THE EVOLUTION OF INTERACTIVE MEDIA TOWARDS “BEING THERE” IN NON-LINEAR NARRATIVE WORLDS

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# Table of Contents

**THE EVOLUTION of Interactive media TOWARDS “Being there” in non-linear narrative worlds**.................................................................1

**From the Photoplay to the Holodeck**........................................................................................................2

- Munsterberg and the Photoplay: A Short Story About New Media, Psychologists, and “Laws of the Mind” .................................................................5
- Interactive Media Along the Road to the “Holodeck” ........................................................................7

**Increasing the interactor’s sense of being inside the narrative space: The Level of Presence** .........................................................................................8

**The evolution of interactive technologies and some implications for narrative experience** ..................................................................................14

- The 21st century proscenium: The computer interface .................................................................14
- Four dimensions of the evolution of communication technologies ........................................16
- Mediated embodiment: Getting more of the user’s body into the narrative experience ............17
- Implications of increased user embodiment for narrative experience ..................................19
- Sociability: Interacting with others in an interactive narrative environment ......................28
- Implications of increased sociability on interactive narrative experience ............................29
- Interface intelligence: Responding meaningfully to the interactor’s actions ......................31
- Implications of increased intelligence for narrative experience ........................................33
- Ubiquity of access: Connecting users to narrative virtual environments anywhere in space and time .................................................................35
- Effect of ubiquitous computing on narrative experience ....................................................36

**Conclusions** .........................................................................................................................................................37

**References** ..........................................................................................................................................................39

**NOTES** .............................................................................................................................................................47

**TABLES** ............................................................................................................................................................48

**FIGURES** ..........................................................................................................................................................54
FROM THE PHOTOPLAY TO THE HOLODECK

The original narrative medium was the body and the spoken word. The body and the word were used to simulate narrative worlds: physical spaces, social interactions, and mental states of characters. But increasingly the body, the word, and all the elements of the narrative world are experienced through various media: books, video, and interactive virtual environments. In her book on Computers as Theatre, Brenda Laurel implored her engineering oriented readers to, “think of the computer, not as a tool, but as a medium” (Laurel, 1991, p. ix). This chapter will consider the narrative implications of the computer medium.

What is striking about the early 21st century is the many ways new media alter the nature of narrative experience. A claim can be made that the computer, what many still see as little more than a “calculator on steroids,” “seeks to become a 3D stage. Cognitive scientist and human-computer interaction guru, Don Norman, points to the number crunching box and asks: “Do you enjoy the experience of using these new technologies? If not, why not? Perhaps it never occurred to you that the concepts of ‘enjoy’ and ‘experience’ could apply to the new devices…” (Don Norman in Laurel, 1991, p. x). In the early 1990s, when Norman wrote these words, the computer was still a dreary drone. With the arrival of advanced multimedia, narrative virtual environments, and the Internet, and computer may now be the leading edge vehicle for artistic expression in our culture. With higher quality audio, video, and embodied interaction the computer has grown as a medium, it has become more expressive, more pliable, and increased its ability to mimic the sensory qualities of other media. It can now mimic the capabilities of all past narrative media: the canvas, the book, the radio, the television, the arcade ride, and, maybe, even live theater (Roehl, 1999).

Predictions of significant alterations in communication experience are most often
asserted when a new communication medium arrives that allows a significant departure in the nature of sensory experience (e.g., Heilig, 1992/1955; Holmes, 1859; Lubar, 1993; Youngblood, 1970).

Why should technology play a role in narrative experience? Significant changes in technology have altered the sensory experience and representational codes that structure narrative. We can see a steady progression of expressive forms from the pre-writing, iconic representational codes of Lascaux Caves to the coordinated multi-sensory codes of the latest virtual reality system. Innovations in technology or technique can go to the heart of narrative experience. For example, computer simulation technologies can alter representational techniques and simulate physical spaces, social interactions, and the mental states of characters (Cassell, Sullivan, Prevost, & Churchill, 2000; Foley, Dam, Feiner, Hughes, & Philips, 1999; Magnenat-Thalmann, Kalra, & Escher, 1998; Sims, 1994).

New media technologies and narrative also share a common goal: the transformation of experience. Narrative has played a role in expanding our experience of other lives, other spaces, and other ways of being. Highly interactive media such as immersive virtual reality technologies (Biocca, 1995; Durlach & Mavor, 1994) are designed to be engines of experience. Immediately upon entering the virtual environment, the user steps on a stage and ceases to be an audience member.

Interactive media transform the audience member into an “interactor” (Laurel, 1991). The very term suggests a new role, a sense of agency and activity. If older narrative structures are a set of train cars steaming down a linear, predictable track, this new agent, the interactor, is a conductor steering the train off the track and into a field of dreams. But the term interactor just as easily suggests a body twitching appropriately to stimulation, yanking levers, transformed into a kind of piston in some narrative engine.
Some see the possibility of immersive, sensory-intensive experiences rich in personal transformation and insight (e.g., Murray, 1997). Others see a random bouncing around a non-linear series of episodes and scenes, the narrative equivalent of the pinball machine. For example, consider the biting observations of Brian Ferren, executive vice president for creative technology and research at Walt Disney Imagineering:

"You know, when it comes to storytelling, people suspect that, 'oh well, I'm just as qualified to tell a story as anyone else is'. It is not true. When you saw Schindler's list … if you had at home a little box with a knob that let you dial in "Happy Nazis", "Mean Nazis", "Nazis that speak Portuguese" a whole collection of different options, it wouldn't make it a better film. The reason Steve Spielberg is paid a great deal of money is because he is a master storyteller". (Ferren, 1997).

In some way no medium is truly new, it harks back to earlier forms. Technologies and techniques of narrative experience are quite old. Only a few aspects of computer-generated narrative experience can be called “new,” or better still, “adapted.” Interactive technologies share a lot of techniques with earlier media.

This chapter will focus on what is different about narrative experiences involving interactive media. This emphasis on what is different will tend to take us towards the more advanced forms of interactive media, those that are less textual, such as hypertext, and more multi-sensory, such as virtual reality. Most of the issues raised by these media also apply to more primitive interactive narrative techniques found in narrative hypertext and primitive computer games. We will avoid focusing on specific technologies, but rather treat interactive media as a family of evolving forms of narrative media. The scope of our discussion will focus on:

- Evolution of interactive media and how the dimensions of this evolution affect the qualities of narrative experience.
Focus on dramatic narratives in interactive media, and only to a lesser degree more mundane representations of everyday narrative sequences,

The experience of presence (e.g., “being there” in the story) in multi-sensory interactive media, especially the families of evolving immersive media,

And, finally, on the application of computer intelligence to narrative form, especially in the dimensions of non-linear interactive narrative forms.

Munsterberg and the Photoplay: A Short Story About New Media, Psychologists, and “Laws of the Mind”

Before we step onto a stage cluttered with technologies like virtual reality, let me briefly tell a cautionary tale. To do this I will take you to a backstage area where in the prop room, we recreate a narrative involving a much older technology. In this more comfortable, familiar place, I can tell you a brief story that will illustrate the dilemma of analyzing the psychology of any young medium.

The date is 1916. The location Harvard yard. Our protagonist is the head of the experimental psychology lab at Harvard, Hugo Munsterberg, (Munsterberg, 1916). He is sitting in the lab watching flickering patterns of light on a wall, puzzled by a new technology, the “fashion” on the streets of Boston. Munsterberg, complains to his close friend, William James, that some of the youth of Harvard are mesmerized by a new technology. It is just a “gimmick” that seemed to be mimicking the theater. From the salons of Paris to the offices of Edison, there are attempts to use a new technology to tell stories. Gears, celluloid, and the electric light had given birth to this new narrative vehicle, the Photoplay. For Munsterberg there is something very interesting psychologically about the relationship of the viewer, of their experience of film.

Munsterberg was conducting research, of course. As a Harvard professor he would be loathe to admit that so plebian an offering as a Photoplay could be enjoyable. But in the spirit of Pragmatism, he sat in the dark observing, exploring, and analyzing the curious
psychological devices of the new medium. The collection of notes and observations gave birth to a book called *The Psychology of the Photoplay*, probably the first substantial psychological study of the new electric media. The book appeared in 1916, the year Munsterberg died.

Like the author of this chapter almost 100 years later, Munsterberg did not have many examples of outstanding narrative in this new medium. But early narrative films like *The Life of an American Fireman* (1902) and *The Great Train Robbery* (1903) displayed early forms of film language. The year Munsterberg was writing his book on the psychology of the photoplay, a classic, the *Birth of a Nation* (1915) was released.

