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DESIGNING FOR INTERACTIVITY: THE CAMERA IN 3D VIDEOGAMES

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ABSTRACT

This paper analyzes the effect that camera control has on art, design, and player experience in 3D video games. It will specifically explore the implications of various methods of camera control that have emerged during the brief history of 3D games: the first and third-person perspectives, fixed and filmic perspectives, abstract non-linear perspectives, and unique perspectives enabled by recent technological innovation, including Virtual and Augmented reality.

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INTRODUCTION

Both games and film are audiovisual media. One understanding of the medium of games is as a form of interactive movie, descending from the legacy of film. While games are certainly their own art form (The 2011 *Brown v. Entertainment Merchants Association* Supreme Court decision gave video games first amendment protection as an art form), many games do contain filmic elements. However, interactivityⁱ is central to the medium and generally takes precedence over aesthetic control. Most 3D games allow the player to control the camera, and the gameplay experience lacks the cinematographic precision of film. Designers craft levels to lead players towards game objectives, as well as composed aesthetic experiences when possible. Certain games take alternative approaches to the relationship between cameras and 3D art. Some games use the techniques of film entirely, while others explore non-linear perspectives of space that optical cameras cannot. Recent technological advances in Augmented and Virtual reality complicate the relationship between game cameras and player interaction with games.

This paper aims to highlight the emergence of camera practices in games to understand the implications of each unique approach. It will explore the relationship between the camera, interactivity, and 3D art in video games through the examination of various genres, beginning with early first-person-shooter games in the 1990s. It will trace the progression of 3D games from this point onward, exploring genres that add a new understanding to the relationship between the camera and game art including the third-person perspective and the fixed cameras of traditional Survival Horror. Some other less prominent camera perspectives have also emerged. Abstract art games explore the use of non-linear perspective but find little footing due to the prominence of Physics-Based Rendering and linear perspective. Recent technologies including Augmented and Virtual reality, and procedural generation workflows may not create entirely new camera perspectives, but alter the effect of existing perspectives, marking them as another important area of analysis. Ideally, this work will create a formalized, foundational understanding of the effects of various camera types across 3D video games, which other researchers can then use to further explore the use and significance of cameras in specific games. Essentially, this work analyzes the tools available to developers to craft visual rhetoric: the emotions and information that each image in the game imparts.

THE EMERGENCE OF 3D VIDEO GAMES

The 1993 release of id Software's *DOOM* dramatically altered the field of video games. The game was both immensely popular and controversial. *DOOM* quickly became one of the most influential games of all time: it pioneered the First-Person Shooter (FPS) genre, established the grounds for the future successes of 3D games, popularized online multiplayer gaming, and marked PC gaming as an important platform for future development after the Golden Era of the Arcade in the 1980s (Anderson). *DOOM* also proved controversial, inciting debate about violence in videogames and its effect on players. In these respects, *DOOM* is a seminal text in the history of game development and game criticism. *Quake*, which id published in 1996, built upon *DOOM*'s foray into 3D space. In terms of 3D art in games, these early FPS games were revolutionary, allowing players to explore stylistically rich environments with both the freedom of interactivity and crafted artistic design, establishing the basis for the future of 3D video game art.

DOOM was not the first 3D, first-person game. Steve Colley released *Maze War* in 1973, and id Software published *Wolfenstein 3D* in 1992. However, *DOOM* embraced 3D more fully, setting it apart from these other titles. It features textured environments rather than the vector graphicsⁱⁱ of *Maze Wars*. As in *Wolfenstein*, enemies and objects are represented with 2D image sprites rather than 3D polygonal meshesⁱⁱⁱ. Sprites rotate based on player and camera position, making them visible from any perspective. Unlike *Wolfenstein*, the environments of *DOOM* are dynamic and rich (Figure 1). The Moon base levels features sci-fi paneling, flashing lights, and the corpses of space marines. Hellscape levels feature pentagrams, upside down crosses, red mountains, and living, fleshy environments (Figure 2). This use of gritty, violent, and satanic imagery contributes to the game's dark mood. This tone complements the game's violent content, enabling art to reflect gameplay. *Wolfenstein* includes the same level of violence, but its drab, grey environments fail to create the same sense of atmosphere and cohesiveness. Additionally, *DOOM*'s environments are fully explorable and set a standard for 3D environments. The player has full control over the camera, so the environments must be appealing from multiple angles. Designers place objects throughout levels, so that no area appears dull or empty.



Figure 1 - Evolution of Aesthetics from the vector graphics of *Maze War*, to the simple environments of *Wolfenstein 3D*, and finally the atmospheric setting of *DOOM* (*Maze War* and *Wolfenstein* images courtesy of Wikipedia).

Allowing player control of the camera also adds design challenges. Because developers cannot control the camera how a cinematographer would in film, they must use other methods to create aesthetically appealing shots. Consider the final boss battle of chapter 1 – “Knee Deep in the Dead.” As the player walks up the stairs to the final pentagram altar, two demons emerge from pillars framing either side of the shot. Here, the developers force the player into a crafted shot with a balanced composition (Figure 3). Windows in the game world allow developers to constrict player view, focusing player gaze on some element of the scenery. In the moon base, windows frame grey mountains, contributing to player understanding of the level’s setting (Figure 4). The extent to which designers and artists can control compositions is limited by the player’s control of the camera to some extent. It is hard to force players to follow the rule of

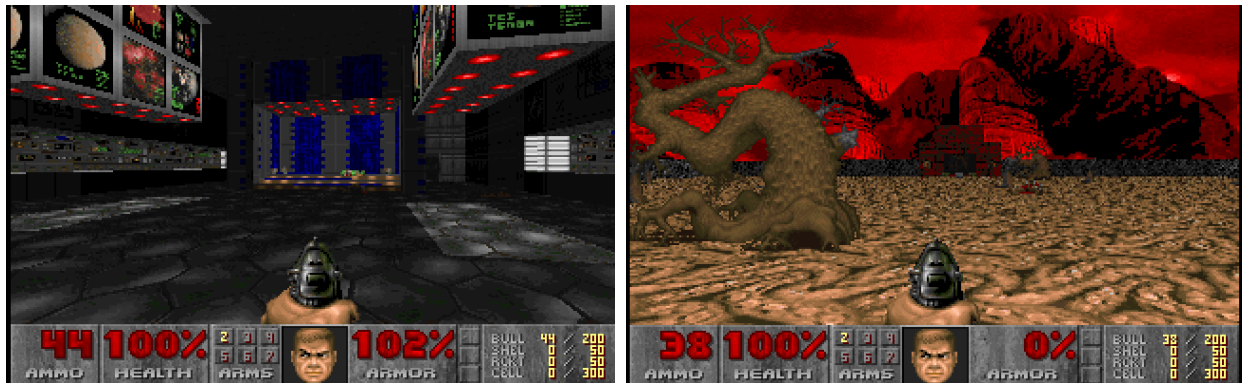


Figure 2 - Moon Base and Hell environments in *DOOM* (Chapters 1 & 3 respectively).

thirds^{iv}, although placement of game objects may make it more likely that players do. In any case, levels are designed so that the potential for exquisite compositions exists. Some players even play photographer within games, seeking out balanced compositions and taking screenshots of them (Gilmour). The interactivity of video games has implications to art design beyond crafting aesthetic experiences. Designers must also make sure that the environment is readable and navigable by players. Sprites of dead bodies not only add to the tone of despair, but let the player know which areas they have already been through. Powerups, which provide the player with special abilities, mark progress in the level and orient players, leading them towards designed experiences.

