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A Taxonomy of the Simulation of the Depth of Field Effect in Videogames

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This essay focuses on the simulation of the depth of field effect in the design of videogames. As a visual aesthetic element in videogames, knowing and mastering the depth of field effect can be crucial for designers to project systems that stimulate players' emotions. However, there are no guidelines for designers to use. With that in mind, this paper proposes a taxonomy for analysing depth of field in games. This taxonomy stems from the notions of depth of field in film, a very influential medium on the design of videogames. We implemented a methodology consisting of the models of research in Art and Design defined by Christopher Frayling and research in videogames by Ashley Brown along with a combination of three reference books as the foundation of our case study selection. We examined the classifications present in film and subsequently explored their presence in videogames. As a result, we found a single category exclusive to videogames and another to film, having discovered six categories: No Depth, Standard Depth, Shallow Focus, Soft-Focus, Rack Focus, and Tilt-Shift.

1. Introduction and Methodology

The present article focuses on a specific element of the aesthetic output and design of videogames: the *depth of field*. When dealing with elements regarding the aesthetics of videogames, designers project the mechanics they believe will elicit certain feelings in players, as they interface with the game and the structures that support play (Hunicke et al. 2004, 2). Play is supported by and manifests through many game spaces. We considered Michael Nitsche's five planes thesis for the study of videogame spaces (2008). Since we focused on the depth of field, which typically manifests through computer monitors and TVs, we have taken into special consideration what Nitsche calls the mediated space. Sercan Sengün has interpreted and described the *mediated space* as consisting "of the visual outlet of the game and mostly breeds cinematic and visual studies" (2015, 186-7).

We review the concept of depth of field, its use in media that preceded videogames, and the current literature on the concept within game studies and culture. Afterwards, we present a taxonomy that is canonical for analysing the depth of field in film and describe its various categories. Alongside such a description, we provide some examples and analysis of its use. This analysis is especially crucial since our taxonomy derives from film's notions on the implementation of depth of field. We chose film as our comparison point since the mediated space of videogames has many elements that are analogous to film. Videogames and film are both audiovisual media with the "potential for experimental, documentary, and narrative-based forms" (Clearwater 2011, 38). Likewise, they share likenesses concerning how they often come to be related to the development of fandoms[1] with specific values and traditions. We can also see comparable interactions connecting creators and the public in both media (ibid.).

After describing the effect in film, we provide a similar description for videogames. We observed the categories present in film and investigated whether they are present in the mediated space of videogames. While establishing a comparison to film is our starting point, we acknowledge that videogames are idiosyncratic and videogame designers often use some tools that are different to communicate with players. As such, our taxonomy needed to adapt such categories to fit the specificities of videogames better. We also found one new category that is exclusive to videogames, and one category that exists in film but not in the videogame medium.

1. "Subculture composed of fans characterized by a feeling of empathy and camaraderie with others who share a common interest, usually a media franchise of some sort" (Yeromin & Charskykh 2018, 82).

Our methodology is based on Christopher Frayling's (1993) and Ashley Brown's (2015) research. Frayling contends that there are three categories of research in Art and Design, of which we position ourselves into the "research into art and design" category (1993). Our study fits in this category because we conducted a study that relies on aesthetic perception. This methodology describes in what manner aesthetics is embodied in the field of videogames, coupled with in what way a particular aspect of a videogame might suggest the corresponding reactions through perception (Xenakis & Arnellos 2014, 1).

Brown argues that descriptive anthropology allows us to be aware of culture through experience. She states that instead of observing other players, ethnographers need to gain context by experiencing the artefacts themselves and interacting with the computational systems that support them. This methodology recognises biases as elements "of the human experience of doing research – even in virtual worlds." Autoethnography exists as a form of descriptive anthropology focused upon oneself, and we can use case studies "to make generalisations about (...) games" (2015, 77-87). We have a collective experience of playing hundreds of videogames from various decades. Intrinsically, we found this methodology particularly suitable for the analysis of the depth of field in videogames and, therefore, we employed it to construct our arguments.

To choose our case studies, we reflected upon the many videogames we have played and how they would support our thesis. To make sure we are making use of case studies of historical and cultural relevance, we used the 3rd edition of Rusel DeMaria's *High Score! Expanded: The Illustrated History of Electronic Games* (2019), Brian Wardyga's *The Video Games Textbook: History, Business, Technology* (2019), as well as Klaus Sachs-Hombach and Jan-Noël Thon's *Game Studies: Aktuelle Ansätze der Computerspielforschung* (2015) as references. Combined, these books cover the history of videogames and videogame technologies up until 2019. We consider that such a combination provides a wide and varied sample of adequate case studies. Additionally, our range of examples symbolises an archetypal combination of distinctive types of videogames, including platforming, action, adventure, shooter, racing, puzzle, survival, and role-playing games, from diverse periods of the history of the medium.