But there were certainly no experimental studies of the psychology of narrative in film. But in the form of the medium Munsterberg could discern the simulation of psychological processes like attention, the devices that stimulated semantic associations and mechanisms that stimulated arousal and emotions. He observed that the close-up and zoom simulated the movement of attention in the environment (e.g., “zoom” theories of attention, Johnston, 1986 #1704]

Although the photoplay and stage play shared many conventions, especially in 1917, emerging techniques foreign to the theater such as the cut, zoom, and other emerging film conventions suggested that there was something fundamentally different about the way the narrative world of the photoplay was constructed and experienced. Observing the curious structure of imagery in this “realistic” medium, he concluded "The photoplay obeys the laws of the mind rather than those of the outer world" (p. 15). In the new medium Munsterberg could see a stimulus that generated a rich environment that modeled not so much the “real world,” as the way the mind experienced the world.

Here again we are at the turn of the century, almost 100 years after Munsterberg began his observations. Sitting in the multi-university, networked Media Interface and
Network Design (M.I.N.D.) Lab we can observe the latest generation of students gathering in cyberspace to experience various interactive media such as MUDS, Moos, virtual environments, interactive games, etc. These environments are the descendants of the 1962 interactive computer experience, Spacewar, the first interactive computer game. Like Munsterberg we share a suspicion that these narrative virtual environments have less to do with the reproduction of world and more with “objectification” of thought processes. In these cognitive artifacts rich in multi-sensory stimuli, there lies a pathway to mental simulation. If these emerging narrative media are cognitive artifacts, they must be defined in relation to cognition. What is most critical to the structure of a new medium is not the silicon, plastic, fiber optics, and copper that form the technology, but the way the medium is coupled to the human mind and body. It is to this coupling of medium, body, and mind that the explanation of the fuzzy concept of “interaction” lies. To quote Norman once again “The key word to finding an illuminating path through the technological maze is ‘interaction.’” (Don Norman in Laurel, 1991 p. x)

**Interactive Media Along the Road to the “Holodeck”**

Interactive technologies vary along several dimensions. Narrative computer experiences may appear on small, hand held computer game consoles, to online hypertext, to highly immersive virtual reality systems. All deliver narrative experiences with “new media.”

Between the time I write this paragraph to the time you read it, computer interfaces will have evolved new configurations. It is important then not to dwell too much on a specific technology. Rather, we will:

1) Focus on two aspects of user narrative experience that have been central to theorizing and research in interactive media: (a) the experience of “presence” or “telepresence” inside interactive narrative worlds, and (b) the experience
of non-linear narrative structures,

2) Outline some basic dimensions that array the families of interactive media and their evolution, and explore how each dimension potentially influences qualities of narrative experience.

**INCREASING THE INTERACTOR'S SENSE OF BEING INSIDE THE NARRATIVE SPACE: THE LEVEL OF PRESENCE**

Media, especially those high in perceptual realism, can engage the user with multiple sensory cues and elicit a strong sense of a perceptual space (Hochberg, 1986). But, sometimes, when engaged with compelling medium or story, we may experience a sense of being transported to a different place (Gerrig, 1993), so much so that we seem to be inside the mediated space. For a brief moment or longer, we may forget that the experiences flashing across a screen (the artificially generated light arrays) are being presented through technology. At some moment we become aware just of the experience, and not the medium. We somehow feel present “there” in the narrative world created by the medium: behind the steering wheel of a flame-red convertible racing down a dusty desert road; floating on a red blood cell through an artery; or clinking a wine glass at a small outdoor café table on the left bank of Paris. Our awareness of the virtual environment may be clear and our mental model vivid, while our awareness of our physical environment may be diminished. The narrative characters conjured up by the medium may feel co-present in this world, as much “there” with us, as any person.

Our reactions to objects and beings in the virtual environment might compel us to flinch and duck when something “jumps” out at us, cry at a “sad scene,” or stand silently in awe as the images and sounds saturate our senses. The effect of being in this virtual place may be so vivid that it might compel us to talk to characters on a screen, “Hey, look behind you!” In rare instances these virtual places may give us a deep sense of
understanding about the world in which we live, a sense of “being in someone else’s shoes,” or allow us to comprehend something about ourselves. These are moments when a narrative is most powerfully connected to the user, moments that users often remember, moments when the distinction between a mediated experience and a direct experience becomes blurred.

Although these media generated epiphanies have been long sought for centuries by artists and communicators (Biocca, Kim, & Levy, 1995), they are little understood. The arrival of interactive media, the desire to “design” such experiences has increased research on the nature of such experiences.

Interactive narratives, like all narratives, are in some ways a simulation of experience. Interactive media are often used to create all kinds of simulations of physical and social environments. Simulations are most often used for training (e.g. Ramesh & Andrews, 1999), for scientific exploration and physical modeling (e.g. Bryson, May, 1996), and, of course, for entertainment (Hawkins, 1995). Simulations can vary from high-end, immersive flight simulations used to train military fighter pilots to simulations of social environments such as those found in the SimCity series (Barfield, Zeltzer, Sheridan, & Slater, 1995; Durlach & Mavor, 1994; Hays & Singer, 1899; Neyland, 1997; Sutherland, 1965). Narratives can be seen as a form of simulation, the product of representational techniques and cognitive artifacts that allows us to extend the range of our experience to other physical and social environments.

In the late 1980s and increasingly in the 1990s advanced media and interface design research centers in universities, the military, and corporations became interested in the role of what came to be called “the sensation of presence” while using different kinds of simulation technologies (Hays & Singer, 1989; Minsky, 1980; Sheridan, 1992; Short, Williams, & Christie, 1976). The preoccupation with the theoretical concept of
“presence” emerged, and the concept became central to a discussion of human experience in high performance, interactive media like virtual reality (Biocca & Delaney, 1995; Durlach & Mavor, 1994). Among the engineering and human-computer interaction community of MIT, a journal with the non-engineering name of “Presence” was founded that focused on advanced virtual environment design (“Teleoperators and Virtual Environment Design.”). A psychological goal, presence, came to define the design focus of a hardware and software engineering community. A research program was launched that focused on the phenomenological qualities of experience in advanced interactive media. To design media that push the limits of mediated experience be it in narrative or in military training, it is believed that we increasingly need to understand these moments of “being there,” moments when our awareness of the medium disappears and we are pushed through the medium to sensations that approach direct experience.

But most researchers in this community are very much aware that the experience of presence predates any advanced media. At the M.I.N.D. Lab, this acknowledgement is bound up with a theoretical conundrum we call the “book problem”: a theory of presence derived for work in advanced media must also be able to explain how the sensation of “being there” can occur not just in a virtual reality system, but with any medium, including much older non-iconic, “low tech” media such as books (e.g., Gerrig, 1993). But presence research using advanced media seeks not just to explicate a theoretical concept, but to better control presence, to more consistently and reliably evoke the experience of presence in the user. By immersing the sensorimotor system into coordinated mediated stimuli such as those found in advanced virtual reality interfaces, designers can generate compelling sensations of leaving behind our unmediated physical body and environment and entering the virtual environment. The key to optimizing human performance and experience in these “mind machines” may lie in understanding
how the machine interacts with the mind to create this deep sense of what has come to be called “presence.” One goal of interactive narrative experience is to immerse the mind of the “interactor” into the narrative world, and the achievement of presence is one way to define the psychological impact and success of a narrative environment.

For the discussion that follows let us offer a working definition of presence. To capture some of the dimensions of presence we will use the concepts of telepresence, social presence, and self-presence. A definition and short explication of these is provided in Table 1.

Definitions of the concept of presence take a number of overlapping forms (Barfield et al., 1995; Lombard & Ditton, 1997; Loomis, 1992; Sheridan, 1992; Steuer, 1995). The “short hand” definition of presence most commonly defines it as the illusion of “being there” in the virtual environment. Some theorists acknowledge that the sensation of presence is not unique to media use and may define a quality of being in any environment or experience. Loomis (1992), Steuer (1992), Biocca (1993) and others consider presence, generally, as a phenomenological state, a mental model and awareness of the physical environment experienced through the senses. For Steuer (1992) it is almost the same as consciousness when he defines it very simply the “experience of one’s physical environment.”

Loomis (1992) provides a more subtle argument grounded in perceptual psychology. For Loomis (1992), the experience of telepresence, the mediated form of presence (see Table 1) is just a form of externalization or distal attribution, the basic psychological process by which stimulation of the senses (proximal stimulus) leads the individual to
attribute the sensation (distal attribution) to an external environment (distal stimulus) as opposed to the sensory organ itself. For example, sight is not experienced as patterns of light stimulating our retina; rather we experience a room “out there.”

