Research Note
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Project: Landscape Perception and Large Image Display Systems

ABSTRACT

The goal of this project is to explore the perceptual and cognitive affects that large image display systems have on our ability to problem solve and augment the creative and learning processes. Recent research suggests a significant change in the way we embody the digital image. Scientists and media theorists believe digital imaging interfaces alter and rearrange the hierarchy of perceptions thus heightening our perceptual attention to more fine-grained levels. If our adult brain selectively adapts to important environmental changes, then large image display systems would drastically increase our ability to multitask information by bringing the linking structure of hypertext to the surface, exposing and utilizing the latent linkage between meaning and knowledge. Extensive research concludes that with the advent of visual aids and computer interfaces, more students are active and creative learners as opposed to reflexive learners. Active learners learn best by doing something physical with the information. A large image display system would provide a platform for students to connect knowledge while simultaneously thinking about the big picture. Finally, these types of imaging systems provide an immersive, collaborative environment that alters the pedagogical hierarchy of the classroom. Because of the integration between presenter and participant, any participant can jump in, offer advice and move the flow of information more freely. Ultimately this flexible spatial environment could be an effective think-space for group consciousness rising. While there has been a lot of research on virtual reality, little research has been done on large image display systems that are spatially open, immersive and interactive on a multi-user platform. More development of these systems needs to be implemented to reveal the implications for new collaborative applications for learning and problem solving.

Executive Summary: Landscape Perception and Large Image Display Systems

Goals: To research the perceptual and cognitive effects of large-scale display systems and to discover new ways in which these large display systems can augment the learning process through team collaboration using complex problem solving.

Perceptual Capacities for new forms of embodiment

The confluence between the neurosciences and the arts is producing strong evidence that our perceptual capacities have been drastically augmented through new technologies. For instance, C. Shawn Green and Daphne Bavelier of the University of Rochester conducted a study in which they found that avid video game players were better at several different visual tasks compared to non-gamers ("Action Video Game Modifies Visual Attention," *Nature*, 2003). From a perceptual analysis, the ability for the body to track a range of stimuli depends on a multitude of factors including motion, color, movements (including saccadic, Vestibular and Vergent movements), peripheral vision versus central vision, memory and attention thresholds. It is important to note that our embodied interactions with new media synthesize the tactile and visual senses through pointing mechanisms and visual feedback. Recent research indicates a fundamental shift in how we interact with new media. Using Henri Bergson's argument that affection and memory render perception impure, that we select only those images that are most relevant to embodied interactions, Mark Hansen updates this by arguing that we filter information we receive to create images and meaning rather than simply selecting them (Hansen, 2004). Contrary to information and cybernetic theorists such as Shannon and Weaver who attempt to optimize information transmission through signal to noise ratios, Hansen recognizes that structural information must consider the changes brought about in the receiver's mind. What needs to be addressed is not a paradigm based on information transmission but one that confronts the issues concerning the role of the affective, proprioceptive, and tactile dimensions of experience in the constitution of space, and by extension, visual media. Large image display systems provide a laboratory for exploring how to multitask information by bringing the linking structure of hypertext to the surface, exposing and utilizing the latent linkage between meaning and knowledge.

A prominent visual phenomena that occurs through our experience with technological prosthetics is the notion of optical flow. Optical Flow is defined as the apparent visual motion that you experience as you move through the world (Khalil & Payeur, 2005). Research has been developed to mimic the perceptual range that an insect may have, that is, a resolution of several thousand pixels to navigate through a complex, cluttered environments that are full of obstacles (see www.centeye.com). In panoramic environments, our peripheral vision is mainly used. Though lacking in resolution, its strength lies in its ability to react to movement. By increasing our peripheral resolution through aided technologies, we could harness our optical flow mechanism to increase the capacity for finding connections between subjects. There is a strong implication that optic flow enables sustained attentiveness within an individual so that our ability to retrieve and retain information is increased. Stephanie Strickland's analyses the digital image including hypermedia as something that exploits different aspects of the time-based human perceptual process with the fusion of interval limits and the synchronized neuronal patterns that must be mobilized for action (Strickland 2001). The implications behind the digital image are a perceptual system that develops a new calisthenics that enlarges the window of the perceptual now: and they do so, specifically, by drawing our perceptual attention to more fine-grained levels of stimuli – "by bringing into consciousness many more microfluctuations and or fractal patterns that had been smoothed over, averaged over, hidden by the older perception and knowledge processes (Strickland, 2002). The marriage of machine time and human time is a synthesis of creativity and image forming that allows the viewer to create their own meaning. The assumption is that the hierarchy of perceptions could be rearranged based on new media and emergent stimuli.

Perceptual Learning

Perceptual landscape environments could make a significant difference in how we learn, though it is important to put this experience in context by understanding *what* is being seen in the immersive environment. That is, how does the content affect the experience within large-scale image display systems? Much of the research on perceptual learning is actually about learning from primary experience that is learning through sense experiences. Recent researchers also suggest that learning may be aided by task irrelevant learning as opposed to task-relevant learning. Aaron Seitz and Takeo Watanabe describe a unified model suggesting that long-term sensitivity enhancements to task relevant or irrelevant stimuli occur as a result of timely interactions between diffused signals triggered by task performance and signals produced by stimulus presentation. This suggests that the adult brain selectively adapts to important environmental changes. For example, with training, experts such as radiologists develop refined abilities to distinguish subtle patterns of tumors in images that show no pattern to the untrained eye. From a neurological perspective, Scientists believe that perceptual learning is triggered through a modulation of neurotransmitters that are paired together in uncertain ways based on the combination of task-relevant and task irrelevant learning processes.

