Shadowplay: Simulated Illumination in Game Worlds

Simon Niedenthal
Malmö University
School of Arts and Communication
Malmö, Sweden
+46 40 665 7164
simon.niedenthal@k3.mah.se

ABSTRACT
Despite the fact that there are currently a number of enjoyable digital games in which light plays a key role, we lack a vocabulary with which to discuss simulated illumination in game worlds. An understanding of lighting practices in other media, such as 3d computer-generated animation and film, must be supplemented with an awareness of real-space disciplines such as architectural lighting if we are to grasp the complexity of the game lighting design task. But game design is more than a repository for existing lighting practices; the interactive nature of games allows for self-reflexive sensitivity to light to emerge, most clearly manifested in games described as "first person sneakers" and "survival-horror" games.

Keywords
Lighting design, game lighting

It has long been a commonplace in gaming communities that "good graphics does not equal good gameplay." Originally growing partly out of resistance to hardware industry agendas, this platitude has, in extreme expressions, ossified into a simple and ultimately less-than-useful dichotomy. But given the capacity to dynamically engage the senses that is inherent in interactive media, a better question for us to pose is "what sort of visual experiences best support gameplay?" One way to approach this rather large question is to focus upon our experience of simulated illumination in gaming environments. For, despite skepticism towards game graphics, the fact is that there are currently a number of very enjoyable games in which light plays a key role. In "Thief 2"and ""Silent Hill 2"," categorized as "first person sneaker" and "survival/horror" games, respectively, a consideration of light can be found not only in the way in which the game spaces are illuminated, but also in the sensorium that is encoded into the game's AI. In this sense, both players and non-playing characters respond to illumination decisions made by game designers and the gamers themselves.

But before we investigate illumination decisions further, it is necessary to create a framework for analyzing the contribution of simulated illumination to the gaming experience. Quite clearly, we lack a vocabulary with which to speak and think about light in games and the effect upon the player. This paper will argue that a foundational understanding for studying lighting design in game environments can be forged by first surveying existing illumination practices. Pre-rendered

Proceedings of DiGRA 2005 Conference: Changing Views – Worlds in Play.

3d computer animation is created using similar digital tools, and the field has begun to develop it own form of cinematography. But the free navigation afforded by games requires us to look to other practices outside of filmic media, such as architectural lighting. Finally, games as interactive experiences must be examined for their own unique potentials. After all, in a game the player sees and is seen, illuminates and is illuminated in turn.

As media artifacts and interactive experiences, games draw from various sources of knowledge about light to achieve their effects. The existing professional practice perhaps closest to game illumination is computer generated animation. As with films such as "Toy Story," most digital games take place in environments created within 3d software packages that take film technologies as organizing metaphors. In 3ds max, Softimage and Maya, surface geometry is refined with a combination of texturing tools and simulated light sources. In some companies, a programmer working as a technical director defines the lights, while in other settings digital artists set lights within 3d software packages and export them to the rendering engine for evaluation and fine-tuning. Lighting decisions for a game must be constantly balanced with the need to maintain a frame rate adequate for real-time playback. The quantity of lights possible in a game scene is determined by the rendering engine. Some rendering engines allow the digital artist to employ 8 lights; really good engines up the number to several hundred [8]. Although in the past the real-time demands of digital games have limited the use of complex lighting setups and effects, a number of new rendering engines, techniques and workarounds allow game designers increasing control of the illumination spaces of their games, opening to them the sort of choices that were afforded digital animators a decade ago.