The perceptual world created by our senses and the nervous system is so functional a representation of the physical world that most people live out their lives without ever suspecting that contact with the physical world is mediated; moreover, the functionality of perception impedes many reflective individuals from appreciating the insights about perception that derive from philosophical inquiry. Oddly enough, the newly developing technology of teleoperator and virtual displays is having the unexpected effect of promoting such insight, for the impression of being in a remote or simulated environment experienced by the user of such systems can be so compelling as to force a user to question the assumptions that the physical and perceptual world are one and the same. (Loomis, 1992, p. 113)

Although a theoretical discussion of presence has been ongoing in the virtual environment literature for most of the 1990s, key theorists feel that the definition of presence remains an “unresolved issue” (Durlach & Slater, 1998). Others worry that the concept “remains confused” and that “different writers mean different things” (Murray, 1998 p. 9). Some take a rather restricted view that focuses solely on human performance and seeks to ignore presence as an “epiphenomenon” (Ellis, 1996; Ellis, Dorighi, Menges, Adelstein, & Joacoby, 1997). Part of the problem is that the early users of the concept (e.g., Minsky, Sheridan, others), were mainly grounded in engineering and, in some cases, perceptual psychology (Held, Loomis). Both communities tended to be uncomfortable focusing on the “soft” and illusive phenomenological tendencies of the concept, a problem that required an exploration of the subtle properties of consciousness. For example, some theorists, especially engineering-oriented researchers, tended to make the mistake of defining a momentary phenomenological state (a cognitive dependent variable) by extensive reference to its causes (engineering independent variables) (e.g.,
Sheridan, 1992; Zeltzer, 1992). As a result such definitions do not assist in understanding the underlying psychological dimensions of presence and their measurement.

The theoretical problem of presence, the sense of “here” in space, is a part of the more general problem of consciousness (Biocca, 1996; Campbell, 1998; Chalmers, 1996; Metzinger, 1995; Weiskrantz, 1997). Evidence from the neurosciences suggests that there are “where” and “what” systems for the processing of stimuli and that perceptual or imaginal stimuli both share resources in perceptual processing (Underleider & Haxby, 1994). The construction of the “where” generates a conscious awareness of the egocentric location of one’s self in a place relative to other objects, and, often, other intelligent beings. A significant part of consciousness is essentially awareness of and the mental construction of this environment. Significant cognitive resources are allocated to processing “where” things are, especially, in relation to the body (Paillard, 1991). At any moment of time we have a sense of being present in one place. Perceptual processing quickly constructs a model of the environment around us: objects in the environment and the position of our body in the environment. Consciousness is filled with a compelling sense of “here,” of place.

In the context of narrative environment, the concepts of presence and its dimensions attempt to tap into the user/reader/viewer’s sense of being inside the narrative space and the feeling of insight into the intelligence of the characters. For an anecdotal insight of how social presence and telepresence are intertwined consider Murray’s description of her sensation of being looked at by a character in a 3D IMAX film:

Sitting in the theater with the 3D-goggles on, I felt myself begin to blush, as if I were actually meeting his gaze. There is a discomfort in not knowing the limits of the illusion. (Murray, 1997 p. 120).
The intensity of the sense of presence, and by extension, telepresence and social presence, can vary considerably within and across individuals. Higher levels of presence are characterized by a strong awareness of the physical space including one’s position in space, the objects in the space, and other intelligent beings in the space. Presence is experienced during the processing of the everyday physical environment, of sensory stimuli of mediated environments, and from purely internal representations, such as in dreams.

Below we will discuss some of the variables that seem to increase the interactor’s sense of presence with interactive media.

**THE EVOLUTION OF INTERACTIVE TECHNOLOGIES AND SOME IMPLICATIONS FOR NARRATIVE EXPERIENCE**

**The 21st century proscenium: The computer interface**

In Greek theater the narrative unfolded in proscenium, the space in front of the backdrop. Architectural technologies allowed unobstructed views of the actors and used large urns to amplify the sound in the theater. The Greek chorus provided a god’s eye view on the unfolding of narrative events. At the theatre of Dionysus, situated on the south side of the Acropolis, one will find a classic example of the proscenium, the “front of the scene” or “stage” where the narrative experience was played to the eyes and ears of the audience. In a way, the proscenium connected the play to the senses of the audience, the eyes and ears, and created a narrative space.

In the world of interactive computer narratives, the interface is the modern proscenium. Interfaces are the devices such as telephones, computers, and television sets that allow the human user to transmit or absorb information. The word interface is defined as “The point of interaction or communication between a computer and any other entity, such as a printer or human operator” (American Heritage Dictionary, 1992). But this misses key dimensions of the concept that are important to understanding how media
work and how they will evolve. There are a number of different ways to conceptualize the idea of an interface (Shneiderman, 1998). We will choose a more psychological approach to defining the interface.

To understand the interface, one must begin with the body, the primordial communication medium. The senses are the locus for the reception of all information, and the motor systems are means of transmitting information, emotional states, etc. Approached fundamentally with the body, we can conceptualize not just past interfaces, but all current and evolving interfaces. The interface is that part of the medium that is directly coupled with the body of the user to send information to the user or to receive information from the user by registering user actions. Effectors or output devices (e.g., monitors, motion platforms) interface with the senses to deliver sensory stimuli (i.e., energy arrays). While codes such as spoken and written language continue to carry much information, other representational codes and conventions such as the “windows” interface organize information, guide user perceptual processing, and goad user action. Sensors capture communicative, navigation, and physical manipulative aspects of the user’s bodily behavior and actions. Interpretive codes and algorithms turn recorded observations of user behavior into inferences about user intentionality (i.e., commands) and user states (e.g., present-absent, emotional states, etc.). Interactive technologies differ from non-interactive technologies primarily in the sophistication of sensory devices and the way data from the sensor devices is mapped to sensory stimuli to create the illusion of “interaction.” So the part that makes a television monitor different from a computer monitor is the element of sensory feedback based on simple choice or communication behavior, as in a primitive menu system, to moment-to-moment motor
behavior, as in a more closed-loop virtual reality system. Below we will see that the raw nature of closed sensory-motor loop has some potentially dramatic effects on the nature of story telling and narrative experience.

In short, the interface is always at an information transformation point where narrative structure is changed into narrative experience as it moves from one form to another, from one system to another system, as from the “bits” inside the computer to the “meanings” interpreted by the user, from the analog world to the digital world, from cyberspace to physical space, or from one code (e.g., spoken language) to another code (e.g., written language).

Finally, all media must store and transmit information narrative content to the user, and they differ on how this is done. Narrative content has been distributed via physical channels by transporting physical storage objects such as paper, CDRoms, and tapes, but increasingly information is stored electronically and is transported to the user via telecommunication channels (e.g., WWW).

**Four dimensions of the evolution of communication technologies**

If all interfaces can be considered as points in the evolution towards some ideal transparent interface, then we could array narrative media on the key dimensions that distinguish one from another (Steuer, 1995). We feel that most of the evolutionary patterns of media interfaces and transmission systems can be captured by four simple dimensions. The dimensions of mediated embodiment, intelligence, ubiquity of access,
and sociability capture the main thrusts in the current evolution of media interfaces. Figure 2 arrays the dimensions into one four-dimensional plot. The figure allows us to locate media along these four dimensions and to see how they cluster. This figure includes more than traditional telecommunication interfaces such as the telephone, but also more general media interfaces such as books and television. We will use these four dimensions to organize our discussion of how interactive narrative interfaces influence the experience of narrative.

**Mediated embodiment: Getting more of the user's body into the narrative experience**

Interactive media vary as to their level of mediated embodiment, or how much of the body is immersed into the narrative environment. The user’s level of mediated embodiment is defined as the degree to which the body is coupled to the interface, or the degree to which sensorimotor channels are immersed (See Biocca, 1997; Biocca & Delaney, 1995; Durlach & Mavor, 1994). In a Gibsonian sense (Gibson, 1966, 1979) the user’s body is linked to the environment, once motor action and sensory feedback are linked. The user is embodied in the virtual environment (Biocca, 1997). To make the user perceptually aware of his or her actions, interactive environments give the user some form of “body” that is linked to the user’s motor action and “represents” the user in the virtual environment. This bodily representation of the user can be as small and impoverished as a mouse arrow that like a hand moves over and “touches” objects in the virtual environment. It can also be as rich as a full 3D graphic “avatar,” a bodily representation of the user, inside the virtual environment.

Media interfaces vary in how many sensory channels are supported, for example, audio, visual, and tactile and the sensory cues provided in each channel. They might vary in how much the sensory channel is immersed in the mediated environment (e.g., small screen versus IMAX screen). They also might vary on the input side, how much of the
user’s body’s motions and responses (motor behaviors) the computer can sense. For example, input devices for an interface might sense a user’s motor channel activity, such as how a user is moving his hand in 2D space (e.g., a mouse) or where the user is looking (e.g., head tracker or eye camera). In some interfaces input sensors also pick up a user’s autonomic responses such as heart rate, blood pressure, etc.