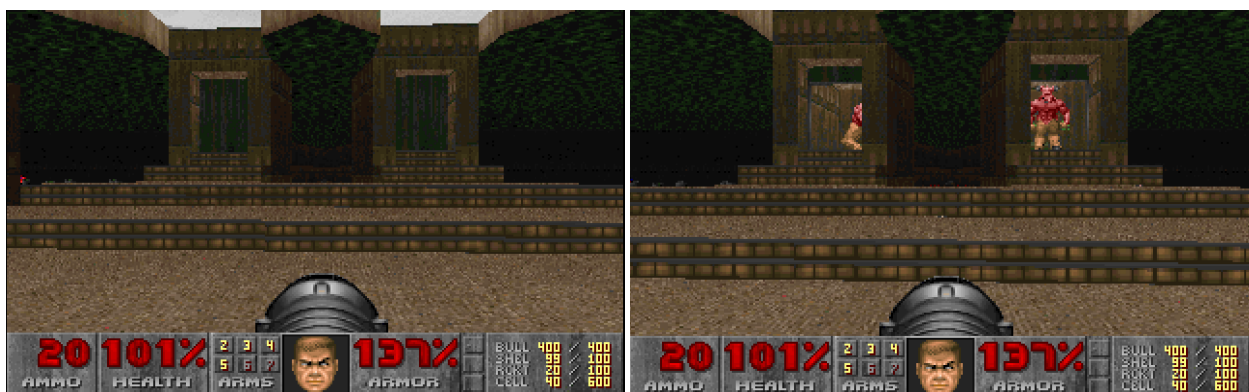


Figure 3 - Inevitable encounter with a level of compositional balance.

While games, as a medium, allow for interactivity, the 3D exploration of *DOOM* elevated this interactivity by adding another dimension. *DOOM* involves more than beating the game—it

is also about exploring an environment in 3D space, finding secrets and designed aesthetic and mechanical experiences (Figure 5). In a market dominated by two-dimensional games, the added exploration of monumental 3D games like *DOOM* changed the nature of games. Indeed, 3D games with interactive environments are now standard. Not only was the market of games impacted, but also the process of development. 3D artistic assets must be viewable from any angle, and the process of making a 3D mesh differs greatly from making sprites. While *DOOM*'s answer to this challenge was rotating 2D sprites, its environment design set the foundation for future 3D games.



Figure 4 - Window view.

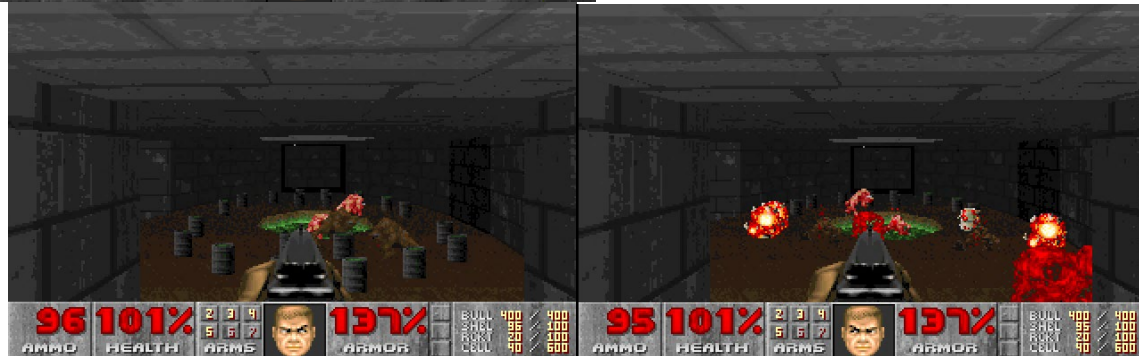


Figure 5 - A crafted aesthetic and gameplay experience at the beginning of “Knee Deep in the Dead.” The player emerges from a doorway to this visually composed scene. This design also provides gameplay satisfaction—shooting one barrel sets off a chain reaction, eliminating the demons.

While *DOOM* only features horizontal camera movement, *Quake* introduces full vertical and horizontal camera rotation. This added verticality creates new gameplay experiences (like aiming up to shoot an enemy on a ledge) as well as new aesthetic opportunities. Assets can be seen from above and below. The ceiling, or sky, of the game takes on more importance, and design must shift accordingly to ensure that these assets also create fleshed-out environments. This change in design is immediately apparent upon beginning *Quake*. A dynamic, purple sky filled with clouds moves above. The ceiling features textured wooden planks (Figure 6). In this introductory sequence, the sky is one of the game’s most visually striking elements. Its appearance stands out, naturally drawing player vision, forcing use of the new camera mechanic. *Quake*’s verticality also introduces the ability to jump. Players may climb up ledges and through the environment, increasing avenues for exploration.



Figure 6 - Opening Tour de Force in Quake, demonstrating the game's verticality.

As in *DOOM*, *Quake* also features a rich 3D environment with a distinct style. Satanic imagery and demons permeate the game once more. Levels are littered with images of pentagrams and skulls. However, *Quake*'s aesthetic is gothic rather than sci-fi (Figure 7). Stone and wood replace flickering computer panels. Medieval knights, bloodhounds, and enemies wearing steel breastplates attack the player rather than the demons of Hell. Environments take the form of castles with drawbridges and towers, not the bloody, organic hellscape and artificial labs of *DOOM*. Again, immersive levels with a clear tone are created through art style.



Figure 7 - shots demonstrating elements of Quake's medieval, gothic aesthetic.

Quake's use of true 3D objects instead of rotating sprites further demonstrates the evolution of 3D games since *DOOM*. Enemies and props are 3D meshes rather than rotating 2D sprites with multi-directional animation sets (Figure 8). Meshes behave as objects do in the real world, and the player's perspective of an item or enemy depends on their view of the mesh rather than the rotation of a flat image plane. This true three-dimensionality is the basis for modern games, and a sharp departure from earlier 2D games. The use of 3D objects also allows for a greater level of realism. Player perspective of an object depends on position relative to that object. In *DOOM*, any in-game object appears the same from basically any angle. Enemies have 4 distinct animations depending on the cardinal direction they face, but the effect pales in comparison to actual 3D meshes seen from any angle.