Since then, the computer-generated animation industry has begun to generate its own form of cinematography, led by companies such as Pixar, whose aesthetic draws heavily upon traditional film lighting practice. Sharon Callahan [3] identifies five objectives of lighting in a digital animation scene:

1. Directing the viewers eye
2. Creating depth
3. Conveying time of day and season
4. Enhancing mood, atmosphere and drama
5. Revealing character personality and situation

If we apply these objectives to an analysis of "Silent Hill 2", we can see that there are useful contributions, as well as important limitations to a filmic approach. First, light qualities are employed to direct the player's the eye, an important part of locating useful objects in any adventure game. Health drinks, medical packs and ammunition to be acquired in a space leap out through contrast and specularity. Depth in exterior scenes is simultaneously created and limited through atmospheric perspective of fog, as well as darkness. Although "Silent Hill 2" is largely an interior game, played out in decayed, boarded-up spaces, larger lighting decisions do convey time of day and interact in an interesting way with the player's felt sense of time. The game

begins in daytime, then after leaving Brookhaven hospital the player emerges into a nightscape. A grey dawn permeates the final stage of the game at the Lake Side hotel; thus ""Silent Hill 2"" is played out over one day. Depending on how skilful the player is, this may or may not correspond to the player's own sense of game time. A cinematic sensitivity to the power of light to enhance mood, atmosphere and drama is readily apparent in "Silent Hill 2". The overall low-key lighting strategy in "Silent Hill 2" is perfectly in tune with the horror genre, and provides one of the greatest sources of the game's pleasures. Finally, one can point to a number of ways in which illumination helps to sketch character and motivation in a cinematic way.

In the opening expository pre-rendered scene, James Sunderland, the game's protagonist, stares into a mirror and relates the receipt of a letter from his dead wife. This scene introduces us to a somewhat ambiguous character, and as the game plays out we are called upon to speculate about James' motivations and role in his wife's death. The illumination here, coming from above and leaving his eyes in shadow, is a cinematic convention often associated with characters whose motivations are unclear. In "The Godfather," for example, cinematographer Gordon Willis chose the same lighting strategy to make the title character appear more mysterious [12]. The case of top lighting the face in such a way that the eyes remain in darkness is an example of the way in which a lighting convention can come into dialogue with deeply ingrained behaviors. According to studies of how humans read faces, we devote great mental energy to analyzing the gaze of others, and it has been speculated that in evolutionary terms this is how we evaluate intentions and whether or not we are likely to become prey. It follows then that the obscuring of the whites of the eyes and the specular highlight from the eyeball through shadowing [1] would tend to leave us somewhat unsettled.[1]

As the foregoing example makes clear, a cinematic approach to game lighting is appropriate as a means of analyzing pre-rendered cut scenes, as well as useful in helping us understand larger lighting strategies that relate to game genres, time of day, narrative elements and mood. But it is also quickly apparent that games as interactive experiences differ from films in significant ways. First, a film scene is of limited duration, and generally must communicate a quantity of information in that time. Games, on the other hand, allow free exploration and examination. In addition, film scenes are lit to be recorded from the camera. A fixed perspective for viewing a game environment of course cannot be assumed (though some games have context sensitive framing that is a kind of middle state between free exploration and fixed perspectives). So though a film lighting perspective is useful for our understanding of how games function as media artifacts with certain narrative elements, the task of lighting the interactive game world, then, also participates in the traditions of real-space practices such as architectural lighting.

If we accept that our experiences of simulated illumination are analogous in some way to our experience of light in real space,[2] there is a body of research on the light effects that can be re-

[1] Thanks to Steve DiPaola for this insight.

[2] This assumption requires a sub-argument. In the late '60s a debate emerged between J.J Gibson and Goodman on the nature of the experience of viewing a picture. Goodman's position was that we learn to "read" a picture, that it functions as a kind of text. Gibson countered that the experience of looking at a picture is analogous to how we see in real space: "a picture is a surface so treated that (it) contains the same kind of information that is found in the ambient optic arrays of an ordinary environment." He also writes, more succinctly, that "interpretation depends on sensations." I take Gibson's side, and believe further that his stance can be transferred to a consideration of dynamic simulations such as games. The argument of this paper is that our experience of simulated light is not just informed

purposed within game design. Recently there has been increased interest in studying the qualitative and non-visual effects of light, the ways in which illumination levels and color influence how people feel and behave. Several themes have emerged from current research. Quite clear gender differences occur; men and woman respond differently to cognitive tasks under differing levels and colors of light [6]. Risk-taking also appears to be a phenomenon that is affected by our luminous environment [7].

