworth, Waterworth, Holmgren, Rimbark, and Lauria [15]; Riva and Waterworth [16]; and Slater [4] have presented substantial theoretical and empirical evidence that supports a view of presence that is based exclusively on external/perceptual phenomena. The following discussion of the external/perceptual perspective is based primarily on the work of Waterworth and Waterworth [1, 12, 14], not because they are alone in adopting this perspective, but because they have articulated the most thorough theoretical argument in favor of it. Evidence that this perspective is widely prevalent within the presence community can be found in the predominant (though not exclusive) engineering focus in the premier journal in the field: *Presence: Teleoperators & Virtual Environments*.

Waterworth and Waterworth [12, 14] argue to justify the external/perceptual view by examining presence experiences as a part of human evolutionary history. They draw a distinction between "core consciousness" and "extended consciousness," suggesting that the former is what we have in common with all conscious creatures that enables understanding of our immediate concrete environment and the latter is that capability, unique to humans, which allows us to imagine consequences as well as to plan for the future. Essential to this talent of extended consciousness, they argue, is the ability to discriminate between the domains of the core consciousness (perception of the immediate physical environment) and extended consciousness (imagination), since to confuse the two would obviously be dangerous to the

individual and maladaptive in terms of evolution. Glenberg [17] makes a similar point in taking up an embodied approach to the function of memory, noting that "clamping" is the function we perform to separate our memory of previous encounters with the environment from our current experience of it.

Waterworth and Waterworth [14] maintain that it is the sense of presence that distinguishes for us the difference between extended consciousness and core consciousness. Presence, they say, is in the domain of the core consciousness.

To support their strictly perceptual understanding of presence, Waterworth and Waterworth [1] counterpose the term "absence" to describe cognitive activities such as thinking and imagining. Absence, they explain, "is characterized as a psychological focus on … conceptual processing, and presence as a psychological focus on direct perceptual processing" (p. 203). The metaphor of the "mind as a two-room apartment" (p. 205) sets up presence and absence in an oppositional and mutually exclusive arrangement. Using the imagery of a cross-section of two adjacent rooms with a hanging light situated at the top of the doorframe between the rooms, it is explained that the room on the left represents concrete processing (presence) while the room on the right represents abstract processing (absence). The lamp between them, which represents conscious thought, can be shined into one room or the other, but not both simultaneously, suggesting that consciousness is a zero sum game that the concrete and abstract realms of thought compete for – "Put simply, you cannot feel present in a virtual world, or in the real one, while also being lost in thoughts, dreams, or fantasies" (p. 207). Following through with this line of reasoning, if we are conscious of the immediate world outside of our bodies we are present and if we are mostly conscious of our own thoughts we are absent.

4.1. Form Factors: Experimental validation

Although an abundance of research deals with different aspects of media form and presence, there are surprisingly few studies that directly compare one form to another based on their presence-evoking capabilities. Three such comparison studies are detailed below which provide evidence for the external/perceptual perspective and, depending upon interpretation, support the notion that form is the exclusive determinant of presence experience.

Waterworth et al. [15] measured the levels of telepresence experienced by participants in an "interactive tent" that displayed films varying in their level of abstraction. Based on a comparison of scores gathered with the Igroup Presence Questionnaire [18], it was determined that "The average presence ratings for the 3D and Camera films [concrete films] were significantly higher than the ratings for the two abstract films [Text and Wireframe]" (p. 6). Based on this it was concluded that "[w]hen the abstraction level of an experience increases, the feeling of presence decreases"

(p. 10). This, of course, is suggestive of one of the basic tenets of the presence/absence distinction: that when abstraction is involved presence is not.

Testing an even more drastic distinction between abstract and concrete processing in the (tele)presence experience, Banos et al. [6] measured the (tele)presence levels of participants at various points as they explored either a virtual park or a park that they were asked to imagine. Data gathered using the UCL Presence Questionnaire [19] indicated that although initial levels of presence in the imagination condition were higher than in the virtual condition, this trend reversed as the simulation played out.

Evidence exists even outside of the domain of presence research that indicates less immersive media offer less telepresence. In an experiment testing male sexual arousal across five modes (media forms) of erotic stimulation, Julien and Over [20] found that "the differences between modes related primarily to level of response. The highest level of physiological and subjective arousal was generated by film, while fantasy produced the lowest level of arousal. Slides, spoken-text, and written-text were equally potent, and these three modes had intermediate influence on arousal" (p. 139). Here, once again, the general association between increased abstraction and decreased telepresence holds.

Overall, these findings lend support to the well established contention that media forms with the capacity to minimize abstraction and more closely imitate physical reality are more conducive to providing a sense of presence in the mediated world.

4.2. Criticisms of the External/Perceptual view of presence

Although the external/perceptual view endorsed by some theorists sets up a logical criterion for discriminating between experiences of presence and "absence" and for understanding the factors and contexts which lead to and detract from presence, it also contains a number of implicit assumptions that neatly avoid the more complex examination of cognition that would be prompted if they were made explicit.

To start with, it is tacitly assumed in the critique of Biocca's [5] "three pole model" [12] that the only role conscious attention has to play is as a necessary precondition of the presence experience. In other words, conscious attention serves solely to permit the prerequisite perceptual resources to be allocated to the immediate surrounding environment. The hidden assumption is that conscious attention occurs independently of cognition, which, according to this view, is not a determinant of presence, but of the opposing condition referred to as "absence." The problem is that it is difficult to define conscious attention without referring in some way to cognition. For example, Hu, Janse and Kong [21] provide a typical definition of attention as "a cognitive process of selectively concentrating

on one thing while deliberately ignoring other things" (p. 4). Of course, deliberate ignoring and selective concentration are activities that would require some cognitive effort.