Figure 8 - 2D sprites representing objects in *DOOM* compared to the 3D polygonal objects of *Quake*.

The artistic evolution present in id Software's early FPS games impacts these games on all levels. Mechanically, the exploration and open-endedness of these games takes on a new level of importance; challenges can be solved in three dimensions. Both *DOOM* and *Quake* established the foundation for interactive 3D videogames, in which the player controls the camera. These games demonstrated, early on, ways in which developers can create experiences of immersion, while maintaining the game's elements of interactivity and exploration in a 3D space. Level design presents crafted shots to players. Doors that players must pass through open to designed shots with compositional balance. *Quake*'s 3D objects allow realistic viewing from any angle. In a market at the end of a Golden Era dominated by 2D games, 3D FPS games reinvigorated the medium and expanded possibilities for player interaction. Although these titles were not the first 3D games, they popularized 3D gaming at large, making 3D a lucrative avenue for future games in the 1990s.

THE THIRD-PERSON PERSPECTIVE

id Software's early FPS games paved the way for 3D, and other camera perspectives quickly emerged in 3D games. Many of these perspectives simply mirrored existing 2D perspectives such as top-down, side scrolling, or isometric^v views. These games are essentially 2D games, and assets and levels are designed according to the already existing design patterns. Of course, the aesthetic effect of using 2D assets in a 3D space (sometimes called 2.5D) is distinct. Lighting can cast more realistic and dynamic shadows, and environments can create a greater perception of depth than in traditional 2D games. However, the design of the game and its art is essentially the same as that of a 2D game and is not contingent upon player control of the camera (Figure 9).



Figure 9 – Never Alone (2014). A 2.5D game with 3D art that behaves as a 2D side scroller. While 2D cameras are outside of the scope of this paper, this image also highlights a common feature of most 2D side-scrollers. The player can see areas of the environment that the protagonist cannot, granting a greater situational awareness.

Other games innovated upon the top-down approach common to 2D games, placing the camera outside of the player character in a similar perspective, while allowing players to rotate the camera around the player to see different parts of the environment. The third-person perspective was extremely popular in 3D platformers of the 1990's. Games like *Crash Bandicoot* (1996), *Spyro* (1998), and *Banjo Kazooie* (1998) all used this perspective to their advantage. Because the third-person camera revolves around the player character, this character's visual personality has a newfound importance. Most 3D platformers of this era capitalized on character personality, creating vibrantly-colored cartoon personas that players would enjoy looking at (Figure 10). These characters also have distinct and interesting silhouettes which read well from behind—the main angle the player will see their character from at any given moment.



Figure 10 – 3D third-person platformer box art, highlighting the cartoony, stylized main characters. Image courtesy of https://aminoapps.com/c/video-games/page/blog/25-game-grey-discuss-a-platform-genre-rare-revival/IJSQ_uD6bRJ0mBV1VLDBeoBQPwV3rq.

Aside from a focus on the player character, the implications to art and design presented by the third-person perspective are generally the same as those presented by the first-person perspective. In both viewpoints, designers must lead the player's movement (and gaze) around a 3D environment that the players are largely free to explore. However, there are some minor differences between these camera styles. First-person games limit player views more than the third-person games. In a third-person game, players typically see at least some of the area around their character on all sides, including their rear. First-person games allow developers to surprise characters from behind to a greater extent than third-person games which provide greater situational awareness (Figure 11). This situational awareness is like what a player might experience in a 2D sidescroller. Generally, this affects level design more than art. Art for environmental assets in third-person games is fundamentally the same as third-person art, although generally the player sees it from further away allowing the level of detail to be potentially lower. The main differences between third-person games and first-person games emerge in the ways developers limit camera movement. In first-person games, movement of the camera generally does not provide problems. First-person games often allow the player to rotate in 360 degrees in all directions. If the camera is limited in any way, it is to prevent the player from looking all the way up or all the way down to avoid realizing that their character often has no rendered feet. In third-person games, giving players full freedom over the camera causes problems.



Figure 11 – The same shot in The Elder Scrolls IV: Oblivion (2006) from the third and first-person perspectives. Notice how the third-person perspective allows the player to see the guard (glowing) behind them.

Game designer John Nesky describes the importance of camera control when designing *Journey* (2012) in a Game Developer's Conference (GDC) talk on camera design. Cameras in games "divert" player attention. Cameras, and the player's interaction with those cameras, must lead players towards designed experiences. Nesky catalogues 50 mistakes made by camera

designers in third-person games. Among the mistakes to avoid: giving players complete control of the camera and breaking line of sight to the player avatar at a time that obstructs gameplay. Cameras must pivot around the player character and be controlled by the player, but they should also be intelligent. They should be able to move around the environment without requiring constant input from the player. Constantly controlling movement and the camera can be overwhelming for inexperienced and veteran players alike. Cameras also should never obstruct the player's ability to navigate an environment. Furthermore, cameras need to pivot at times to lead the player. If a player has wandered for too long without making progress, a good game will pivot the camera towards an objective, guiding players. This gentle hinting allows for both player control and interaction with the game, and designer control of player's movement. Again, these techniques allow designers to create designed and guided camera shots. At the same time, interactivity takes precedence over camera control in most third-person games. Nesky's lecture highlights the importance of the balance between interactivity and guiding the player camera. Taking away control entirely should also be avoided. Instead, developers should hint and nudge the camera, but not prohibit the player from moving the camera back to any other perspective. Hints are useful, both to lost players and to designers creating crafted shots, but players should be able to ignore hints for the sake of interactivity and exploration (Nesky).

Aside from these considerations, first-person games and third-person games are largely similar in how they lead the player towards designed experiences. Because both camera perspectives grant the player a large amount of control, designers and artists must ensure that player's see designed experiences. This concept has been briefly explained in this paper's section on id Software's early FPS games which pioneered these techniques of player manipulation. However, the problem of controlling people's eyes to present designed experiences is not limited to, nor originally from games. Consider the experience of visiting a theme park like Disneyland. These parks mimic the structure of movies, drawing directly on cinematic principles (Freitag 704). Disneyland heavily employs "visual framing" in rides to draw the eye in a way that simulates the effects of cameras in film (Freitag 708-709). Rides shift and spin, pointing spectator gaze at specific areas of attractions. Some games (like the traditional Survival Horror games explored later in this paper) control player vision in the same way, but the more interesting comparison between games and theme parks emerges in the area of the park in which a park-goer has freedom to explore. Even Disneyland's "spatial organization" draws upon film (Freitag 714-715). The park is designed to present images to spectators. Visitors first walk down main street, captivated by the complex scenery and storefronts around them. The Disney castle acts as a focal point, and visitors are "drawn towards it" (Freitag 715). From the central plaza, each separate area of the park is presented as a "closed composition," featuring a "tall central structure" that serves as an additional focal point and is surrounded by "smaller structures." (Freitag 716). Here, the architectural and visual design of the park draws visitors towards sights with crafted compositions. Thus, the park draws people towards its most visually striking and memorable elements, while obscuring all that goes on behind-the-scenes (Figure 12).