Very interesting implications for game design emerge from experiments on the effect of light on decision-making. According to Costykian, decision-making is one of the defining hallmarks of the gaming experience [4]. One interesting thesis that comes out of light research is that light may affect decision-making through its impact on autonomic arousal—our overall state of alertness—affect, our emotional condition or mood, and vision, our ability to receive visual phenomena under given light conditions. Belcher and Kluczny suggest that "Mood and vision compete with decision strategies for working memory capacity. If the subject is in a good mood, and/or if the luminous environment renders difficult the visual task, selection of a decision making strategy that eases cognitive strain . . . may ensue" [2]. The authors posit that in particular illumination conditions we are more likely to employ quicker heuristic strategies rather than engage in detailed analysis. "Silent Hill 2" is an excellent environment in which to trace this line of thought with reference to the experience of the player. There are a number of different types of decision that one is called upon to make in the game: should I blast this zombie? How do I solve this puzzle? Clearly some decisions are on the level of reflex, others require analysis. Belcher's model suggests that tasks such as killing approaching zombies, which are solved best by applying heuristics rather than launching into detailed analysis, are supported by luminous surroundings that would be described as poor or low acuity lighting, often the case in Silent Hill. The significance of this for the game lighting designer is that there is room for subtle modulation of tactical and strategic effect in the matching of the lighting environment to the desired game experience.

We can employ a simple game taxonomy to map architectural and filmic sources of light knowledge appropriately to game design. Craig Lindley proposes a triangular model integrating ludology, narration and simulation. Lindley's ludological definition of a game, the basic assumption of game theory, is "a goal-directed and competitive activity conducted within a framework of agreed rules;" a narrative is loosely defined as "an experience structured in time;" and simulation is "a representation of the function, operation or features of one process or system through the use of another "[6]. One benefit of generating such a taxonomy is, as Lindley points out, is that it can help us apply knowledge to game design in a productive way: "The distinctions of the taxonomy also allow us to see where techniques from other fields can be applied. For example, acknowledging the narrative elements of a game indicates where methods for the construction of narratives, heavily developed for film script writing, can be applied within games."

Overlaying illumination practices upon this game taxonomy also demonstrates how other types of lighting knowledge can contribute to game lighting design. Narrative can clearly be supported

---

by our experiences within media and by ingrained "codes" of light, nor are our perceptual systems simply cultural constructs. What makes light so interesting is the way in which socially informed media conventions come into dialogue with our bodies and senses, which have their own codes.

by illumination techniques coming from 3d computer animation and film, especially relevant in pre-rendered cut scenes. Our understanding of how light influences people in real space has consequences for the "goal directed and competitive" activities of ludic behavior, through arousal, affect, risk-taking and decision-making. Knowledge of the digital simulation of light has come to games from computer graphics, and an example of how our experience of light can be foregrounded in simulations can be seen in the current crop of fireworks simulators [9].

So far I have been concentrating upon illumination decisions made by professionals, but what is interesting about games is that these decisions are increasingly being made by players. Tactical lighting decisions by the player are an important part of the game experience in "Silent Hill 2." Early on in the game, one acquires a flashlight, and must continually decide whether or not to use it. With the light on, objects to be acquired in an environment leap out through contrast and specularity, and one can read the maps picked up as overviews of each space. The light is comforting; without it, one moves through a twilight gloom almost sub-aquatic in character. The player must choose from moment to moment how to illuminate the scene, and the decisions are crucial for survival and continued forward-movement in the game. Konami's website tips the player off to the significance of illumination in balancing the game's risks and rewards:

> "The monsters have eyes and ears, and will use these to locate James. If they are not alerted to James' presence, they may not attack. Turning off the flashlight and carefully bypassing unnecessary confrontations is advised, however, with the flashlight off, James cannot search or look at the map and his accuracy with projectile weapons is severely impaired." [11]

The attention to light in "Silent Hill 2" thus goes far beyond storytelling and world definition; it also directly engages the player and becomes a key part of the gameplay.