The issue of conscious attention stems from a larger problem with the external/perceptual view: its denial of the role that cognition plays in perception. It is possible for the presence experience to rely upon cognition and conscious attention without being confused with them. The distinction that determines the presence experience should not be made between cognition and perception, but among the contents of cognition. As Ryan [22] has observed, "It [the mimetic concept of immersion, i.e. telepresence] applies to novels, movies, drama, representational paintings, and those computer games that cast the user in the role of a character in a story, but not to philosophical works, music, and purely abstract games such as bridge, chess, and Tetris, no matter how absorbing these experiences can be" (p. 14-15). In the first set of examples, content tends to be narrative and to portray natural environments, whereas, in the second set, it is abstract and symbolic, but all involve *both* cognition and perception.

Also stemming from this denial of the role cognition plays in perception, it is claimed that a major criterion for the sense of presence is the experience of an external, sharable world that yields the same perceptions among different individuals [14]. In attempting to emphasize the distinction between the clarity and accessibility of the virtual and real worlds (as opposed to the internally generated mental world), Waterworth and Waterworth [14] note that "[t]he virtual world is the same for everyone who acts in it, just as the real world is," but find themselves backtracking immediately afterward, qualifying parenthetically that "our experiences and reactions differ" (Presence and Media Form). Of course, anyone who has played the game "telephone" (where a verbal message travels through a number of people to come out very different in the end) knows that our perceptions tend to combine with our cognitions even as they are being formed.

A second point of contention lies with the use of the term "absence" that describes the state of non-presence resulting from conceptual processing. Although labeling conceptual space as "absence" maximizes the distinction of the presence concept and simplifies what it is through a reduction in the application of the term, there is a danger that the deeper underlying phenomenon will be missed for the sake of simplicity. Especially within the realms of memory and dream, where previously experienced physical locations can be recalled to mind, it would seem that an argument for the presence-invoking capacity of cognition could be made. Most of us have probably had the experience of having a dream that, at the time it was dreamt, seemed absolutely real. A sizable minority of undergraduate students has even reported the experience of false memories based on the inability to discriminate between perceptually realistic dreams and waking reality [23]. If phenomena such as this are examples of absence, based upon their conceptual nature, then it would seem that an understanding of presence as a

subjective psychological state is no longer salient because it is now determined based on objective location of the body, regardless of where the mind is focused.

A third criticism of the external/perceptual view rests with how the experimental data is interpreted. At first glance, the experimental evidence described above appears to favor the exclusively external/perceptual view of presence which endorses form as the single determinant of presence, but, in actuality, it may serve to support the conceptual model for two reasons.

First, results from each experiment indicate that media which require internal/conceptual processing, such as imagery instructions, fantasy [6, 20] and abstract content [15], while providing a lower level of experienced telepresence, still elicit *some* form of the telepresence experience that is presumably commensurate with individual imaginative capabilities. If it were true that media requiring conceptual processing did not produce telepresence, but instead produced "absence" because of the conceptual component involved, then levels of reported telepresence should not simply be lower than immersive media, they should be zero. By definition, one cannot read or engage in imaginative activities without entering the space designated as "absence" [1] to indicate, not only its lack of similarity, but mutually exclusive opposition to presence. In light of this, Pinchbeck and Stevens [9] are correct when they point out that "[s]imply stating that reported presence from media with low immersive capabilities is not presence but something fundamentally different, if indistinguishable when using existing measures, is an unacceptable theoretical stance" (p. 222).

Second, the fact that more immersive forms of media produce a more intense feeling of telepresence does not mean that cognition has no role to play. If it is true that incoming stimuli, regardless of the level of their immersive quality, serve only as the raw material out of which a mental model is constructed [5, 10, 18], than an initially more complete environment would naturally be easier to process, reducing (but not eliminating) conceptual tasks and providing a more intense presence experience.

A related criticism of the external model involves the methods of determining whether a sense of presence has been achieved. Adopting what Nunez and Blake [24] refer to as "behavioral presence" or the "postural or movement approach" (p. 115), Waterworth and Waterworth [1] distinguish presence from mere conscious attention in the following statement: "The reader of a novel may become deeply engrossed in the lives of the characters and the action that is described, but they are unlikely to move their bodies unconsciously to avoid a hazard that is only described in text" (p. 204-205). While there seems to be little disagreement that some level of physical response to the medium (given circumstances that would elicit physical response) is prerequisite for telepresence, the precise level of response that is required is debatable. For example, citing Cuthbert, Vrana and Bradley [25], Glenberg [17] explains

that "although overt responding is inhibited during an imagery task, there may well be 'efferent leakage' that can be measured using psychophysiological techniques" (p. 5). Indeed, change in galvanic skin response (GSR) as a result of exposure to a non-immersive mediated stimulus (one that depends upon conceptual processing) requires efferent leakage for measurement to take place. Examples in which GSR has been successfully used to evaluate responses to low-immersive media such as text and television include Clariana [26] and Osborn and Endsley [27].

Finally, the external/perceptual perspective allows little room for the exploration of user, style, and content factors insofar as they contribute to presence. The following sections provide an argument as to why these factors should be taken into account.