Figure 12 – Disneyland map. Note how each section of the park has at least one central “tower” structure surrounded by smaller structures.

Games use this same technique of designed layouts and focal points particularly well. Early third-person games struggled with the freedom of camera control and even popular titles like *Banjo Kazooie* have instances in which the camera clips through scenery in the game (Anderson). But now, game design generally draws player vision effectively. Many games even use the same technique directly employed by theme parks to indicate player destination. *The Elder Scrolls IV: Oblivion* (which can be played in either third or first-person, highlighting the similarity between the perspectives) places towers in the barren planes of oblivion to indicate player objectives (Figure 13). Games also use sound to effectively draw players. The distinct clicking noise produced by zombie-like “clicker” enemies in *The Last of Us* (2013) can push players towards designed aesthetic and gameplay experiences by making them avoid confrontation.



Figure 13 – Towers in the Planes of Oblivion that serve as player objectives. Note how the towers are framed by smaller structures and rock outcroppings.

Film, which acts as inspiration for both games and theme parks, has begun to incorporate some of these design tricks from games. Virtual Reality (VR)^{vi} allows for true audience

interaction with the medium, to a formerly impossible extent. In VR movies, or “experiences,” viewers can control the camera, acting as a cinematographer. The viewer is both a creator of the experience and its spectator. Of course, the amount of control is again limited here. In a VR filmmaking guide, VR filmmaker Logan Dwight explains how “guiding action” can draw a viewer’s focus and attention to specific parts of the scene. Because the viewer has freedom to look where they want, “secondary” and “tertiary” action fills the rest of the scene to create a sense of immersion in the experience (Dwight). Dwight notes how these techniques are mastered in videogames using level design. VR filmmaking, and even theme parks, highlight the increasingly blurred boundaries between media.

So, first-person and third-person camera perspectives are strikingly similar in terms of player experience in a game, and generally have the same implications to art and design. In both instances, developers must guide players through environments which are open to exploration. Generally, this is achieved through points of interest (POI) that draw player attention for a variety of reasons. POIs can be related to the mechanics and goals of the game (i.e. powerups that help the player), to aesthetics (such as the visual framing in *Oblivion*) or through sound cues and hints. In any case, this guidance can either be used as a tool to progress the game, or to showcase the game visually with a crafted shot. Minor differences emerge between these perspectives because of their focus. Especially in early third-person games, character art and design take on increased importance. Third-person views create greater situational awareness, but also give the player less camera control at certain times. As these camera perspectives and game genres developed, another meaningful camera perspective emerged in response to the clumsiness of many early third-person platformers.

ALTERNATE APPROACHES TO THE CAMERA: IMITATING FILM

Video games invite players to create their own experience as they play. Both games and film are audiovisual art forms, but games introduce an element of interactivity that film lacks. Games require input and control—players alter the game’s outcome, and their experience of it, through participation. In film, cinematographers compose crafted shots to provoke emotion or convey information. Alternatively, many 3D games allow players to control the camera, making the creation of composed shots more difficult. Designers can make levels that lead players through the game, exposing them to crafted aesthetic experiences when possible, but some games draw directly from the techniques of cinema. Early Survival Horror games like *Alone in the Dark* (1992), *Resident Evil* (1996), and *Silent Hill* (1999) use fixed camera angles with cinematic compositions. Here, the term fixed refers to cameras that will behave in a fixed way, determined by the game designers. These cameras are not necessarily static and can move along a path. Because controlling a character from a limited vantage point proves difficult, this cinematic style, and traditional Survival Horror, has become largely obsolete. Regardless, Survival Horror is demonstrative of the appropriation of the techniques of cinematography in games. Many modern games like the *Uncharted* and *Metal Gear Solid* series utilize filmic techniques to a lesser extent, intermingling cinematic control with the interactivity that defines games.

The Survival Horror genre flourished in an era in which games struggled to create fluid, intuitive controls. According to games journalist Jim Sterling, “fixed camera angles, dodgy controls and clunky combat were seen as problematic in most games, [but] the traditional Survival Horror took them as a positive boon.” (Sterling qtd. in Perron 110). The clumsiness of the games contributed to the fear and distress of the experience. Monsters encroached upon panicked players who couldn’t aim well enough to protect themselves (Figure 14). The ability to defend oneself easily would decrease the game’s tension. In this era, the medium of games struggled with another issue: the “representation gap” between games and film (Weise). Developers wished to make games with environments that were as aesthetically rich as film, and by mimicking filmic techniques, this goal became more attainable. The limitations of games in the 1990s and the goals of developers propelled the genre to success.



Figure 14 - A zombie, seen in the mirror, approaches the player early in the game. Here the clever placement of a mirror allows the player to understand the danger they face without being able to see it clearly-the environment is designed with the camera angle in mind.

Survival Horror games most directly resemble film from use of fixed cameras; cinematic angles constrict and obscure the player's view, allowing developers to hide scares (Figure 15). While cutscenes certainly contain cinematic elements, this influence appears in gameplay as well (Perron 79). In fact, the cameras of Survival Horror define gameplay. The sound of an offscreen danger, and the inability to see that danger, leaves players uncertain and afraid. In the *Film Quarterly* journal, UC Berkley Ph.D. candidate Irene Chien notes that as players progress, "the game viewpoint switches without warning from one fixed and limited vantage point to another [in a] cinema-style montage that can be awkward and jarring" (64-65). This awkwardness distresses the player further, while allowing designers to play the role of cinematographer, "confin[ing] players in dark, claustrophobic interiors" with the "restricted [...] framing" of "horror cinema" (Chien 64). Shots have both the crafted composition of film and functionally convert "off-screen space [to an] out-of-reach source of dread and danger" (Chien 64). The framing of the games surrounds the player as much as its pressing environments. Both narrow hallways and narrow camera angles trap players in dangerous situations they cannot look away from. Yet this cinematographic control also allows for shots that shock the player with their aesthetic quality, creating a sense of discord between unexpected beauty and fear.



Figure 15 - A typical Survival Horror shot.

This controlled upset and awe is rare in games. Restricted cameras contrast starkly with the “360- degree views of vast, exquisitely textured landscapes that are open for free-roaming exploration” of recent open-world 3D games (Chien 64). Survival Horror’s setting and framing encroach upon the player, evoking fear. The lack of grace the player experiences from being unable to control their view of the environment increases unease. Survival Horror elicits “intense automatic emotional responses from players” (Perron 114). A shot that obscures part of a room would usually annoy players, but in Survival Horror this shot, borrowed from film, suggests hidden danger to the player (Figure 16). Ultimately, the constrained, claustrophobic style of Survival Horror is almost antithetical to most 3D, exploration-focused games.