When we array all narrative media interfaces along the dimension of embodiment, we can see a high degree of variance. On one end of the extreme are non-interactive narrative media such as the book, which utilizes only a small part of the visual channel with non-iconic stimuli. When there are no pictures, the book uses a small part of the sensory cues detectable by the visual channel to carry information. Closer to the other end of the embodiment dimension among non-interactive media we find the visual iconic extremes of widescreen, IMAX theaters. These saturate the visual channel with information, filling all that the eyes can see with information from the virtual as opposed to the physical environment. But still, the viewer cannot interact with the virtual environment on the film screen.

At the absolute other end of the dimension are narrative media that not only provide a lot of sensory information to a large number of senses, but they are interactive (intelligent) as well and make real time use of more of the user’s actions and responses. For example, immersive VR bathes the visual, aural, and sometimes the tactile senses, but also tracks every fine movement of the head, the hands, and other parts of the body to increase the ways in which the body can interact with the objects and characters inside the narrative virtual world (Biocca & Delaney, 1995). To be able to sense and meaningfully use the user’s motor behavior, a medium must have some minimal intelligence.

Looking at the graph, we see a clear trend where advanced media like virtual and
augmented reality are steadily increasing the mediated embodiment of the user both in
terms of improved sensory displays and greater and more intelligent sensing of motor
behavior. This trend means media involve more the sensory, motor, and autonomic
channels; it further means that sensors and displays increase steadily in their fidelity; and
that media use more of the bandwidth of each channel.

The most compelling media interfaces found with advanced telecommunication
systems such as virtual reality can be further classified according to their level of media
embodiment. Table 3 briefly lists various classes of virtual environments according to
the degree of mediated embodiment, that is the degree to which they are coupled to the
user’s body. All of these have been used for the experience of narrative environments.

Insert Table 3 about here.

Implications of increased user embodiment for narrative experience

As the user’s body is more and more immersed in the virtual environment, does this
change some aspect of the narrative experience? There is widespread belief among
interface designers, and some research support, for the proposition that increasing levels
of mediated embodiment (sensory immersion, motor immersion, and sensorimotor
coordination) in the medium will influence user’s sense of presence (Akiyama, 1991;
Barfield et al., 1995; Biocca, 1997; Durlach & Slater, 1998; Hatada, Sakata, & Kusaka,
Barfield, 1996; Ijsselsteijn, Ridder, Hamberg, Bouwhuis, & Freeman, 1998; Ijsselsteijn &
de Ridder, 1998; Lombard, Bomacicich-Ditton, Gabe, & Reich, 1994; Lombard & Ditton,
1997; Loomis, 1992; Pausch, D., & Williams, 1997; Reeves & Nass, 1996; Sheridan,
1992; Steuer, 1995; Tromp, 1995; Witmer & Singer, 1994). Some findings suggest that
immersing the body of the user in the virtual environment (sensorimotor immersion)
increases the sense of presence, all other things being equal. Increasing the number of sensory channels receiving stimuli from the virtual environment (e.g., Gilkey & Weisenberger, 1995), increasing immersion of the visual channel (Arthur, 2000; Hatada et al., 1980; Hendrix & Barfield, 1996; Prothero, Hoffman, Parker, III, & Wells, 1998), or providing some key sensory cues such as motion of the visual field appears to increase the level of telepresence. Systems such as immersive virtual reality tightly couple motor action and sensory feedback. This tight coupling appears related to the sense of presence in these systems, and presence is disrupted when delays are introduced between action and perception (e.g. Welch, Blackmon, Liu, Mellers, & Stark, 1996). Fidelity defined as image resolution, on the other hand, has an inconsistent effect on presence and expected correlates such as learning and memory (Alessi, 1988; Christel, 1994; Hays & Singer, 1989; Welch et al., 1996)

**Reality Monitoring**

Extending the evolution of existing interface, over time we can expect higher levels of embodiment with each medium, what we call “progressive embodiment” (Biocca, 1997; Biocca & Nowak, in press). With each increase in the level of immersion or arrival of any new immersive medium, commentators speculate euphorically about the medium or moan Cassandras predicting fearfully about the confusion between direct experiences in the physical world and mediated experiences in virtual environments (Heim, 1993; Lanier & Biocca, 1992; Lauria, 1997; Murray, 1997; Rheingold, 1991). The history of media shows interesting occurrences of users’ confusion about the “reality” of mediated, fictional experience (See Shapiro & McDonald, 1995 for a historical “reality monitoring” in the context of virtual reality). Immersive technologies have long been presented as sources of powerful illusion in utopian or dystopian hues in science fiction: for example, Orwell’s ‘feelies”, Bradbury’s “televisors,” the Star Trek “holodeck” and Gibson’s
“simstim.” Since Socrates’ anxiety about the powers of “mimesis” has often greeted technologies that increase presence, a concern that, at high levels of presence, physical, fictional, and imaginal become “almost” indistinguishable. But as yet, in studies of the current generation of virtual reality systems there is little evidence of “reality monitoring” confusion in (Johnson & Raye, 1981), for example, blurring the boundary between direct and mediated virtual experience (Hullfish, ; Johnson & Raye, 1981). While it may seem far away and out of reach, making the virtual, mediated perception, indistinguishable from the “real,” direct perception, has been the goal of virtual environment engineering since its birth (Sutherland, 1965). But the ambition of virtual reality has a long history, because the creation of powerful “replicas of experience,” “windows on reality” and “dream states” has, historically, been the goal of many media technologists at each stage in the long history of media (Biocca et al., 1995).

The goal of full perceptual immersion in a narrative illusion, an absolutely “transparent” medium, has not yet been achieved, of course. But confusions in perceptual reality judgments do occur, but only in highly constrained settings (i.e., stationary monocular viewing) or for very short periods of time. A certain level of perceptual realism has been achieved in film special effects in that many viewers are unable to distinguish between computer generated simulations of physical reality and filmed physical events and scenes. But such judgments are made in a highly constrained environment, as it is an illusion within the film medium and not a “real time” interactive medium. During the richly rendered boat scenes from the movie, Titanic, for example, few in the theater believe they are riding on the Titanic, and in film, none can take the helm.
**Arousal**

With increased mediated embodiment, and more contact between the body and the medium, comes the issues of the increased arousal of the user. When the narrative space surrounds the body of the user, some believe that emotional arousal may be intensified (e.g., Laurel, 1991; Murray, 1997). There is some evidence that increased mediated embodiment may contribute to higher levels of arousal in narrative experiences. For example, the highly subtended field-of-view of wide screen IMAX, interactive motion rides, and high-end virtual reality systems can produce physiologically arousing illusions of vection during motion sequences (Boothe, 1994; Casali & Wierwille, 1986; Hettinger, 1990; McCauley & Sharkey, 1992).

Both traditional and interactive narratives will manipulate mood by setting up and violating expectations. MacDowell and Mandler (MacDowell & Mandler, 1989) manipulated expectations in an adventure game. The degree of both positive and negative discrepancies was related to heart rate and higher subjective reports of intensity, with negatively toned (discrepant) effects producing significantly higher intensity and autonomic responses.

A significant amount of narrative interactive media are (1) designed to heighten arousal through direct physiological stimulation or arousing content, and (2) used by interactors to regulate mood states. Research on media underlines how media content, including the experience of narrative, is often used for “mood management,” when the user seeks to use the content to alter or maintain a mood state (Kubey & Csikszentmihalyi, 1990; Zillmann & Bryant, 1994). Much of the research on arousal has been concerned with the effects of pornography, violence, or fear-enducing content on children and adolescents and, especially, transfer of emotional effects to behavior or mood states outside the mediated environment (e.g., Cantor, 1994; Gunter, 1994). So it
appears that arousal and interactive media are systemically linked both by the design
goals of producers (e.g., “twitch” games, violent games, interactive adventure) and by
user intentions when using them (e.g., the design for stimulation, diversion, etc.).

Some theorists and critics have voiced concern about the effect of advanced
interactive media on interactor emotion and arousal. Many argue some variation on the
following: as interactive media immerse more of the body in narrative experience (i.e.,
increased level of mediated embodiment) and as users’ gain more control over the
pacing and unfolding of the narrative, then:

(a) emotional effects and control of the user becomes harder to design,
    weakening narrative emotional effects and/or
(b) arousal and mood states in interactors may become more intense or extreme
    than with media lower in embodiment and intelligence (i.e., less vivid and
    interactive), and/or
(c) interactors become more susceptible to the effects of content category (e.g.,
    violence, pornography, etc.) on social cognition and behavior.