5. The Internal/Conceptual View of Presence

What is now referred to as presence (or telepresence) theory/research emerged from a telerobotics engineering perspective and has changed substantially to recognize the capacity of other media forms to provoke the same underlying experience. In what is commonly regarded as the seminal article in the field, Marvin Minsky [28] coined the term "telepresence" and referred to it strictly in terms of telerobotics. For example, he notes, "*Telepresence* emphasizes the importance of high-quality sensory feedback and suggests future instruments that will feel and work so much like our own hands that we won't notice any significant difference" (p. 47).

Biocca [5] calls attention to the telerobotic origin of telepresence explicitly and further concludes that, as a result, much current research is guided by what he refers to as the "two pole model": "Inherited from early telerobotics and telepresence research, the two pole model of presence posits that presence shifts back and forth from physical space to virtual space" (p. 1). The problem with this model is its implicit acceptance of the previously defined "sensorimotor immersion assumption" which fails to explain instances of high telepresence in media of low immersion, such as when one experiences telepresence while reading a novel ("the book problem"), as well as instances of low presence in physical reality, such as when one is present in a physical place but is relatively unaware of the place because they are mentally focused on something other than the immediate environment ("the physical reality problem") [5].

The solution to the inconsistencies in the two pole model, according to Biocca [5], is to add an additional pole that accounts for "mental imagery space." As described previously, the addition of this third pole allows spatial cues, which contribute to the mental model that facilitates presence, to be generated by mental imagery in addition to virtual or physical imagery. Looking at things this way, there no longer is a direct relationship between level of immersion and level of telepresence experienced because mental imagery is seen as having the potential to fill in the gaps of low immersion media. Thus, regardless of how immersive or impoverished the medium is, the experience of telepresence is determined by the quality of the physical, virtual, and/or mental spatial cues and the individual's awareness of them [3].

5.1. User Factors: The Mental Model

Schubert, Friedmann, and Regenbrecht [18], Schubert and Crusius [10], and Biocca [5, 13] have advocated an understanding of presence that conceives of the experience as deriving from interaction with a mental model of the surrounding environment. Similar theories concerning mental models have been applied to the process of reading. Oatley [29], for example, argues from a similar stance when he writes "Human mental life depends strongly on constructive abilities. What human minds do generally is to make models that parallel the workings of the world" (p. 105). The important point in terms of presence, however, is the individual's interpretation of their mental model, for it is within this internal conceptual act that a sense of presence is felt [18].

It is also important to recognize that the mental model does not only apply to situations where technological mediation is involved. When Schubert and Crusius [10] refer to "cognitive representations as another theoretical layer" (Five Theses), they are implying that all perceptual cues, whether originating in the physical, virtual, or imaginary environment, serve to construct an internal representation that we react to – i.e. they are all filtered through cognitive representations. A sense of presence then may result from a distal attribution of that internal model [13]. Loomis [30] defines distal attribution as a phenomenon in which "most of our perceptual experience, though originating with stimulation of our sense organs, is referred to external space beyond the limits of the sensory organs" (p. 113). Put simply, the model we have constructed from within becomes mapped onto or attributed to the external environment.

Arguing that the experience of telepresence in text, film and virtual reality originate from the same cognitive process, Schubert et al. [18] explain the mental model using the "potential action coding theory of presence," which they describe in terms of construction (of the model itself) and suppression (of irrelevant information). The MEC Model of Spatial Presence [31] similarly stresses the importance of the mental model in the constitution of presence. According to this model, an SSM (spatial situation model) is formed based upon two components of information: a "bottom-up component" which constructs the mental model based upon descriptive information, and a "top-down component" which relies on the implementation of preexisting knowledge to construct the model. The central elements of each of these models (top-down/bottom-up construction and suppression of irrelevant information) will form the basis for discussion in the following sections that describe the details of how the mental model functions to promote a sense of presence.

5.2. User Factors: Mental Simulation

Mental simulation is the functional act of the mental model. Biocca [13] sees dreams, hallucinations, and daydreams as evidence that the mind is able to produce "compelling spatial environments" (The Imaginal Environment), and Schubert et al. [18] compare mental model construction to language comprehension and memory. In a similar vein, episodic memory may be contingent upon the same process as mental simulation. Tulving [32] describes "autonoetic consciousness" (the subjective representation of a progression of events through time) as basic to episodic memory, and Mar, Oatley and Eng [33] point out the commonality between autonoetic consciousness and the process of mental simulation in general. The relatedness of these processes is especially evident in Tulving's [32] realization that "mental time travel involves awareness not only of what has been but also of what may come" (p. 20). Thus, if autonoetic consciousness is not bound to the service of memory, it may be instrumental in constructing simulations of the present and future as called for by acts of imagination.

5.3. User Factors: Suspension of Disbelief

One function that would appear integral to the act of mental simulation is what has commonly been referred to in the literature on fiction, film, and presence as the "suspension of disbelief." Because engaging in a narrative requires some effort, willingness and motivation on the part of the individual [34, 7, 22] that initial step toward receptivity to the narrative requires explanation.

Biocca [13] defines the experience of presence in the imaginal environment in terms that seem very similar to suspension of disbelief, noting that diminished attention and responsiveness to sensory cues in the immediate environment (versus the virtual one) is a prerequisite to telepresence. In a similar capacity, suppression of the physical environment is a task that is essential to involvement [18, 35] memory, and language comprehension [17]. Such suppression, it might be argued, is accomplished through suspension of disbelief on the part of the individual. Regarding language comprehension, Glenberg further points out that suspension of disbelief (though he does not refer to it as such) is accomplished through suppression of the physical environment and the structure of the language itself. Thus, to run a mental simulation, the physical world must be left behind and the tokens (i.e. the physical symbols that signify the mediated world) must fall away to reveal the connotations they were crafted to produce.