Figure 16 - A wall obscures player vision, foreshadowing possible danger.

The cinematic elements of these games extend beyond the use of camera angles and the compositions of shots and scenes. Visual noise in *Silent Hill* mimics the grain of film stock. In-

game lights produce lens flares (Perron 79-80). The author Bernard Perron even compares the game's aesthetic to that of German Expressionism, in which the protagonist's interior and mental state is mirrored by the environment and the presentation of it (85). The Survival Horror genre appropriates the conventions of film both through the composition of its shots, but also through the depiction of its environments and visual camera effects.

While the inability to control a camera reduces interactivity, this design decision initially benefitted Survival Horror games. The filmic nature of Survival Horror earned the genre its positive reception (Perron 93). Its reliance on the authority of film established it as art in the eyes of critics. Even though early Survival Horror games relied heavily upon the language of cinema, they are still distinct as an art form. In 2002, the influential film magazine *Cahiers du Cinéma*, affirmed that videogames allow the “actor and the spectator” to be one and the same, something film cannot achieve. (Higuinen and Tesson qtd. in Perron 96). While film may involve a spectator intellectually, they can't control its outcome or the framing of the film itself (except in the case of modern VR experiences). Additionally, games engage senses that film cannot. Controller vibrations allow for tactile stimulation, indicating damage to the player or a simulated “acceleration of the heartbeat” (Perron 108). The added sense of touch creates a greater level of immersion within a game. While games and film are both audiovisual media, the stereoscopic nature of sounds in games also increases immersion. As the player moves, sounds increase or decrease in volume depending upon their spatial relationship to the player (Perron 116). Survival horror depends upon film, but also engages with that legacy by exploring it through the interactivity of games.

The initial success of the genre eventually dwindled. In the 90s, Survival Horror “was a formula for success ... Restricted cameras caused players to fear every step they took, while characters that couldn't hold a gun steady encouraged players to flee rather than fight.” (Sterling qtd. in Perron 110). The clumsiness of these games' controls and restricted framing led to “chilling—or, for some gamers, frustrating—moments.” (Perron 84). Eventually this frustration won out over fear, leading to the genre's demise. Intuitive control in other game genres (like third-person platformers) improved, and the market shifted towards games that harnessed this newfound ease of use. In the early 2000s, Survival Horror tried to follow suit, offering third-person over-the-shoulder camera views (Figure 17). “Yet this more responsive and intuitive” gameplay sacrificed the genre's hallmark “disorientation and terror.” (Chien 65). These games no longer elicited the fear of earlier titles, playing like action games instead. The genre of Horror still plays an important role in the sphere of games, but the dependence of Survival Horror on fixed, cinematic cameras is gone.



Figure 17 - Over-the-Shoulder view in *Resident Evil 4* (2005). Image from Sterling: <https://www.destructoid.com/how-survival-horror-evolved-itself-into-extinction-114022.phtml>.

Most modern 3D games either take on a first-person perspective or a third-person over the shoulder perspective during gameplay. Game developers still employ the language of cinema

during cutscenes and even during specific portions of gameplay, but ease of control generally takes precedence over controlling player emotion and experience. Players, not designers, control the camera. Still, *The Walking Dead* (2012) and *Heavy Rain* (2010), both narrative driven games, employ a variety of camera angles and techniques from film. Because gameplay is not the central element of these games, the decreased precision of control generally does not impede player experience. Additionally, some action games, like *Uncharted 3* (2011), remove player control of the camera at certain points in favor of the aesthetics of cinematic composition. As the player wanders through the desert, cuts demonstrate the passing of time, and one shot with a tracking camera reveals the vastness of the desert (Figure 18). These cinematic moments within the larger game “recreate what it feels like to be inside [the] cinematic world” without the downfalls of purely cinematic camera angles (Weise). The use of filmic techniques is widespread, from AAA to indie^{vii}. Indie developer Blendo Game’s critically acclaimed *Quadrilateral Cowboy* uses several techniques from film including jump cuts and elliptical structures (Keller). Most modern games draw upon the legacy of film more subtly than traditional Survival Horror. “The dream of the interactive movie is still [alive], but [developers are] smarter about using ... these conventions” (Weise). Games use the language of film, but do so sparingly, at specific times to evoke reactions. Rockstar Games’ more recent titles like *Red Dead Redemption 2* (2018) even allow players to use first-person, third-person, and cinematic camera perspectives at any point (Figure 19)



Figure 18 - Tracking shot in Chapter 18 of *Uncharted 3* (2011). The camera zooms away from the protagonist, Nathan Drake, highlighting the danger he faces in the desert. Screenshot from <https://www.youtube.com/watch?v=UNlpbfWeeE0>.

Ultimately, film provides games with a useful legacy and the opportunity to build upon an established art form. Survival Horror’s use of this legacy conferred respect upon the medium early on. Eventually, the medium grew out of the limitations and clumsiness of the genre. Horror games today are less filmic than their predecessors, but perhaps they still draw on the legacy of film tactfully and subtly. Rather than mimicking a horror film, games place the player in that film, and allow them to experience it from a new perspective. As an artistic style, and genre, Survival Horror forms an important section of the aesthetic history of videogames. Few genres demonstrate the same interconnection between film and games. The aesthetics of Survival

Horror depends upon the calculated control of cinematography, not harnessing the chaos of interactivity that is the hallmark of the medium, and the specialty of other third-person and first-person titles.



Figure 19 – Three shots from Red Dead Redemption 2 (2018) demonstrating the variety of camera perspectives available to players: First-person (top left), third-person (top right), and cinematic (bottom left).

Before exploring some of the more novel camera perspectives in games, I would like to briefly mention visual rhetoric^{viii} in relation to the common camera perspectives already explored in this paper. According to game designer and academic Ian Bogost, “visual rhetoric is often at work in video games” (124). Games are a visual media, and therefore use the techniques of visual rhetoric to convey ideas. This paper aims to explore how cameras, and the tools available to game designers, can contribute to the visual rhetoric of a game rather than to explore the foundations of visual rhetoric itself. For instance, I have explored how a designer might create compositions in a game through level design and world-building, or through cinematic cameras. I have not, however, mentioned the emotional or intellectual impact of such a composition because this is out of the scope of this work (visual rhetoric encompasses a whole field of research). Instead, this paper explains the tools game designers can employ using various camera types to take advantage of visual rhetoric in their work. I have mentioned visual rhetoric because it is a necessary consideration when analyzing game cameras, and because it contributes to another key feature of games: procedural rhetoric.