For example, consider the following in a recent review of the video game and violence
literature:

If the latest three dimensional video games have more potential to build the
aggressive behavior repertoires of consumers than television shows and movies,
then violent virtual reality games constitute another step forward into the danger

But it appears that most of the research on video games and violence (see reviews by Dill
& Kill, 1998; Griffiths, 1998) has sought only to reproduce the findings from early
television research. We can find little research on whether any of the variables that
distinguish interactive media from passive media increase post-exposure aggressive
thoughts and behavior as compared to television or other media with lower levels of
mediated embodiment or intelligence (or versions of these concepts confounded in the notions of “interactivity” and “vividness”).

Narrative designers tend to be more concerned with modulating and controlling states of arousal during exposure to the narrative experience. For example, Murray, an MIT instructor in interactive narrative design:

…if a participatory immersive experience is not to be pornographic and if it is not to lead to frustration or to inappropriate explosion…, then the participant’s arousal must be carefully regulated. The trance should be made deeper and deeper without the emotions become hotter and hotter (Murray, 1997, p. 119)

Murray seems to want to achieve high levels of presence (the “trance should be made deeper and deeper”) but somehow dampen arousal effects. But there is some preliminary evidence that presence and arousal are linked. Lang (personal communication) has found that high levels of physiological arousal measured by skin conductance and heart rate is related to higher levels of presence (A Lang, personal communication, March 24, 2000). Decoupling presence effects from arousal effects may not be easily achieved. There is not yet enough research showing that higher levels of mediated embodiment interacts with the “same” content to intensify arousal and its related effects as compared to traditional media.

Can interactive narrative worlds distort the user’s sense of their body

Media mediate our perception of the physical and social environment. They substitute mediated stimuli (e.g., a video image of a room) for unmediated stimuli (direct perception of the room). Most interactive media interpose themselves between the motor actions of the user and the sensory feedback afforded by the physical world. For example, head motion in an immersive virtual reality system is coupled with a change in the virtual scene visible in a head-mounted display. Sensory experience can change the user’s internal representation of the body’s morphology and the relationship between motor
actions and sensory feedback (Welch, 1978; Welch, 1998; Welch & Warren, 1986). The body schema is more labile and unstable than most people would believe. Meyer & Biocca (1992) found changes in young women’s perception of the shape of their bodies following exposure to no more than ½ hr of programming that emphasized a thin ideal body image.

When a narrative world substitutes mediated perception for direct perception, it is almost certain that some aspect of the mediated stimuli will not match the characteristics of unmediated stimuli. For example perceptual cues in traditional media such as film and video are distorted (Hochberg, 1986). It is unlikely that virtual reality will successfully match the perceptual characteristics of the sensory environment any time soon (Durlach & Mavor, 1994).

Distorted perceptual cues in an interactive narrative, especially in an immersive environment, can take the form of competing cues within a sensory channel (e.g., vergence and accommodation within vision) or competing cues across sensory channels (i.e., intersensory conflict, for example, conflict between the seen and felt position of the arm). Most commonly there may be competing cues across and within the senses as to the location, depth, and characteristics of an object or scene coming to the senses. Welch (1998) lists a number of cues that can be different in virtual environments, including: (1) inadequate sensory resolution, (2) an absence of certain sensory cues or entire sensory modalities, (3) constricted range of stimuli (e.g., fields of view), (4) sparse, ambiguous, or distorted object, motion, and depth cues from computer graphics, (5) delayed, faulty, variable, or absent sensory feedback from the user’s movements, and decorrelations between sensory cues or systems, and (6) distortions of visual size, shape, and spatial orientation. Distortions in these sensory cues means that interaction with the virtual environment is different than interaction with the physical environment. To the degree
that the virtual body is that part of the sensorimotor system interacting with the virtual environment, we might describe the condition as a mismatch between the virtual body and the physical body. The virtual body in mediated perception is inevitably composed of a distorted subset of the dynamic perceptual range of the physical body in direct perception (see Ellis, 1993; Barfield et al., 1995).

What is the effect when the interactor’s virtual body does not match the range and properties of the physical body? Or more precisely, what is the effect when mediated sensorimotor cues do not precisely match unmediated forms of those cues. In media with low levels of user embodiment, such as television, distortions in visual cues such as optical distortions from off center viewing or zoom lenses cause non-noxious perceptual distortions in the user’s perception of the represented space, for example distortions in depth perception and motion perception (Kraft, 1986, 1987). But what happens as the level of embodiment increases and the body is more tightly coupled to the medium? There is some evidence of more noxious effects as perceptual distortions become more visible.

In conditions of high user embodiment the potential for noxious effects increases. A widely reported side-effect of the use of highly immersive virtual reality systems is simulation sickness (Baltzley, Kennedy, Berbaum, Lilienthal, & Gower, 1989; Barret & Thornton, 1968; Biocca, 1992; Casali & Wierwille, 1986; Ebenholtz, 1992; Fowlkes, Kennedy, Hettinger, & Harm, 1993; Fowlkes, Kennedy, & Lilienthal, 1987; Hettinger, Berbaum, Kennedy, Dunlap, & Nolan, 1990; Kennedy, Allgood, Van Hoy, & Lilienthal, 1987; Kennedy, Hettinger, & Lilienthal, 1987; Kolasinski, May, 1995; Stone, 1993). Simulation sickness is best classified as a syndrome with a variety of causes and symptoms (Kennedy & Fowlkes, 1992). Users experiencing simulation sickness report various symptoms such as stomach awareness, sweating, ataxia (postural instability), and
vomiting (Kennedy et al., 1992). Simulation sickness is believed to be a form of motion sickness (Reason, 1975) caused by intersensory cue conflict between visual and vestibular cues in the virtual environment. Lag between head motion and visual feedback in some virtual systems is believed to be a key source of the problem (Meyer, Applewhite, & Biocca, 1992).

Can time spent in an interactive narrative alter the interactor’s sense of their own body? The effects of a mismatch between the virtual and physical body can be more disturbing. Humans tend to adapt to some degree to a wide range of changes in the perceptual environment (Welch, 1978). Cue conflict in the virtual environment can temporarily alter the way the individual perceives and interacts in the virtual world, and aftereffects can carry this effect to the user’s interaction with the physical world (Biocca & Rolland, 1998). Biocca and Rolland (1998) found that when users entered a virtual environment that significantly altered the user’s sense of their felt and seen hand position, users adapted their hand-eye coordination to fit the relationship in the virtual world. But when the user left the virtual environment and returned to the unmediated physical environment they continued to show evidence of perceptual adaptation. The users’ hand-eye coordination had been altered so that their reaching and pointing actions were no longer accurate, but distorted and adapted to the distortions found in the virtual environment. To put it another way, the configuration of the user’s virtual body altered their mental representation of their body, and this altered representation continued into the physical environment.

In summary there is widespread speculation and some narrow evidence that interactive narratives inside media high in embodiment may increase arousal, presence, and expose the user’s body to possible sensorimotor disturbances. These effects depend
on the specific configuration of the medium and may be heightened or diminished by the
properties of the content and elicited behaviors.

**Sociability: Interacting with others in an interactive narrative environment**

Interactive narrative environments can be very sociable worlds, especially in advanced virtual environments. We define a medium (especially the interface) as sociable when two or more individuals interact with each other *through* the mediated environment represented in the interface (e.g., networked games, collaborative virtual environments) or *around* the interface (e.g., multiple viewers of a TV set sharing/commenting on the experience), especially when that interaction is synchronous and in real time. The more individuals can interact with each other at the same time, the more sociable the medium. It should be noted that the medium’s contribution to the quality of the interaction is usually a function of the level of the mediated embodiment and/or the intelligence of the interface. So sociability in interactive technology is related to the (1) number of interacting users, and (2) level of synchronicity.

Let’s take the example of books once again. Books are not sociable. It has been claimed that they were designed for one user in isolation. McLuhan (1964) made much of the isolation of the printed work, and at the turn of the century, the lack of sociability of the book was considered a real social problem by critics (Lubar, 1993). They are rarely used for two people to interact synchronously. Although many people talk about books, they never interact *through* the book.

Media may be sociable when people interact *around* the use of the medium, such as in film, although clearly this is passive interaction. When you are at a film you are in a social setting around the medium. You are a member of an audience and you are made aware of the others’ emotions and responses to the narrative experience, i.e., their laughter, silence, applause, etc. But you do not interact with the people on the screen.
(inside the medium) or through the medium to some remote individual. While film and video may be viewed in groups, individual interaction is rare and very rarely occurs inside the narrative space, with some notable exceptions such as the elaborate costumed rituals that audiences to the Rocky Horror Picture show created in the 1970s (*The Rocky Horror Picture Show*, 1998).