From the perspective of the previously described external/perceptual view, suspension of disbelief is insufficient to invoke telepresence [see 1, p. 204]. One potential problem with this objection is its neglect of the suspension of disbelief required for certain highly immersive virtual experiences. For example, it could be convincingly argued that the disbelief stemming from the sensation of additional weight or haptic pressure from a head mounted display must be suspended in order to feel telepresence in the virtual environment. Put differently, devices employed to create a display, which somehow themselves impinge on the senses in a way that does not correspond to the content of that display, serve as constant reminders of the mediated nature of the experience. Examples of this problem can be found in any current technology intended to foster telepresence.

5.4. User Factors: Anomalous Suspense

Gerrig's [34] notion of "anomalous suspense" does not rely on suspension of disbelief to explain mental simulation as it occurs in the experience of narratives. He suggests that something deeper than intentional ignorance is at work.

In place of suspension of disbelief, Gerrig suggests that anomalous suspense explains how the narrative world comes to take precedence over the individual's immediate surroundings. Anomalous suspense describes the phenomenon of reader suspense under conditions in which their real-world knowledge should prevent the sensation of suspense. To test this concept and demonstrate its salience, Gerrig set up two conditions in which experimental participants must read a story and respond to questions. In one condition, the story is written in such a way as to inspire suspense in the reader while, in the other condition, the story is not written to inspire suspense. It was found that, on average, participants in the suspense condition took significantly longer to determine the truth of actual outcomes (that they had knowledge of beforehand) than participants in the non-suspense condition [34]. Gerrig attributes this intriguing finding to the reader's propensity to consider potential conclusions insinuated by the text. In other words, when a set of hypothetical circumstances or conditions is presented that provides a congruent internal framework, alternative scenarios are entertained in spite of real-world awareness. Gerrig further argues that this occurs because of an "expectation of uniqueness" (p. 170) that we experience while progressing through the event structure of a narrative. Such an expectation, he suggests, derives from an "optimization of cognitive resources" (p. 170) that evolved from our interactions with physical reality, which never quite repeats itself the way our own manufactured narratives do. This is a reasonable conclusion considering that throughout the majority of our development as a species the precise repetition of an event (or even a story that is told orally) has rarely, if ever, been encountered. With the advent of recorded narrative, details are held standard even though, on some primitive level, we never expect to encounter the identical set of details when revisiting the same narrative despite the fact that, logically, we should.

5.5. User Factors: Emotion

Emotion, which is another factor that often enters into the equation of mental simulation, is not simulated at all [33, 29, 22]. This means that when an individual is said to have experienced a certain emotion, that experience is real regardless of whether or not the event that produced it is fictional or real, mediated or nonmediated. This subjective reality of emotion may be said to result in what Gerrig [34] has called "*nonpenetration* of belief into emotional experience" (p. 181) – that is, our awareness of the falsity of an emotional stimulus does not stem the tide of the emotion itself. On one level we can be aware that the event that prompted the emotion never really happened, but on another level we experience the emotion that would correspond if it actually had happened.

5.6. Form Factors in Media of Low Immersion

Shifting the focus from user characteristics to medium characteristics, there are some structural features of low-immersion media (such as text) that may be manipulated to ease the process of mental simulation and create a stronger mental model that is more capable of producing telepresence. Media requiring much mental imagery and conceptual processing often use strategies to transcend the medium. The often cited quotation from Joseph Conrad [36]: "My task which I am trying to achieve is, by the power of the written word, to make you hear, to make you feel – it is, before all, to make you see" (p. xxvi) reveals the author's intention to use language in such a way as to access the perceptual senses of the reader through the written word.

Low fidelity iconic and text-based media are, to some extent, designed to be transcended. The connotative and denotative capacity of words and symbols allow abstract codes to be processed in such a way as to draw attention to what they signify rather than their own particular characteristics as signifiers [22, 37]. This quality is most obvious and apparent in the ability of a single word to conjure to mind a specific place. Gerrig [34] makes this point with the word "Texas" and Glenberg [17] does the same with the word "Amazon." While it is, of course, possible to focus on the spelling of the word, the shape of its letters, the particular font used, etc., it is also possible to look past the formal characteristics and into the environments they are meant to invoke. It is this latter possibility that Birkerts [37] is referring to when he writes, "reading is a conversion, a turning of codes into contents" (p. 97). Ryan [22] makes a similar point when she describes a text as realistic when it creates a "language-independent reality" (p. 158). Most explicitly, however, Glenberg [17] notes, "we understand language by creating embodied conceptualizations of situations the language is describing" (p. 12). The formation of these embodied conceptualizations is at the heart of the process of mental simulation that is responsible for the experience of presence.

5.7. Style Factors: Flow, Trajectory, and Distillation

Beyond the fundamental representational attributes of the medium, much of mental simulation in low immersion media depends upon how words or other symbols are combined. To this point, O'Neill and Benyon [8] remind us, with respect to the book problem, that "[t]he mistake, of course, is to think that the book is the medium. It is the words and skills of the storyteller that is the medium through which we interact with the significances that the story has for us" (p. 84).

There are three related qualities that emerge from word or symbol combination, which are important to facilitating the process of mental simulation, especially in media of low immersion. Flow, the first of these qualities, was initially explored by Csikszentmihalyi [38] and has since been applied to presence in a number of ways [e.g. 39, 40, 41, 42]. In this context, flow will refer to the level of continuity in the progression of symbols. Drawing from McCullogh [43], O'Neill and Benyon [8] note, "an engaging medium allows for continuity and variety, for 'flow' and movement between many subtle differentiations of conditions" (p. 81). Similarly, Ryan [22] asserts that "fluidity, wholeness, and a space-time continuum" (p. 352) are prerequisites for immersion in the textual world. Flow is what allows the individual to experience the world depicted through the medium as a coherent whole rather than as an abrupt assemblage.