As visual rhetoric refers to persuasive (or communicative) use of imagery, procedural rhetoric refers to “the practice of using processes persuasively” (Bogost 125). Essentially, the use of gameplay for the sake of an argument. Bogost argues that the gameplay of a game like *America’s Army: Operations* (2002), which closely simulates real-life military experience, communicates the importance of the “chain of command” in the military, as well as the importance of values like honor and discipline. The gameplay offers an “an incomplete, yet embodied experience” of life in the US military. I would also argue that the first-person camera perspective of the game further places players in the shoes of a soldier. Essentially, the game’s visual rhetoric reinforces, and contributes to, its procedural rhetoric. Again, any deep exploration of procedural or visual rhetoric is not within the realm of this paper, but I thought it necessary to mention these core elements of games briefly due to their intimate relationship with game cameras and camera perspectives.

THE NON-LINEAR PERSPECTIVE: EXPERIMENTAL ART AND SIMULATED CAMERAS

Returning from that detour to the core investigation of this paper: game designers generally use cameras in conjunction with games' interactivity to create a medium which draws from film but is simultaneously unique. Alternatively, some games use the camera to draw upon other art forms. Game developers see the relationship between cinema and games as "fruitful" and able to push the medium to explore "new directions" (Weise). This relationship allows developers to use the language of games, interactivity, "to recreate what it feels like to be inside [the] cinematic world [of a movie]" (Weise). However, this relationship is not required, nor inherent to games. The camera in videogames is simulated, and therefore need not restrict itself to the constraints of physical reality faced by an optical camera (Thomas and Haussmann). Games can explore non-linear perspectives^{ix} that cinema cannot, just as movements like cubism explored facets of artistic expression that realism (or photography) could not (Thomas and Haussmann 3). Essentially, game cameras can explore our perceptions of space, drawing upon inspiration from media like painting.

Game developers David Thomas and Gary Haussmann outline the potential games have for exploring nonlinear space. Traditionally 2D games like *Asteroids* (1979) present perspectives that would be impossible in any medium using real cameras. Because the screen wraps from top to bottom and left to right allowing player to move out of the screen on one side and back onto it in another, the space explored in *Asteroids* must be a torus^x (Thomas and Haussmann 5). But this space is presented as a flat rectangle, meaning the camera can view all sides of a torus in a way which no real camera could. 3D games have the same potential. The Bug Eye Project, made by the paper's authors, was meant to explore these possibilities. Unfortunately, the experiment was short-lived and is no longer around due to the difficulty of working in 3D game engines^{xi} and systems designed around linear perspective (Thomas and Haussmann 7). Games have long strived towards realism in terms of graphical fidelity and realistic perspective. Certainly, games have explored stylized graphics with exaggerated forms, lighting, and materials, but these games still rely upon linear perspective (Figure 20). Increasingly, game technology supports this perspective. Innovations like Physics-Based-Rendering (PBR)^{xii} and real-time raytracing^{xiii} depend upon the assumption of linear perspective.



Figure 20 – Realism in *Call of Duty: Black Ops 4* (2018) contrasted with the stylization of *Overwatch* (2016). Both games are first-person shooters, but their art styles are entirely distinct. Nonetheless, both games use linear perspective. Black ops 4 image courtesy of Forbes.

While non-linear camera perspectives highlight an interesting opportunity for the future of games, only a few games, to my knowledge, explore the use of such a perspective. Perhaps the reluctance to create experimental games with non-linear perspective stems from the relationship between cameras and interactivity in the medium at large. Games are built for player interaction, and humans understand and interact with the world using the linear perspective that our eyes

present to us. Therefore, creating interactive games requires a system that allows for human engagement. While the level of control over the camera varies from game to game and genre to genre, all games must present the world so that the player may navigate it. The aesthetic elements of games, whether stylized are not, are designed with the assumption of linear perspective, allowing for easy interaction.

However, some recent puzzle games explore unique uses of the camera. For instance, the winner of the 2019 Intel University Games Showcase award for innovation, *Moncage* (2019), revolves entirely around camera perspectives. The game (self-reflexively) begins with a camera inside a cube-shaped cage. As the player progresses, each face of the cube becomes a window (or a camera) into a new environment. Moving the game's camera around each face of the cube will change the angle from which the player can see into each scene. To solve puzzles, the player must match up objects from various scenes, connecting the spaces between them (Figure 21). Here, the game employs multiple cameras that go beyond a linear understanding of space. Each camera provides a linear perspective into a scene, but also connects the scenes to one another. *Monument Valley* (2014) employs a stationary, isometric camera, but the physical space of the game takes advantage of Escher-esque optical illusions that could not exist in a linear space. It is no coincidence that both these titles are puzzle games. They challenge our understanding of space in a way that would hamper gameplay in most other genres. While the medium of games has not yet progressed towards abstract camera perspectives at large, other recent technological innovations present noteworthy implications to camera design.

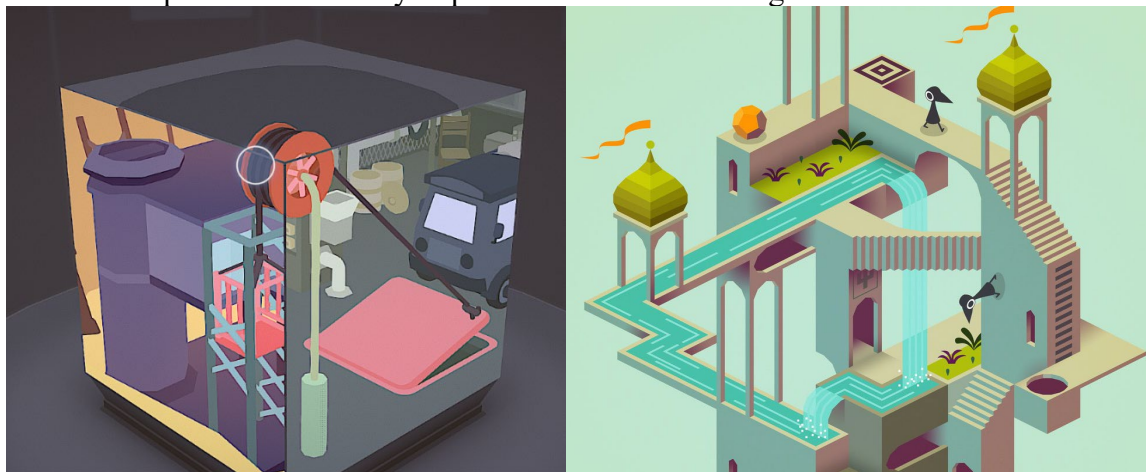


Figure 21 – *Moncage* - left: Here the player must connect images from 3 separate cameras to allow the machinery to function. *Monument Valley* - right: An optical illusion in the vein of M.C. Escher. (screenshot from Polygon.com)

THE IMPLICATIONS OF INNOVATION: MODIFICATION OF EXISTING PERSPECTIVES

New technology and design workflows introduce new considerations into the interaction between art and control in games. New camera perspectives like Augmented Reality (AR)^{xiv} require designers to create games and art considering their interaction with the real world. Even VR, which many consider an extreme version of the first-person perspective, has important implications to game art and design. Some research suggests that the intense immersion of VR creates greater player impact, requiring the intense experience of some games to be toned-down to prevent player harm (Madary and Metzinger). Procedural Generation^{xv} requires careful monitoring over player control of the camera to create detailed environments when the player is not looking.