Multi-user virtual environments allow multiple users to experience the narrative world both through and around the media interface. In fact, some systems can support more than a thousand simultaneous users interacting synchronously as a character inside some large, quasi-narrative virtual environment.

The property of sociability is one of the key defining features of interactive narrative. In older non-interactive media such as books and television, most dramatic narratives have held a clear boundary between the author, actor, and audience. In interactive media this become a fuzzy boundary. The crossing of this boundary is both a source of pleasure and problems for the narrative.

To become an interactor in a narrative experience is to have a role. Highly social interactive narrative experiences most resemble other human pursuits involving role playing. It is perhaps not surprising that the first quasi-narrative interactive mediated experiences evolved from role playing games such as Dungeons and Dragons (Cook, Tweet, & Williams, 2000).

**Implications of increased sociability on interactive narrative experience.**

A highly sociable interface presents problems for narrative structure. If the interactors have a certain amount of freedom, then each contributes to the plot and to characterization. There the two key components of narrative, plot and character, must be negotiated. As a result, rule structures, often similar to games and Dungeons and Dragons, control certain aspects of the narrative such as character motivation, the relative
“powers” of a character (i.e., social status, work role, gender, physical power, and “otherworldly” attributes) and the setting for the action, with other constraints. One of the problems of such a design is the need to sometimes jump in and out of character to arbitrate, remove an obstacle, or communicate an understanding. This movement in and out of the narrative space tends to interfere with the sense of presence, “a constant negotiation of the story line and also of the boundary between the consensual hallucination and the actual world.” (Murray, 1997, p. 115)

Narrative often portrays life at the extremes. Turkle’s (Turkle, 1984, 1997) interviews with role players suggest that role playing environments allow individuals to express thought, feel emotion, and engage in behaviors that are easily accessed in everyday life (see also Murray, 1997). This train of thought has given birth to a spate of anthropological, social, and psychological studies that explore the relationship of the individual to gender, class, and other roles and identities that users take in virtual environments of all kinds (Cutler, 1996; Frissen, 1992; Lipton, 1996; Nowak & Biocca, 1999; Spender, 1996; Waskul & Douglass, 1997; Yates, 1997).

Observing and playing roles may have an important formative role in social cognition (Bandura, 1985). Role playing narrative virtual environments have some potential value in socialization, training, and counseling. In the past, narrative forms such as the “morality play” have been used to instruct about correct behavior as well as to entertain. The more sophisticated the system, the more likely that the role playing has some organizational function such as training or collaborative work. For example, immersive virtual reality systems are often used in quasi environments such as military simulations and “team building” environments (Crane, 1999; Dacunto & Prybyla, 1997; Neyland, 1997; Singhal & Zyda, 1999).
Does occupying a social role in a virtual environment give you significant insight into the existence of another? Does it support empathy (Zillman, 1991)? Jaron Lanier, a pioneer of virtual reality technology, believed that interactive virtual environments could give insight into other people’s realities (Lanier & Biocca, 1992), a classic function of narrative. He used to demonstrate his pioneering system to male Silicon executives. When they passed a strategically placed mirror in the virtual environment, the blue suited executives were often shocked to find that their virtual body was that of a chubby, homeless, bag lady! As suggested by this example and the work above on distortions of the body in highly embodied systems, one’s virtual body, the interactor’s “avatar” inside the virtual environment, may influence both judgments of others and of oneself (Nowak, 2000)

In summary, the evolution of interactive technologies towards higher levels of sociability has significant implications for the psychology of narrative. From a design viewpoint, the sudden crowding of the virtual stage by audience members turned interactor presents significant challenges to producing recognizable and satisfying narratives. Turning the audience into role playing interactors strikes at the very heart of human identity exploration, experimentation, and formation. As environments increase in their level of mediated experiences, the psychological impact of role playing may be heightened. The intelligence of the environment can also interact with sociability, so we now turn to this aspect of interface evolution.

**Interface intelligence:**

*Responding meaningfully to the interactor’s actions*

Consider the dimension of interface intelligence. Over time computer interfaces are evolving to incorporate progressively higher levels of intelligence. The interface has intelligence ("interactivity"), when it can sense its environment (usually the user), process the information within some representational or logical scheme, and respond in
physically or socially appropriate and varied ways to the environment (i.e., user behavior). The interface is perceived as “more intelligent” when its responses are more varied, quicker, and perceived as more physically or socially appropriate or effective.

For the purpose of contrast, let’s again take the classic example of narrative, the novel, and contrast the book interface with evolving families’ interactive interfaces. It is true that books are written by intelligent people and filled with intelligent information. But considered as interfaces and our definition of intelligence, books are very un-intelligent. Why? Books do not sense, respond to, or adapt to the user.

Now let’s consider intelligence in an interface. Because early computer interfaces were text-based, there has been a historic tendency to think of the computer as a “talking brain” (Pratt, 1987). This is one form of interface intelligence. But it misses many other ways in which an interface displays intelligence. The “talking brain” view of computer intelligence only emphasizes one aspect of the simulation of intelligent beings and, missed the application of intelligence to the computer simulation of the physical dynamics of the non-virtual world. For example, an intelligent virtual environment may simulate a virtual room where objects obey the rules of gravity. In virtual worlds gravity is produced by intelligence not physics!

Intelligence lies at the very heart of the idea of interactivity, a uni-dimensional concept that is best replaced by reference to multidimensional patterns of sensorimotor interaction. Whether simulating a talking agent or the laws of gravity, the machine intelligence must link its sensor inputs intelligently to its effector outputs (displays) in physically and socially appropriate and meaningful ways. Desktop computers can display moderate to high levels of intelligence depending on the way they sense the user and make use of that information to alter the display. Immersive virtual environments, especially those with sophisticated agent technologies, incorporate comparatively higher
levels of interface intelligence. Virtual environments are continuously recalculated, with the user's perspective tracked. The display is continuously updated to account for the user's motions and actions in the environment.

In summary, in narrative virtual environments interface intelligence is used to:

1) Link interactors’ motor inputs (e.g., head movements) perceptually and meaningfully to sensory displays or outputs (e.g., a change in the translation or rotation of the user’s visual perspective on the virtual room) \(^1\) (e.g., Barfield & Furness, 1995; Durlach & Mavor, 1994).

2) Simulate the physics and dynamics of virtual inanimate objects and process (e.g., gravity, object deformation, fluid dynamics of water wave action), biological entities and process (e.g., simulated plant growth), as well as animate body motion (e.g., Foley et al., 1999).

3) Animate the physical and social behavior of intelligent agents in response to the virtual environment and interactor behavior (Cassell et al., 1999; Chorafas, 1997; Magnenat-Thalmann et al., 1998; Reeves & Nass, 1996).

4) Provide an “intelligent playwright,” i.e., the control of narrative storylines and the meaningful unfolding of events (Laurel, 1991).

Implications of increased intelligence for narrative experience.

Of the many applications of intelligence to interactive narratives, none has more compelling psychological implications than the interactors’ perception and response to embodied agents. The engineering design and specification of embodied agents relies very strongly on psycholinguistic, social psychological, and communication research (e.g., Cassell et al., 2000; Picard, 1997; Reeves & Nass, 1996). Although there are a number of interesting psychological issues in the engineering of agents, we will focus on
the interactors’ psychological responses to their interactions with agents in virtual environments, especially narrative virtual environments.

Two key sets of issues have been the focus of research, 1) what minimum stimuli are needed for an interaction to be perceived as social and intelligent (i.e., to be a “believable agent”)?, 2) what differences are there between an interactor’s social perceptions of virtual humans who are intelligent agents, i.e., controlled by a computer program, versus those that are avatars, i.e., controlled by a human intelligence, and 3) what is needed to make interaction with an intelligent artificial intelligence indistinguishable from an interaction with a human intelligence (i.e., the psychological basis for a successful Turing test result)?

Research from earlier work in film animation suggests that very impoverished stimuli can illicit perceptions of emotion and personality (Bordwell, 1985). It appears that a similar principle applies to the interactive realm. A program of research by Cliff Nass and Byron Reeves (Reeves & Nass, 1996) suggests that interactants tend to respond socially to computers in general, and more importantly appear to apply the same social cognitive rules to any stimuli that behaves socially. Replicating various social psychological studies in which two humans are interacting, but substituting a computer for one of the human interactants, they consistently find the same results. It appears that human interactants apply the same social rules to artificially intelligent agents including being polite to them. Furthermore, some of these social responses have been achieved with either primitive stimuli and/or primitive programmed intelligence (e.g., a linear fixed set of text responses). Unlike the Turing test which sets a very high threshold for programming intelligence, the artificial intelligence must fool the user into believing it is a human communicator, Reeves and Nass’ work suggests that users will respond to
stimuli “as if it were human” even when they know they are interacting with an artificial intelligence.