Trajectory is the force that guides the flow of events in the mediated world, shaping them through "physical and cultural constraints" [17, p. 47] and allowing for consistency of experience from one moment to the next. It reduces uncertainty from one event to the next by delimiting possible outcomes and fostering expectations in the user.

The reason flow and trajectory are important to mental simulation (and presence) is because they are important to physical experience as well. Glenberg [17] emphasizes this point in distinguishing between a recording and the act of perception:

> Details of the physical environment, except as affecting the particular experiencer's actions in a particular situation, are irrelevant. The same is true for understanding a situation described in a narrative. As we read, we develop an action-based understanding of the situation described by the text. (p. 42)

Another way to consider how flow and trajectory work to close textual gaps is by looking at what is included versus what is excluded. Because our mental simulations are action-based and every detail need not be included to enable the simulation and a corresponding level of telepresence to take place, the question of which details are included comes to the fore. The most immersive and involving discourse structures include only those aspects that are vital to the flow of action in the mediated world. The included details cohere

with previous details but push further through the action, connecting past, present and future in a way that does not depend upon the inclusion of the minutia of details that would be present in a perfectly faithful recording of reality. Such a structure can be compared to *distillation* – the process by which a liquid is purified through evaporation and subsequent condensation. Adhering to this metaphor, the most essential or "pure" aspects of the mediated world are retained while the excess of details is left behind.

In their exploration of "the book problem," Gysbers et al. [7] discovered that, in terms of spatial telepresence, text that includes an abundance of details relating to spatial information actually yielded less telepresence experience in participants than text that included few details. The authors note that "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" [7, p. 18]. Overall, this finding supports the contention that a distilled narrative, one that makes use of details economically and on the basis of action, better facilitates mental simulation and telepresence.

Specific techniques that give rise to flow, trajectory, and distillation will vary based on the capacities and conventions of the particular medium. For example, editing in film, sentence structure and paragraph logic in literature, and spatial layout, graphics, and coordination of sensory inputs in virtual reality applications can all be manipulated to maximize presence through these qualities. Further experimentation is necessary to determine the effectiveness of particular techniques.

5.8. Top-Down User Factors

What has been described thus far is only half of the equation. The construction of the mental model through the active process of simulation cannot be performed when it is based exclusively upon cues from the medium (the bottom-up component). Media, especially non-immersive media, must rely upon the psychological warehouse of previous experience and memory in order to give shape to the objects and events suggested by the symbols in the text. This second aspect is referred to as the top-down component [see 5, 7]. In what follows, I propose a connection among three concepts that are relevant to the top-down component: the *umwelt*, the *schema*, and the activity of *closure*.

The term *umwelt* originated in the work of Jakob von Uexkull [44, 45, 46] and is used to describe "the mass of knowledge that we carry around with us into every interaction, which has been formed and continues to form as a result of those interactions" [8, p. 82]. The umwelt is the source of our internal models that are called upon when we interact with abstract or non-immersive media.

A related, though more specific, term is *schema*, which refers to the way experience is organized cognitively within the umwelt. Deriving an understanding of the schema from Rumelhart and Ortony [47], Nunez and Blake [48]

describe it as a cognitive structure that "encodes complex concepts by means of associations between simpler ideas" (p. 102). Schemata become active through this association when simpler ideas are attended to cognitively or perceptually. In simpler terms, the activation of a particular idea (either internally or externally) serves as a trigger to all of the related concepts that compose the particular schema the idea is associated with. Just as a set of ideas compose the schema, a set of schemata might be said to compose the umwelt. For example, thinking about or handling an agricultural implement such as a pitchfork or a ho may trigger schemata related to farming, rural environments, particular ideological values, etc.. In turn, those schemata fit into the broader knowledge-base of the umwelt which is modified based upon the outcomes of interactions between stimuli and active schemata.

Pinchbeck and Stevens [9] indicate that presence is determined, at least to some extent, by the interaction between stimuli and the individual's schemata. They argue that, rather than being defined as a state, presence should be seen as "an indicator of the ongoing development of relationships of significance between the user and the perceived environmental stimuli (i.e. schemata)" (p. 221). This suggestion is not unreasonable considering that schemata have a great deal to do with the ease of processing of incoming stimuli. If incoming stimuli are inconsistent with currently activated schemata, they will delay processing and interrupt mental simulation and model construction. It is perhaps this phenomenon that is responsible for what has been referred to as a "break" in presence [49].

Umwelt and schema are two strongly related concepts that come into play during the act of mental simulation. They serve as the cognitive "spackle" used to fill in the gaps within and between the signs and symbols of the mediated message. McCloud [50] refers to this process of "filling in" as closure, the "phenomenon of observing the parts but perceiving the whole" (p. 63). The original use of the term is in reference to comic art, however, in principle, it can apply to any situation in which previous knowledge and experience is used to connect or elaborate upon the signs and symbols of a mediated message. In terms of the written word, personal experiences and memories play a critical role in bringing the text to life (34, 7, 33, 29, 22). Gysbers et al. [7] and Oatley [29] even suggest that the text serves primarily as a program that designates which memories to retrieve in order to complete the scenario. Thus, when we consider imagery or spatial location in non-immersive media, we are considering our own memories and experiences that have been conjured to mind based on the needs of the text. It should be noted also, though, that closure does not apply exclusively to non-immersive media. When viewing a film, for instance, we are not presented with perfect continuity from beginning to end. The flow of action is divided up by shots, sequences and scenes that we must piece together cognitively. In immersive virtual reality systems, there are still inconsistencies and aspects that are lean in detail. Even

the physical environment is broken up to some extent by saccadic eye movement and blinking. Flow and trajectory actually help to facilitate closure by de-emphasizing the salience of the missing information.

