

Visual Attention in 3D Video Games

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Visual attention has long been an important topic in psychology and cognitive science. Recently, results from visual attention research (Haber et al. 2001; Myszkowski et al. 2001; Yee et al. 2001; Cater et al. 2003; Dumont et al. 2003) are being adopted by computer graphics research. Due to speed limitations, there has been a movement to use a perception-based rendering approach where the rendering process itself takes into account where the user is most likely looking (Haber et al. 2001). Examples include trying to achieve real-time global illumination by concentrating the global illumination calculation only in parts of the scene that are salient (Myszkowski 2002). Video games have achieved a high degree of popularity because of such advances in computer graphics. These techniques are also important because they have enabled game environments to be used in applications such as health therapy and training.

We believe that research on visual attention can further improve the design of game environments, thus decreasing frustration and increasing engagement. Many non-gamers get lost in 3D game environments, or they don't pick up an important item because they don't notice it. Visual attention research results can be used to inform designers how to compose colors and placements of objects to stimulate attention and eliminate these problems.

While the visual attention process has been extensively researched and is still under much research within psychology and cognitive science, most experiments within these fields often employ simplified strictly controlled composition of 2D objects e.g. combination of lines and blocks (Weidemann et al. 2005), some have used photographs as well as simple 3D synthetic objects (O'Sullivan 2005). These environments are very simplistic considering video game environments that employ complex 3D architectures and highly dynamic objects and characters. While some of the concepts generated by visual attention research may transfer to 3D environments, experimental confirmation is needed.

We focus on exploring whether visual attention within a 3D game follows the bottom-up or top-down visual attention theories. We also seek to explore the difference in visual attention process within two game genres: first person shooters and adventure games. Our hypothesis is that different games will stimulate different visual attention patterns depending on the activities involved.

Studying visual attention within a 3D environment as the one employed by video games is hard. While there are methods established that study visual search through the use of eye tracking techniques within interactive environments, most of these methods focus on web applications, which are 2D, slow pace (i.e. no rapid movements), and most of the interface is usually static (e.g., buttons mostly stay in the same place in the monitor). By comparison most gaming environments are highly complex due to their use 3D graphics with many moving elements.

We conducted preliminary experiments involving 6 participants: 2 avid gamers, 2 common gamers, and 2 non-gamers. We asked them to wear an eye tracking device while playing the video game. We then video taped their interaction with a superimposed cursor showing where each participant is looking. We then analyzed this data.

Although the experimental results collected are exploratory since our subject and game pools are small, they present several worthwhile contributions. (a) Our results confirm previous visual attention research concerning saliency of stimulus in a bottom-up visual attention process (Treisman 1980). (b) According to our results, both adventure games and first person shooter games tend to illicit a top-down visual search pattern. Visual stimuli are more salient when located near objects that fit player's top-down visual search goals. (c) In terms of eye movements, players playing first person shooter games tend to concentrate their eyes on the center of the screen while adventure game players' gaze patterns explored the entire screen (see figure 1).

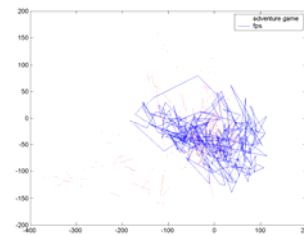


Figure 1: comparison between visual patterns exhibited in *Halo II* (First person shooter) and *Legacy of Kain* (adventure game)

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