This has important implications for responses to agent characters in interactive narratives. It suggests that the same kind of strong emotional responses that are found in film and animation can be easily achieved in interactive settings. But, furthermore, the interactant is likely to use and ascribe highly complex mental models of intentionality, personality, and person perception to interactive agents, even in cases when the cues of intentionality and personality are minimal, and when there is clearly no personality or intelligence present other than in the most primitive programming use of such terms.

The larger question of long term interaction with artificial characters has not been adequately studied. The research on parasocial interaction with film and television characters, anthropomorphization of interactions with animals, as well as perceived “relationships” with non-corporeal agents such as “gods” and “spirits” suggests that the tendency to apply human mental models to all manner of interactions is widespread and ancient. Although work by Turkle (Turkle, 1984, 1997) suggests possible concern with “interpersonal relationships” with agents in which the interactant exercises inordinate amounts of control, especially concern about the generalization of inappropriate interaction patterns to “real” human interactions.

**Ubiquity of access:**

Connecting users to narrative virtual environments anywhere in space and time

When we consider ubiquity of access we consider when and where users have interactive narrative experiences, the spatial and social context of narrative experience. Consider an interface as a window or port to the narrative world. When and where is the port attached to the senses to trigger a narrative experience? There are two ways in which an interface can facilitate more ubiquity of access: (1) we can have copies of the
interface in many locations, or (2) it can be mobile and portable. Film theaters carry narrative experiences but have very low ubiquity of access. We can only access their information in a few places in each town, and they are not easily or practically portable. TV sets can display the same information as film (at lower levels of embodiment) in more places, almost every home in America. Satellite phones also have very high levels of ubiquity. Although there are few of them, each user is able to access the telecommunication network from any place on earth. In general, ubiquity of access and level of mediated embodiment are negatively correlated. The user usually has to surrender some level of embodiment (e.g., the small screen size of a portable TV) to gain great ubiquity of access.

**Effect of ubiquitous computing on narrative experience.**

This is one of the least studied areas of narrative processing. All narrative experience is situated. There is an interaction of narrative experience and the physical and social setting in which the medium is located and the experience is “consumed.” When this issue is studied, the issue of attention is usually of central concern (Hancock & Meshkayi, 1988; Johnston & Dark, 1986) although there have been some studies looking at the effect of properties of the physical environment on the sense of presence in the mediated environment (e.g., Kim & Biocca, 1997). Books and portable radios have been ubiquitous, but these media have minimal intelligence and are not social. They are unaware of their physical setting and non interactive.

This issue associated with ubiquity becomes particularly important when the user is connected to a system that is mobile, has higher levels of mediated embodiment, intelligent awareness of some aspects of physical environment, and, finally, is social. This is true of some mobile systems, such as wearable computers, and media that mix virtual environments and physical environments, such as augmented reality (Barfield &
Caudell, 2000). In a wearable computing augmented reality system, the narrative characters and objects can appear superimposed in the physical environment. Perceptually and psychologically there is a tight interaction of the physical and narrative worlds. For example, Starner reports a game system used at MIT that is an early example of some of these properties. (Starner, 1999).

In immersive, mobile, augmented reality systems, the narrative environment is interpreted within the physical environment and the meaning of both is strongly linked. This clearly has implications regarding the blurring of the boundary between narrative, fictional experience and unmediated, direct experience of the physical and social world. Such a blurring has a number of important implications for reality monitoring and the transfer of behaviors, attitudes, and other effects from the narrative world to the physical world. At the time of this writing, there were only a few systems in place and, certainly, to our knowledge no empirical studies of narrative experiences using such systems.

**CONCLUSIONS**

We have presented a view of technologies of interactive narrative and the current discussion of some possible psychological consequences of narrative experience in this media. We have stressed the importance of looking not at the specific configuration of computer interfaces, but at the evolutionary trends in interactive technologies. I have stressed that one fundamental goal of media technologies and some narrative environments is the elimination of mediation, and the creation of simulation environments that deliver very high levels of presence. We have also stressed that embedded in the evolution of media is the goal of ubiquity and sociability, that is, that the interfaces are eventually to be used anywhere to interact not only with fixed narrative but with many other users in worldwide, interactive quasi-ritualistic narrative environments. If the reader has followed this argument closely, you may have noticed that the endpoint
of the evolution appears to be the embedding of narrative structures into everyday life, and the kind of interaction in environments in which interactors enact a series of “roles” that steadily blur the boundaries between social roles and “real” action and narrative roles and play. In some ways this portrayal of the evolution of interactive narrative is like a vision of the past: a world of ritual where narratives are enacted by participants in a ritualistic environment. For example, consider the dancing shaman wearing an eagle mask as he attempts to cure a sick child by enacting a tale of “the eagle and the fish.” Is this an enactment of narrative or a medical procedure? Where is the boundary between the narrative environment and the physical environment? Now transpose this possibility to a world wide telecommunication system supporting mobile, immersive augmented reality systems, and this observation by Murray takes on additional meaning:

We are all gradually becoming part of a worldwide repertory company, available to assume roles in ever more complex participatory stories. Little by little we are discovering the conventions of participation that will constitute the fourth wall of this virtual theater, the expressive gestures that will deepen and preserve the enchantment of immersion (Murray, 1997 p. 125)
REFERENCES

Use the “Cite” style for citations


NOTES

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Table 1: Three dimensions of the user's sense of presence in mediated environments.

<table>
<thead>
<tr>
<th>Three constructs that define presence in mediated environments</th>
<th>Definition of the construct</th>
<th>Related Definitions</th>
</tr>
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</table>
| Telepresence (Physical presence)                             | **Telepresence is the sense of “being there.”** the level of vividness of a remote or simulated place experienced via a communication technology. The sensation of telepresence arises out of the effort by the user to construct a mental model of the space in the mediated environment. The sensation of telepresence is characterized by temporary suspension of attention to the physical environment, a dominant spatial mental model of the mediated environment, and some level of behavioral response or acceptance ("suspension of disbelief") of the mediated environment. When the illusion of telepresence is broken subjects often report a sense of having been "transported" to another place and momentary disorientation as they readjust to the physical space they are in. | • “mediated perception of an environment” (Steuer, 1995, p. 36)  
• “being there” (Reeves, 1991; Heeter, 1992; Sheridan, 1992)  
• "form of out-of-the-body experience" (Rheingold, 1991, p. 256)  
• “feeling like you are actually 'there' at the remote site of operation” (Minsky, 1980, p. 120)  
• “sense of transportedness” (Gerrig, 1993; Kim & Biocca, 1997) |
| Social Presence (Mediated Co-presence)                        | **Mediated co-presence is the level of phenomenal vividness of a remote or simulated intelligent being experienced via a communication medium.** Co-presence is the sensation of the presence of another intelligence or consciousness (Sartre, 1956) and, usually, the other’s awareness of you. The sensation of copresence arises out of the effort by the user to construct a mental model of other intelligent actors in the environment who are capable of intentionality and action. The inference of a human or artificial intelligence is extracted from the experience of the other’s mediated embodiment: voice, virtual body, body movement, etc. The level of co-presence is variable and higher levels are characterized by an increased sense of access to the other’s existential states: others perceptions of the environment, emotional states, intentional and goal states. | • “social presence” (Heeter, 1992; Short, Williams, & Christie, 1976)  
• “co-presence” (Goffman, 1963)  
• “closeness” of others (Muhlbach, Bocker, and Prussog, 1995; Perse, et al., 1992)  
• Sense of “togetherness” (Ho et al., 1998).  
• Presence of “the other” (Sartre, 1956). |
Mediated self-presence is the experience of self as situated and active in a mediated environment, especially when characterized by an increased sense of self-awareness, self-mastery, or creativity.

The mental model of the self is a cognitive construct not unlike the construction of the co-present other or the perceived space surrounding the self and other. Mediated environments are often designed to engage mental models of the self; they are created to alter the self in some way: change skill sets, mood states, or attitudes.