Perhaps the best explanation of how much we rely on our preexisting mass of knowledge in order to decode texts comes from Ryan's [51] "principle of minimal departure" which proposes that we experience a fictional world as being the same as our own except for those changes actually stipulated by the text. This principle also bears similarity to her later concept of "recentering" in which "consciousness relocates itself to another world and, taking advantage of the indexical definition of actuality, reorganizes the entire universe of being around this virtual reality" [22, p. 103]. The point in common between both of these ideas is that we subconsciously and automatically fill in the unanswered questions and missing pieces of experience with our own knowledge of the world; we close gaps in both mediated and nonmediated experience with our own physical and cultural knowledge.

Waterworth and Waterworth [14] are correct when they observe, "Our internal worlds and their meanings are built on the foundation of what it feels like to be consciously in a concrete world, on what it means to be present" (Summary). What we learn and experience in the physical world contributes to the umwelt and is applied according to the needs of the medium. This logic, however, can be extended to include not only the physical world, but other mediated worlds as well.

5.8. Content Factors: Content Knowledge, Thematic Inertia, and Cognitive Priming

Although content knowledge, thematic inertia, and cognitive priming are technically all user factors, they are treated separately here because their influence on the presence experience depends wholly upon the content of the medium.

Nunez and Blake (2006) [52] present evidence that content knowledge, thematic inertia, and cognitive priming effect presence experiences in users of flight simulator games. Their findings suggest that specific content knowledge – "knowledge of the actual content being simulated" (p. 42) – reduces presence by establishing more specific expectations in the user which lead to a greater likelihood for noticing inconsistencies in the simulation.

On the other hand, thematic inertia – "the tendency to engage in thematically related activities" (p. 41) – was a powerful predictor of presence, indicating that preexisting interest in content has a positive influence on presence.

Finally, cognitive priming – "cognitively preparing users for a VE experience by presenting them with materials thematically related to the VE's content prior to their experience" [53] – was found to have almost no effect on presence. However, closer examination reveals that this likely results from a close covariation with thematic inertia

leading to a drowning out of the priming effect in the initially performed multiple regression.

Additionally, there are at least two primary studies that examine cognitive priming as a determinant of the presence experience [48, 53]. Although no main effect was found for [48], results indicate an interaction between priming and stimulus quality, which suggests priming is at least a mediating variable. In the second study [53], priming was found to positively affect telepresence if subjects reported a pre-established preference for the theme of the priming condition.

The preceding discussion concerning schemata is relevant to this concept because it is the individual schema (or set of schemata) that is activated through cognitive priming. Considering the umwelt as a collection of many different schemata, it is logical to suppose that, unless a particular schema (or set of related schemata) is active prior to exposure to media content, these schemata will initially compete with each other in the processing of incoming stimuli. As Nunez and Blake [48] observe, "The activation of schemata will pre-allocate processing resources, facilitating the processing of related perceptions. Simultaneously, the processing of unrelated perceptions will occur with more difficulty, due to the reduction in cognitive resources available" (p. 106). This difficulty results from the fact that cognitive energy that is devoted to selecting from among schemata detracts from the seamless experience of presence that would result from an already active schema set that produced closure based on the related accumulation of cognitions gathered from previous experience with similar content.

Taken together, these studies seem to indicate that content characteristics play a significant role in presence, depending upon the schematic activation of the individual.

6. Summary and Application

I began this paper by distinguishing among four factors that contribute to the experience of presence: form, user, style, and content. From there, I defined the book problem as a point of contention between the two major theoretical approaches to presence. The external/perceptual view, adopting a Gibsonian perspective, considers the potential for presence to occur only in situations where our sensory organs are responding directly to an external stimulus (as in a real or virtual environment). Due to the fact that this perspective acknowledges only form factors and dismisses user, style, and content factors, it is tempered with an internal/conceptual view of presence.

Proponents of the internal/conceptual view of presence recognize the role of user factors and, thus, understand it as a response to a mental model of an environment that takes shape in the mind of the individual based upon a combination of cues that originate both externally and internally. This mental model is then attributed to the surrounding world.

The central function responsible for the construction of the mental model is the act of mental simulation, which is facilitated in part by information presented through the medium that is organized in such a way as to produce a stable and cohesive environment via the effective manipulation of style factors such as flow, trajectory, and distillation. Complementing the external cues generated by the medium, the individual's personal knowledge and experience (umwelt) plays a vital role in completing the mediated world that the individual feels present within. Toward this end, various schemata become activated based on content factors and bring to consciousness certain expectations that serve as cognitive filler used to bridge the gaps within and between the mediated patterns of information.

In light of the discussion of how presence occurs internally, we should consider the use value of the medium factors described which complement this process. Since modifying user factors (our cognitive apparatus) isn't a real option, medium factors can be exploited toward the end of enhancing the presence experience. This has historically been the dominant approach, of course, but the emphasis, guided as it is by an external/perceptual perspective, takes for granted the "sensorimotor immersion assumption" (Biocca, 2003) which guides researchers and engineers toward an exclusive emphasis on form factors that are aimed at developing and testing virtual worlds that seem to the senses to be as close as possible to physical reality. The trouble with this approach is that it is subject to the limitations described in the "physical reality problem" [5], which acknowledges experiences of low presence in the real/physical world.