In the context of AR, the most important consideration is the presence of real-world objects. In terms of art and design, the implications of real objects depend on the goals of the project. If the goal is to create realistic gameplay experiences, then objects and textures should follow the styles of realism. Alternatively, stylized assets can create novel experiences that make the world more exciting. In Apple's guidelines for AR developers, they acknowledge that not all AR experiences "require realistic virtual objects," but those that try to create "convincing illusions" should contain "detailed 3D assets with lifelike textures." Additionally, these assets should reflect environmental lighting and cast virtual shadows on real world objects (Apple). Stylized games like *Pokémon Go* (2016) have been wildly successful without this realism because they place beloved characters and creatures within the real world, while encouraging explorative and social gameplay. Essentially the novelty of seeing Pokémon in the real world contributes to a compelling experience made possible through AR. Apple also outlines several other design guidelines for developers that further reveal some of this "perspective's" implications. AR requires an open space to play in, sufficient lighting, and flat surfaces to place game objects on. Players will often play in suboptimal environments, requiring developers to come up with solutions to these anticipated problems. For instance, if a user tries to play in an area without enough lighting, developers should give the users a simple message that they need to turn on more lights (Apple). Apple's guidelines offer various other suggestions about creating intuitive and immersive experiences, but perhaps the most salient implication of AR as a camera perspective comes from the way users control the camera. Users directly manipulate their viewing device (be it a HMD^v like the Microsoft HoloLens, or mobile phone), moving the camera around the environment physically. Ultimately, the intuitiveness of AR experiences stems from ease of controlling the camera. To see an object more closely, the player need only move closer to the object. To see something from a new angle, the player simply moves around.

VR is like AR in terms of ease of camera control. To change the camera perspective, players need only look around as they do in the real world. However, the extreme levels of immersion created by VR may have serious implications. Jeremy Bailenson, the director of the Stanford Virtual Human Interaction Lab has researched the uses and effects of VR since it has been available commercially (Nintendo released the Virtual Boy in 1995). His suggestions for using VR: "VR can be stored in the brain's memory center in ways that are strikingly similar to real-world physical experiences ... If it's an activity that you're ethically not comfortable with in real life, don't do it. If you think of it that way, the guidelines on what you want to do in VR become very clear" (Bailenson qtd. in LaMotte). Of course, one might argue that on the higher level of reason and logical thinking, users in a VR experience know what they are experiencing is not real. Scott Stephan, a VR designer, provides an interesting understanding of VR horror games that may serve as a counterargument to this point: "The way I process these scares is not through the eyes of a person using their critical media-viewing faculty but through the eyes of I,

the self, with all of the very human, systems-level, subconscious voodoo that comes along with that” (qtd. in Parkin). So perhaps VR affects us on a deeper level than that of conscious reasoning.

In fact, research done at various other labs may indicate that VR experiences even blur our understanding of the boundaries between the self and the other, and muddle our understanding of our own agency (Twilley). The ethical and psychological implications of VR have even led a team of German researchers to compile a near comprehensive set of guidelines to using VR that addresses developers, researchers, and consumers (Madary and Metzinger). The product warning for Google’s Daydream view headset warns users that “If the [VR] content is frightening, violent, or anxiety provoking, it can cause your body to react physically, including increasing your heart rate and blood pressure. It can also, in some individuals, cause psychological reactions, including anxiety, fear, or even Post Traumatic Stress Disorder” (qtd. in LaMotte). Many VR headsets also include suggestions to not allow children under a certain age to explore VR.

Alternatively, VR has been used for many positive applications in the field of psychology since its inception. Researchers have used VR for Exposure Therapy^{xvi} treating PTSD and phobias (“Bravemind”, “Virtual Reality Therapy for Phobias”). It has been used to increase empathy and self-esteem (Twilley). VR may be particularly beneficial for anxiety treatment and pain management (Jerdan et al.). Ultimately, addressing all the psychological effects of VR is not within the scope of this work. But considering that VR may have different effects for players than traditional video games will be important for both designers and consumers of VR technology in the future.

Procedural generation is not a modification of any existing camera perspective, but as a technology and workflow, it requires designers to consider new elements. Looking at *Minecraft* (2009), worlds are procedurally generated before the player steps foot in them. However, enemies spawn in areas of low light. The spawning of enemies must occur outside of the player line of sight to maintain a sense of immersion. This requires that the game track the player camera and respond accordingly. Looking further into procedural generation, the *Endurance* downloadable content^{xvii} (DLC) for *Rise of the Tomb Raider* (2015) also tracks the player camera to generate a world as the player plays, creating a unique gameplay experience every playthrough. However, procedurally generated games often lack the same handcrafted element that comes from other games. To combat this randomness, developers using procedural generation insert specific handcrafted elements into the environment, allowing for a greater degree of environmental storytelling and emergent narrative. In *Endurance*, the game uses a “vignette system” to track player stats. Based on whether a player needs help or is doing quite well and needs some sort of roadblock, the game spawns “vignette” assets that affect player experience by providing supplies or acting as a source of danger. As in *Minecraft*, spawning of these assets must occur outside of player vision, but also cannot occur where the player has already been to maintain a sense of immersion. Based on user research conducted by the *Endurance* team, players would typically explore their environments in a spiral. This allowed designers to place these “vignettes” out of the player’s vision, in an area where the player had not been, that they would likely find (Thayer). These design considerations, and their implications to the game camera, will likely become more prominent as game developers continue to refine procedural generation.

CONCLUSION

Game cameras, and player control of them, deeply affects the way players experience a game and the way designers create the game and assets within it. Although many 3D games grant players freedom of control over the camera, developers design worlds and spaces to lead players. Developers often draw upon other forms like film, creating crafted compositions despite the freedom of interactivity granted to the player. The exploration of the purpose and use of 3D cameras began, at a large scale, in the 1990s with the emergence of first-person shooters, third-person platformers, and games which used fixed cameras like Survival Horror. Even now, developers continue to explore new ways to use the camera to create unique aesthetic and mechanical experiences. The idea of abstract, non-linear games is alluring, albeit complex and difficult. New technologies and workflows mirror earlier camera perspectives and techniques with greatly different effects. AR blurs boundaries between reality and games by using real cameras to place games in our world. VR creates previously impossible levels of immersion, presenting positive benefits and potential dangers. Procedural generation workflows require additional monitoring of player use of the camera to create immersive environments.