While the self has sometimes been conceptualized as a relatively stable, rarely changing, unitary mental structure (Allport, 1955; Snygg & Combs, 1949), there is also a tradition descendant from the symbolic interaction perspectives (Cooley, 1902; Gergen, 1971; Mead, 1934) that sees a more fluid, multiple role model version of the self that emerges in interaction of the self with others and in different environments (Cantor & Kihlstrom, 1987; Rosenberg, 1986; Rosenberg & Gara, 1985). In the latter perspective and in hybrid hierarchical models of the self (Kihlstrom & Cantor, 1984; Kihlstrom, 1994; Klein & Loftus, 1990). There are moments when the individual self-consciously observes his or her behavior to form a network of traits and behaviors that compose a mental model of the self (Markus & Ruvolo, ). Some of these moments are characterized by an increased sense of insight and accessibility to the self. We call such moments of self-awareness, self-presence. The level of self-presence is variable across individuals, media, and across time. Some tasks or encounters may make us more-or-less aware of our own consciousness. Higher levels of self presence may be characterized by increased awareness and insight into one’s own bodily states (e.g., spatial position, movement, etc); intentional states, cognitive processes, and mood states. For Kant, this self-consciousness was called the “transcendental consciousness,” an awareness of the stream of experience as a representation, a kind of insightful observation of one’s self, thinking and acting. Csikszentmihalyi’s (Csikszentmihalyi, 1990; Csikszentmihalyi, 1996) concept of “flow” appears to describe a level of self presence associated with task mastery, creativity, and positive affect, a mental state purportedly associated with higher levels of creativity and human performance.
### Four Dimensions of Evolution of Telecommunication Interfaces

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Definition</th>
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<tbody>
<tr>
<td><strong>Level of Mediated Embodiment</strong></td>
<td>Mediated embodiment is defined as the degree to which the user's body is connected to the telecommunication system. Level of mediated embodiment is a combination of: (1) the number of sensory, motor, and autonomic channels engaged (e.g., vision, hearing, taste, hand motion, heart rate), (2) display or sensor fidelity for each channel, and (3) amount of channel bandwidth filled with stimuli from the mediated environment versus stimuli from the physical environment (e.g., field of view, 0-100%) , and (4) level of coordination of stimuli across sensory and motor channels.</td>
</tr>
<tr>
<td><strong>Level of Interface Intelligence</strong></td>
<td>Interface intelligence refers to the ability of the interface to interact, to sense, respond, and adapt to the user’s behavior. Intelligent response to user behavior includes the interface’s ability to simulate both the interactive properties of: (1) physical environments (i.e., space and objects), and (2) intelligent beings (i.e., simulated animals, humans, and other sentient beings).</td>
</tr>
<tr>
<td><strong>Ubiquity of Access</strong></td>
<td>Ubiquity refers to how many physical locations the interface can be accessed. Ubiquitous access can be achieved by having many interfaces in the physical space (e.g., TV sets) or by making interfaces more portable (e.g., satellite phone).</td>
</tr>
<tr>
<td><strong>Sociability</strong></td>
<td>Sociability is defined as a combination of: (1) the number of mediated and non-mediated simultaneous users, and (2) the quality of interpersonal interaction of these users that the interface can support remotely. Sociability is not exclusively a property of the interface. It is more dependent on other properties of the telecommunication system, such as the quality of the network and of the nature application, than the other interface dimensions.</td>
</tr>
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</table>
Table 3.
Classes of Narrative Interfaces
Arrayed According to the Level of the User’s Mediated Embodiment

<table>
<thead>
<tr>
<th>Classification</th>
<th>Level of Mediated Embodiment</th>
<th>Description</th>
<th>User Sensorimotor Experience</th>
<th>Example narrative applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Window Interface</td>
<td>Very low</td>
<td>The basic personal computer where only the window display monitor and mouse connect the user’s body to the virtual environment.</td>
<td>Limited field-of-view and limited sensorimotor interactions provide a modest experience of presence.</td>
<td>Internet VRML narrative worlds, Moos, consumer computer games</td>
</tr>
<tr>
<td>Mirror Interface</td>
<td>Low</td>
<td>An image of the user’s body is captured by video equipment. The image of the user’s body is superimposed on the computer environment, which is projected onto a screen in front of the user.</td>
<td>Users see a video image of themselves on a large screen often with other people. Cutout images interact with the environment. Can be compelling, but sense of presence is modest.</td>
<td>Walk-through museum or narrative art experiences, Some arcade gaming applications.</td>
</tr>
<tr>
<td>Panoramic Interface</td>
<td>Medium</td>
<td>Large wide-screen projection system fills the user’s visual field. Often includes 3D stereographic glasses and tracked, hand-held input devices, and high-end audio systems.</td>
<td>One or more users stand in front of large 3D window on the virtual world. Motion effects and sense of depth can deliver higher levels of presence.</td>
<td>Corporate product visualizations. Scientific and medical visualization.</td>
</tr>
<tr>
<td>Virtual Rooms</td>
<td>Medium</td>
<td>Takes panoramic portals to their logical extreme. Users walk into a physical room that is a large display system. The motion and perspective of the user are continuously updated by tracking devices as the user interacts with the virtual environment seamlessly projected on at least three walls and the floor.</td>
<td>Sense of space can be quite compelling. The virtual environment immerses the user’s visual sensory system. Usually viewed through 3D glasses. Expensive system ideal for multiple users.</td>
<td>Scientific visualization. Corporate product and design visualization.</td>
</tr>
<tr>
<td>Interface Type</td>
<td>Rating</td>
<td>Description</td>
<td>Applications</td>
<td></td>
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<tr>
<td>Vehicular Interface</td>
<td>High</td>
<td>Users enter a mock vehicle (i.e., cars, planes, submarines, tanks, flying carpets, etc.) where they are allowed to operate input devices that control their vehicle inside the virtual environment. The vehicles often include motion platforms to simulate physical movement, and the computer graphics based world is projected onto the ‘windows’ of the vehicle.</td>
<td>Sense of presence and motion can be quite compelling. The interface can faithfully reproduce a lot of detail, and a feeling of being inside the &quot;real&quot; vehicle.</td>
<td>Military and corporate training, simulation. High-end location-based entertainment rides.</td>
</tr>
<tr>
<td>Immersive VR Interface</td>
<td>Very High</td>
<td>Users wear displays that fully immerse a number of the senses in computer generated stimuli (e.g., vision, hearing, and touch). These systems often use the distinctive head-mounted, stereographic display, 3-D spatial audio. Input devices (sensors) immerse the motor actions of the user into the virtual environment. Trackers may register head and hand location. Data gloves may sense finger movement. Other sensors may track eye movement, walking, etc. It is primarily the much higher levels of sensorimotor integration; the linking of sensory feedback to body movement that distinguishes immersive systems most differ from other VR systems.</td>
<td>Arguably provides a significant ‘jump’ in the level of ‘presence’ because of the tight sensorimotor integration and the full immersion of at least the key senses of vision and hearing. Some purists argue that immersive environments are the only true VR systems because they are the only systems that attempt to completely immerse the sensorimotor system into a virtual environment.</td>
<td>Scientific and medical visualization. Corporate product and design visualization. Military training. Some low quality systems used for gaming.</td>
</tr>
<tr>
<td>Augmented Reality Interface</td>
<td>Medium to High</td>
<td>The most advanced augmented reality systems use hardware similar to that found in immersive VR. But rather than fully immerse the user in a virtual world, augmented reality systems overlay 3-D virtual objects onto real world scenes. The goal here is to enhance the user's experience with reality.</td>
<td>Few systems yet achieve a truly convincing integration of a stable 3D virtual object and the real world, but many of these show promise with less compelling implementations and schematic virtual displays.</td>
<td>Medical imaging. Battle display systems. Manufacturing and equipment maintenance. Facilitating navigation with the natural environment.</td>
</tr>
</tbody>
</table>
Figure 1.

The figure illustrates key points in the communication interface where information is transferred from one system to another: human-interface, interface-network. Key to communication researchers are the parts of the interface that represent information to the user's senses and those that register and code the motor actions of the user's body.
FIG. 5.1 Four dimensions of media interface evaluation
The graph illustrates the evolution of all media along four dimensions towards an ideal medium positioned at the end point of the graph. All existing media are characterized by a location along the four dimensions.
The body is the primordial communication medium (i.e., the user is embodied in the physical world). It is the primordial medium for receiving and sending information. Computer-based networked media alter the way the body, the primordial communication medium, interacts with the environment. In mediated embodiment the medium interposes itself between the user's body and the (represented) environment. In mediated embodiment the body of the user is represented in many ways: (1) as a physical body connected to the computer's sensors and effectors, (2) as a representation of the user's body (i.e., controls of effectors and sensors) inside the computer, (3) as an avatar representation inside the virtual environment for the user and others to experience the user's actions, and finally (4) as the user's internal representation of his or her body, the body schema, which may be altered by experience of one's body via the medium.

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1 This includes handling more mundane aspects of computing such as data storage and retrieval, etc.