An alternative approach that would be fruitful for the task of enhancing presence in all media, regardless of their level of immersion, would be to refine the effectiveness of content and style in addition to form. While aspects of form focus on familiar variables such immersion, realism, and interactivity, content deals with subject matter. Style characteristics, however, concern technique and presentation and include qualities such as flow, trajectory, and distillation, which were discussed earlier.

In sum, the maximum presence experience is the product not only of *form elements* (such as immersion, realism, interactivity), but also of *content elements* (such as content familiarity and preference), and *stylistic elements* such as the continuity in the progression of experience (flow), reduction of uncertainties about future outcomes (trajectory), and clarification of the most important aspects of the content (distillation).

References

[1] Waterworth, E. L. & Waterworth, J. A. (2001). Focus, locus, and sensus: The three dimensions of virtual experience. *Cyberpsychology & Behavior, 4*, 2, 203-213.

[2] Biocca, F., Harms, C. & Burgoon, J. K. (2003). Toward a more robust theory and measure of social presence: Review and suggested criteria. *Presence: Teleoperators & Virtual Environments, 12,* 5, 456-480.

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

[4] Slater, M. (2003). A note on presence terminology. *Presence-Connect,3*,3.Available: http://presence.cs.ucl.ac.uk/presenceconnect/articles/Jan2003/melslaterJan27200391557/melslaterJan27200391557.html

[5] Biocca, F. (2003). Can we resolve the book, the physical reality, and the dream state problems? From the two-pole to a three-pole model of shifts in presence. Presented at the EU Future and Emerging Technologies Presence Initiative Meeting. Venice, May 5-7, 2003. Available: http://www.mindlab.org/images/d/DOC705.pdf

[6] Banos, R. M., Botella, C., Guerrero, B., Liano, V., Alcaniz, M., & Rey, B. (2005). The third pole of the sense of presence: Comparing virtual and imagery spaces. *PsychNology Journal, 3*, 1, 90-100.

[7] Gysbers, A., Klimmt, C., Hartmann, T., Nosper, A., & Vorderer, P. (2004). Exploring the book problem: Text design, mental representations of space, and spatial presence in readers. In M. A. Raya & B. R. Solaz (Eds.), *Seventh Annual International Workshop: Presence 2004*. Universidad Politecnica de Valencia.

[8] O'Neill, S. & Benyon, D. (2003). A semiotic approach to investigating presence. *COSIGN-2003*, September 9-12, 2003.Available: http://www.cosignconference.org/cosign2003/papers/Oneill.pdf

[9] Pinchbeck, D. & Stevens, B. (2005). Schemata, narrative, and presence. In M. Slater (Ed.), Proceedings of *The 8th International Workshop on Presence*. University College London – Department of Computer Science, 227-230.

[10] Schubert, T. & Crusius, J. (2002). Five theses on the book problem: Presence in books, film and VR. Paper presented at Presence 2002 – 5th Annual International Workshop on Presence. Porto, Portugal.

[11] Phillips, M. (2000). The sadeian interface: Computers and catharsis. *Digital Creativity, 11*, 2, 75-87.

[12] Waterworth, J. & Waterworth, E. (2003). The core of presence: Presence as perceptual illusion. In *Presence-Connect,3*.Available: http://www.informatik.umu.se/~jwworth/perceotual%20core.html

[13] Biocca, F. (1997). The cyborg's dilemma: Progressive embodiment in virtual environments. *Journal of Computer-Mediated Communication, 3,* 2. Available: http://www.ascusc.org/jcmc/vol3/issue2/.

[14] Waterworth, J. A. & Waterworth, E. L. (2003). The meaning of presence. *Presence-Connect, 3,* 3, posted 13-02-2003. Available: http://www.informatik.umu.se/~jwworth/PRESENCE-meaning.htm

[15] Waterworth, E., Waterworth, J., Holmgren, J., Rimbark, T., & Lauria, R. (2001). The illusion of being present: Using the interactive tent to create immersive experiences. *Proceedings*

of Presence 2001, 4th International Workshop on Presence. Philadelphia, May 21-23.

[16] Riva, G and Waterworth, J A (2003).Presence and the Self: a cognitive neuroscience approach. *Presence-Connect, 3* (3).

[17] Glenberg, A. M. (1997). What is memory for? *Behavioral and Brain Sciences, 20*, 1-55.

[18] Schubert, T., Friedmann, F. & Regenbrecht, H. (2001). The experience of presence: Factor analytic insights. *Presence: Teleoperators & Virtual Environments, 10,* 3, 266-281.

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

[20] Julien, E. & Over, R. (1988). Male sexual arousal across five modes of erotic stimulation. *Archives of Sexual Behavior, 17,* 2, 131-143.

[21] Hu, J., Janse, M. & Kong, H. (2005). User experience evaluation of a distributed interactive movie. Available: http://www.idemployee.id.tue.nl/j.hu/publications/HCII2005_icecream.pdf

[22] Ryan, M.-L. (2001). Narrative as Virtual Reality: Immersion and Interactivity in Literature and Electronic Media. Baltimore: The Johns Hopkins University Press.

[23] Rassin, E., Merckelbach, H. & Spaan, V. (2001). When dreams become a royal road to confusion: Realistic dreams, dissociation, and fantasy proneness. *The Journal of Nervous and Mental Disease, 189*, 7, 478-481.