But as the foregoing snippet from Konami suggests, illumination decisions in game design do not just affect the player's surrogate and perspective, they also shape the conditions for interaction with non-playing characters through the game's AI. For the game "Thief," in which the game experience is built around avoiding detection while accomplishing missions, a sensory system was developed with the aim of increasing the suspense of possible discovery. Tom Leonard relates the aim of the game's developers:

> "The primary requirement was creating a highly tuneable sensory system that operated within a wide spectrum of states. On the surface, stealth gameplay is about fictional themes of hiding, evasion, surprise, quiet, light and dark. One of the things that makes that kind of experience fun is broadening out the grey zone of safety and danger that in most first-person games is razor thin. [5]"

AI vision in "Thief" is simulated through a viewcone and raycast-based system, and framed in terms of "awareness" and "visibility." Visibility is defined "as the lighting, movement, and exposure (size, separation from other objects) of the entity . . . the lighting of the player is biased towards the lighting near the floor below the player, as this provides the player with a perceivable way to anticipate their own safety."

Finally we must consider digital games not just as a repository for existing lighting practices. One of the most interesting experiences in "Thief" 2" is the development of a kind of self-reflexive awareness about illumination. The degree to which one is present in light or darkness in

a scene, for reasons given above, strongly affects one's fortunes in the game, and is fed back to the player through the "glowing crystal" in the interface. This dynamic awareness has the capacity to alter one's sensitivity to illumination after leaving the game. The contribution from the interface engages the player in the sort of "double consciousness" of the game as both mediated and directly felt that is, according to Katie Salen and Eric Zimmerman, one of the most promising areas of future game development [10].

Illumination decisions in games take many forms, are made by both designers and players, and have strategic and tactical consequences for the game experience. But whether one is seeking to evoke a world or set up the conditions for perception and interaction, light allows us to advance our goals for the felt game experience, be they the evocation of suspense, dread, comfort or ecstatic abandon. Light engages us through our bodies, our nervous systems, and our collective social interactions. Digital games, in which light is made present through a combination of media conventions, computer graphics algorithms and sensory phenomena, thus represent an arena in which the aesthetics of light and the mechanics of perception are open for exploration and redefinition by designers and players alike.

References:

1. Alton, John, *Painting with Light*, University of California Press, 1995, p. 113.
2. Belcher, M. Clay and Raymond Kluczny, "A Model for the Possible Effects of Light on Decision Making," Lighting Design + Application, Feb. 1987, p. 21.
3. Callahan, Sharon. "Storytelling through Lighting, a Computer Graphics Perspective," from Apodaca and Gritz, *Advanced Renderman*, Morgan-Kaufmann 1999, p. 338.
4. Costykian, Greg, "I Have No Words but I Must Design" http://www.costik.com/nowords.html
6. Knez, Igor, "Effects of Light on Non-visual Psychological Processes," Journal of Experimental Psychology, v. 21, 2001, pp. 201-208.
5. Leonard, Tom, "Building an AI Sensory System: Examining the Design of Thief: The Dark Project," GDC 2003 http://www.gamasutra.com/gdc2003/features/20030307/leonard_02.htm
6. Lindley, Craig, "Game Taxonomies: A High Level Framework for Game Analysis and Design," http://www.gamasutra.com/features/20031003/lindley_01.shtml
7. McCloughan, C. L. B. et al, "The Effects of Light upon Mood and Decision Making," CIBSE Lighting Conference 1996, p. 239.
8. Olsén, Daniel, conversation (12/4/2003) and David Polfeldt (12/3/2003), Modern Games, Malmö Sweden.
9. Pyroinfinity website: http://www.pyroinfinity.tv/en/default.asp
10. Salen, Katie and Eric Zimmerman. *Rules of Play: Game Design Fundamentals* (Cambridge, MA: MIT Press, 2004), pp. 450-455.
11. Silent Hill 2 website: http://www.konami.com/silenthill2/
12. "Visions of Light: The Art of Cinematography" (1992).