Memory also plays a vital role in learning. Some scientists, most notably George Miller, believes that information is normally divided into small “chunk” structures in working memory. Theoretically, an individual can only hold 5-9 chunks on information or seven plus or minus two (Kehoe, 1999). When information can be sent to long-term memory storage then it usually signifies that the information had some sort of meaning. Researchers believe that by using visual aids such as video and computer interfaces, people are more susceptible to “chunk” information easier and find more meaning in the subject matter thus sending what is learned to the long-term memory part of the brain.

Comments that People learn in different ways and multimedia environments are most suitable for active learners rather than reflexive ones. Active learners learn best by doing something physical with the information while reflexive learners do the processing in their head. Visual learners prefer charts, diagrams, and pictures while verbal learners prefer spoken or written word. Finally, global learners must get a big picture before the individual pieces fall into place while sequential learners make linear connections with data (Montgomery, 1995). Although there are different forms of learning, Susan Montgomery from the University of Michigan points out that “ 67 % of the students learn best actively, yet lectures are typically passive. 57% of the students are visual, yet lectures are primarily verbal and 28 % of the students are global, yet we seldom focus on the “big picture”(Montgomery, 2005). Conclusively, active learners are creative learners. These statistics reinforce the need for multimedia development, specifically large-scale display systems that elicit collaboration.

Experiential and Cognitive Learning in Multimedia Environments

Although the perceptual elements introduced in large image display systems are critical to forming a new context for which to learn and problem solve, it is equally important to provide a context that harnesses cognitive, real-life problem solving skills as opposed to older models of in-school teaching methods. Real-life problem solving involves problems that are embedded in a specific and meaniful context as opposed to problems that are largely abstract and de-contextualized Lebow & Wagner, 1994) Real-life problem solving also involves cooperative relations and shared consequences instead of competitive relations and individual assessment. Finally, what is most important to the learning process is finding problems perceived as real and worth solving as opposed to problems that seem artificial and contrived (Herrington and Standen, 1999)

What large image display systems can do is provide an interface that provides an ecological approach of information gathering. This is a system devised to provide a reflective path of knowledge gaining rather than an automated one. Students could potentially associate the meaning of an object with its destination rather than click forward through a linear progression. Experiential learning also entails the notion of incidental learning; something that happens quite frequently during internet surfing. Not everything is fun to learn, but by picking up information in passing, students can often learn something unintentionally (Schank, 1994). This incidental learning should be considered in the overall architecture of the display system. Ultimately, Significant learning takes place when the subject matter is relevant to the personal interests of the student (C. Rogers, 2000).

Collaboration in Multimedia Environments

The more our technological prosthetics become grafted-on perceptual capacities, the more we become independent from human to human interactions. The computer for instance, is therefore providing somewhat of a paradoxical value to its users. It enables a world of information to be explored via a powerful and relatively easy-to-use system. On the other hand, it is challenging the very notion of classrooms and groups (Pobiner, 2005). Therefore, large image display systems could offer a way to balance the interaction between screen and person. Students must be able to follow their own paths (similar to the experience of surfing the web) but there should also be multiple experts available to answer questions. Collaborative multimedia environments alter the pedagogical hierarchy of the classroom. Because of the integration between presenter and participant, any participant can jump in, offer advice and move the flow of the information more freely. Scott Pobiner from Harvard University recently developed an integrated multimedia learning environment and discovered that "when students and other participants are able to manipulate the digital and spatial environment of a classroom in real-time, the instructor no longer is required, nor able, to mandate the flow of the discussion" (Pobiner, 2005). Another implication that shared large screens have, is the ability to share the interface of the software. This can be extremely helpful when students are trying to learn software and other various tools on the computer. The result of this large shared space is a flexible spatial environment that simultaneously makes the participants active while sustaining the ability to listen to advice and observe others discover solutions to problems. This system could be a platform for group consciousness rising.

Conclusion

The evidence that VR display systems and other perceptual technologies changes perceptual and cognitive capacities is undisputed. Little research has been found with a *direct* focus on the cognitive and perceptual affects of large image display systems. While much attention has been focused on VR, little focus has been directed towards open collaborative systems that are immersive. It is important to emphasize that different large image display systems will produce an array of different implications. It is important to build these multiple systems to evaluate the perceptual and cognitive learning capabilities. The progression of information processing cannot be discussed without the legacy of hypertext and the graphical user interface. If hypertext introduced a new paradigm for information exchange and mobility then these large image display systems have the potential to bring information connections to the surface as opposed to hiding them behind the links and buttons. Through the use of scale and collaborative application, the potential for physically mapping the connectivity of information can augment the learning process and allow users to create meaning from a knowledge management environment.

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