[24] Nunez, D. & Blake, E. (2001). Cognitive presence as a unified concept of virtual reality effectiveness. Proceedings of AFRIGRAPH 2001, 115-118.

[25] Cuthbert, B. N., Vrana, S. R. & Bradley, M. M. (1991). Imagery: Function and physiology. In P. K. Ackles, J. R. Jennings & M. G. A. Coles (Eds.) *Advances in Psychophysiology*, vol. 4. JAI Press.

[26] Clariana, R. B. (1992). Media research with galvanic skin response biosensor: Some kids work up a sweat! Showcase of Achievement presentation at the Annual Convention of the Association for Educational Communications and Technology. Washington, D.C., February 8, 1992.

[27] Osborn, D. K. & Endsley, R. C. (1971). Emotional reactions of young children to TV violence. *Child Development, 42*, 1, 321-331.

[28] Minsky, M. (1980). Telepresence. *Omni, June*, 45–51.

[29] Oatley, K. (1999). Why fiction may be twice as true as fact: Fiction as cognitive and emotional simulation. *Review of General Psychology, 3*, 2, 101-117.

[30] Loomis, J. M. (1992). Distal attribution and presence. *Presence: Teleoperators & Virtual Environments, 1*, 1, 113-119.

[31] Vorderer, P., Wirth, W., Saari, T., Gouveia, F. R., Biocca, F., Jancke, F., Bocking, S., Hartmann, T., Klimmt, C., Schramm, H., Laarni, J., Ravaja, N., Gouveia, L. B., Rebeiro, N., Sacau, A., Baumgartner, T., & Jancke, P. (2003). *Constructing Presence: Towards a two-level model of the formation of Spatial Presence.* Unpublished report to the European Community, IST Program, Project "Presence: MEC" (IST-2001-37661). Hannover, Munich, Helsinki, Porto, Zurich.

[32] Tulving, E. (2002). Episodic memory: From mind to brain. *Annual Review of Psychology, 53,* 1-25.

[33] Mar, R.A., Oatley, K., & Eng, A. (2003). Abstraction and the vividness of details in fiction. In Brock, T. C. (chair), Models and mechanisms of narrative persuasion. Symposium presented at the 111th Annual Convention of the American Psychological Association, Toronto, Ontario, Canada.

[34] Gerrig, R. J. (1993). *Experiencing Narrative Worlds: On the Psychological Activities of Reading.* New Haven: Westview Press.

[35] Schubert, T. W. (2003). The sense of presence in virtual environments: A three-component scale measuring spatial presence, involvement, and realness. *Zeitschrift fur Medienpsychologie, 15,* 2, 69-71.

[36] Conrad, J. (1951). The Nigger of the Narcissus: A Tale of the Sea. New York, NY: Harper.

[37] Birkerts, S. (1994). The Gutenberg Elegies: The Fate of Reading in an Electronic Age. Boston, MA: Faber & Faber.

[38] Csikszentmihalyi, M. (1991). *Flow: The Psychology of Optimal Experience*. New York: Harper & Row.

[39] Klimmt, C. & Vorderer, P. (2003). Media psychology "is not yet there": Introducing theories on media entertainment to the presence debate. *Presence: Teleoperators & Virtual Environments, 12,* 4, 346-359.

[40] Retaux, X. (2003). Presence in the environment: Theories, methodologies and applications to video games. *PsychNology Journal, 1,* 3, 283-309.

[41] Partanen, E. (2003). Presence, flow and their relationship to interactivity in a mediated experience. Helsinki University of Technology. Telecommunications Software and Multimedia Laboratory.

[42] Takatalo, J. (2002). *Presence and Flow in Virtual Environments: An Explorative Study*. Master's Thesis. University of Helsinki. Department of Psychology.

[43] McCullogh, M. (1996). *Abstracting Craft: The Practiced Digital Hand.* Cambridge, MA: MIT Press.

[44] Uexkull, J. (1909). *Umwelt und Innenwelt der Tiere*. Berlin: J. Springer.

[45] Uexkull, J. (1913). Bausteine zu einer biologischen Weltanschauung. Mhnchen: Bruckmann, A.-G.

[46] Uexkull, J. (1920). Theoretische Biologie. Berlin: Gebr. Paetel.

[47] Rumelhart, D. E. & Ortony, A. (1977). The representation of knowledge in memory. In R. C. Anderson, R. J. Spiro & W. E. Montage (Eds.), *Schooling and the Acquisition of Knowledge.* Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

[48] Nunez, D. & Blake, E. (2003). Conceptual priming as a determinant of presence in virtual environments. Proceedings of the 2nd International Conference on Computer Graphics, Virtual Reality, Visualization and Interaction in Africa (AFRIGRAPH 2003), Cape Town, South Africa, 2003, 101-108.

[49] Slater, M. & Steed, A. (2000). A virtual presence counter. *Presence: Teleoperators & Virtual Environments, 9,* 5, 423-434.

[50] McCloud, S. (1993). *Understanding Comics.* Northampton, MA: Tundra Publishing.

[51] Ryan, M. L. (1980). Fiction, non-factuals, and theprinciple of minimal departure. *Poetics, 9,* 403-22.

[52] Nunez, D. & Blake, E. (2006). Content knowledge and thematic inertia predict virtual presence. Proceedings of The 9th International Workshop on Presence, Cleveland State University, Ohio, USA, 39-50.

[53] Ladeira, I., Nunez, D., & Blake, E. (2005). The role of content preference on thematic priming in virtual presence. The 8th International Workshop on Presence, University College London, UK, 227-230.