Aside from exploring new camera perspectives, developers also continue to refine the techniques for camera control, aiming to preserve player interaction as well as a level of control over design. First-person and third-person games are still predominant perspectives in the market of 3D games. Although developers have improved camera techniques over decades and continue to do so, these principles are only now being formally investigated and described. Indeed, many of the observations and analyses of camera perspectives within this work are not groundbreaking. This paper simply aims to explicitly articulate the implications of camera perspectives within games. The scholarly exploration of “gamatography” is still in its early stages in terms of an explicit and formalized understanding of the purpose of game cameras (Nesky). This paper highlights the difference in gamatography among various camera perspectives from gaming’s relatively brief history. Hopefully, this work can serve as a foundation for other game developers and academics to further explore gamatography in specific games, or to explore uses of visual rhetoric that are unique to the medium of games.

This paper should also grant developers a greater awareness of how they use cameras in their own games. This increased awareness of camera function will enable designers to take advantage of opportunities to create crafted aesthetic compositions, if they are not already doing so. Any time a player emerges from a choke point, like a doorway they must pass through, designers can reasonably predict the player will be moving and facing forward. Designers who read this work should recognize this opportunity to craft a shot, and hopefully consider what the visual rhetoric of that shot conveys, as well as the interaction between visual rhetoric and procedural rhetoric. For instance, a designer for a new *Doom* title might use this opportunity to create a jarring composition that complements the fast-paced action and destruction of the series by challenging typical notions of aesthetic value. Furthermore, considering the implications of camera design in emerging platforms like AR will be extremely important, because standards for AR design are not fully-formed.

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ⁱ Interactivity - When referring to interactivity in this paper, I refer to direct involvement of the spectator in the creation of the game. Player interaction with the game largely determines their experience of it. Other media arguably feature interaction as well, and artists have long investigated the question of spectator involvement in the creation of an artistic experience. Readers create an understanding of a text based on experience and knowledge. Someone watching a film performs the same construction of a narrative. In games, this interaction is more explicit because players influence the form itself. What is played depends on the player, as well as the player's interpretation of the played content. Games have an added level of interactivity that other media generally lack, and I refer to this specifically with the term interactivity.

ⁱⁱ Vector Graphics – 2D graphics defined by the connection of vertices in 2D space.

ⁱⁱⁱ Sprites and Meshes – Sprites are computer graphics that may be manipulated as a single entity (Google). 3D Meshes are composed of a network of interconnected vertices in 3D space creating a mesh. This is how 3D models exist in videogames.

^{iv} Rule of thirds – One of the basic guidelines for composition. Typically, a frame is divided horizontally and vertically into thirds. Subjects should be placed at the intersection between these dividing lines, or along the lines themselves.

^v 2D game views – Top-down is as it sounds. Side scrolling cameras follow the player character from a side view, and do not rotate. The Isometric perspective preserves equal proportions between the X,Y, and Z axes of 3D space, creating the illusion of 3D, however this does not allow for linear perspective and is an impossible perspective in the real world.

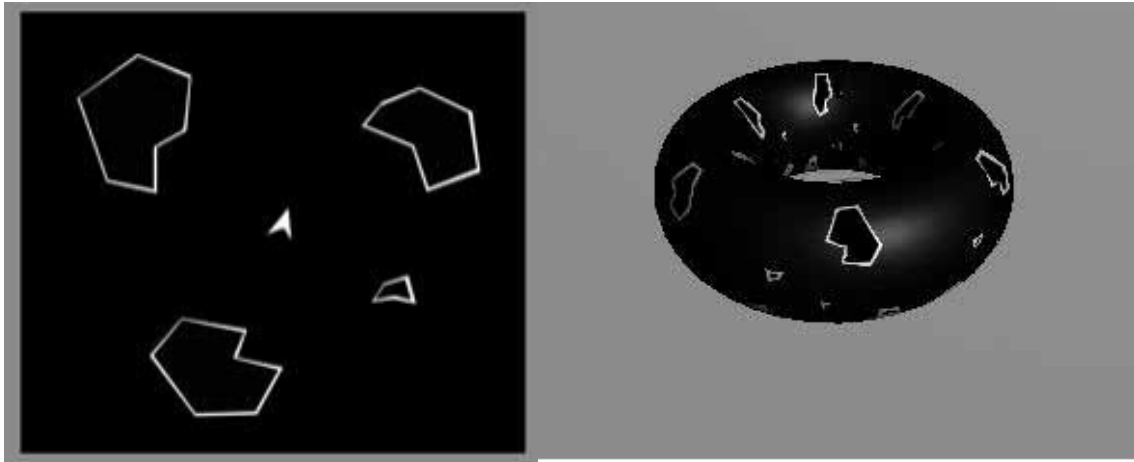
^{vi} Virtual Reality - Total immersion of a user in virtual space. Usually through a Head-Mounted-Display (HMD) consisting of goggles and headphones.

^{vii} AAA and Indie – AAA (pronounced “triple-A”) is a designation within the industry indicating games with the highest budgets and marketing. These are made by large, studio teams. Alternatively, Indie games are made by (usually) small, lower-budget teams, and are published by the developer, rather than a games publisher.

^{viii} Visual Rhetoric – The “figures and forms” of expression in visual media (Bogost 124). Just as the art of rhetoric serves as a means of understanding written and verbal communication (that uses words), visual rhetoric is the understanding of visual media (that uses images and scenes). For instance, certain compositions or camera shots have emotional significance. A shot below a subject might make the subject appear more powerful, whereas a shot from above might make the subject appear weaker. In games, a gigantic boss (a common trope) forces the player to look up, therefore the composition imparts the power and strength of a formidable enemy. This communication of emotions and ideas through camera angles and composition is a basic example of visual rhetoric at work.

^{ix} Linear Perspective - a type of perspective used by artists in which the relative size, shape, and position of objects are determined by drawn or imagined lines converging at a point on the horizon (Google). This perspective mimics our perception of the real world.

^x Torus – a 3D primitive shape resembling a ring. Refer to the figures from Thomas and Haussmann to understand their explanation of *Asteroids* game space:



^{xi} Game Engines – Software tools that facilitate the creation of video games.

^{xii} Physics-Based Rendering - Rendering computer graphics using simulations of real-world physical properties.

^{xiii} Real-Time Raytracing - A recent innovation in computer graphics that allows for detailed light simulation in real-time. Ray-tracing simulates the emission of light particles from a light source as well as how they bounce around the environment. This technique creates realistic light and shadow but is quite computationally intensive. The ability to use raytracing in real-time as opposed to only in pre-rendered scenes will allow for extremely realistic lighting in videogames.

^{xiv} Augmented Reality - Games which superimpose game content on the real world.

^{xv} Procedural Generation – the creation of games and content through automated, programmed systems.

^{xvi} Exposure Therapy – A technique for reducing negative responses to stimuli. Typically, a patient is gradually exposed to the anxiety-producing stimuli in a safe environment. This technique aims to decouple the negative response from the stimuli.

^{xvii} Downloadable Content – Additional content that is added to a released game. These can often be purchased for an additional cost and can range from cosmetic items to new gameplay experiences.