2. Use of Depth of Field: From Photography and Film to Videogames

2.1. Photography

A lens can focus only on a single target at a distance at any given time. Technically, the forefront and background elements of the span of the target in which the lens is centred on would never appear sharp in an image. In reality, an acceptable sharp target is rarely restricted to only one plane. Instead, surfaces near our target can turn up sharp and in focus. The *depth of field* represents the spectrum of target ranges within which subjects are seen with appropriate sharpness. The depth of field is not restricted to the zone centred on, since the human visual system has restricted processing capacity, such that a circular area up to a determined proportion looks like a dot. The largest possible area which still looks like a dot is entitled the "permissible circle of confusion" (Salvaggio 2009, 110).

Depth of field changes according to many variables, including aperture size, the distance separating the sensor or film and the target, as well as the focal length of the lens. *Depth of field* can be exploited for artistic effect and helps the artist adjust the region of emphasis in a photo to a tiny region of limited focus, a broad region of general sharpness, and other options located in-between those two poles (Warren 2005, 383).

Depth-from-focus approaches are premised on a reality where, through an image created by an optical device like a convex lens, artefacts at a specific range from the lens should be centred. At the same time, objects at any other location are distorted or blurry at different degrees based on position.

In Fig. 1 we can observe the same objects photographed at the same focal length *f* as well as the same distance between camera *v*, with variations only on the aperture diameter *d*. We can see that focus position *u* is affected by the *d*, which results in images with different *depth of field* values.

Fig. 1a and 1b. On the right, an image with a *shallow* depth of field, taken with a low *f-number*. On the left, the same objects, with a wide depth of field. They were shot with a high *f-number*.

The front and the back of view cameras "have four possible basic movements in addition to focusing — tilt, swing, vertical shift, and lateral shift — for a total of eight movements" (Stroebel 1999, 266). Similar movements can also be achieved in other camera formats by using tilt-shift lenses. Adjusting these movements can increase or decrease the *depth of field*.

We believe that *depth of field* is a crucial component the photographer must consider when producing their work. The iconic photographs by Ansel Adams were not exact representations of the reality beyond his lens. Instead, they were perceptions of the subject associated with his intense feelings. His artistic motivation was a genuine vision. Ansel accomplished his vision by incorporating an elevated perspective, a flattening of the picture, depth of field, sophisticated composition and exhaustive detail. His photos display an extraordinary virtuosity, especially in mastering the *depth of field* (Alinder 2014, 327). By observing Adams' *Mt. Williamson, Sierra Nevada, from Manzanar, California* (1944), one can find such evidence in the near-infinite depth of field. To the

human eye, it allows one to perceive that focus seems to be equally present in all objects within the frame.

We find that the mastery of the *depth of field* was also an essential element of composition for other authors such as William Christenberry, Gregory Crewdson, Jack Delano, and George Hurrell, among others.

2.2. Film

In film, *depth of field* is especially important for the concept of suture. Suture was initially presented as a psychoanalysis principle in an essay by Jacques-Alain Miller, followed by a transformation into film studies by Jean-Pierre Oudart (Heath 1981, 76). Oudart tells us that "suture represents the closure of the cinematic *énoncé* in line with its relationship with its subject (...), which is recognised, and then put in its place as the spectator" (1977, 35). The concept of suture sought to assess how to transcend the division between the different framed sections of a film in order to convey a cohesive, united cinematic language (Branigan 2013, 133-4).

Like Jean-Luc Godard, Robert Bresson placed the recorded subject back where it belongs as a symbolising entity. Nevertheless, he places the recorded subject inside the context and in the conceptual position of film itself. Suture is better grasped when understanding what we are speaking about in the practice of film reading. To grasp it, it is essential to interpret the picture to its detriment, a reading of which modern film has often caused us to lose our understanding. Such loss happened because the use of imagery without depth conceals what the depth-of-field in film has always shown, Oudart writes. Both the cinematic areas tracked by the lens and all entities shown via the depth of the field are replicated. They are replicated by yet another field, the fourth wall, as well as the omission it originates. Such factors indicate that a picture on its design approaches the signifier's function (Oudart 1977, 35-6).

A missing area mirrors each cinematic area, the location of a person positioned there by an imagined audience, and whom Oudart calls the Absent One. At some period of the interpretation, all the items in the *mise-en-scène* join together to produce the signifier of its absence. At such crucial times, the picture reaches the "order of the signifiers, and the undefined strip of film the realm of the discontinuous, the 'discrete'" (Oudart 1977, 36).

Theatrical stages, before film, expose little of its essence, but this demonstrates that it is only the cinematic space, "only the depth of its field", that is "echoed by the other field, the side of the camera" (Oudart 1977, 41). Film can be distinguished by the incompatibility of interpretation and enjoyment, since space in turn often revokes the object. The depth of the field allows the entities depicted inside it to disappear (Oudart 1977, 42-3).

To illustrate how suture works, Branigan describes what he believes to be the nine phases of Oudart's explanation of the viewer's shifting focus throughout a shot in *The General* (1926) (Branigan 2013, 135-6):

1. The audience "experiences an animated photograph", leading up to the film, not a proper filmic area.

2. The audience learns that they are in the movie theatre when confederates abruptly spring up from the bottom picture rows.

3. "The spectator experiences a "vertiginous delight" in an "unreal" filmic space and its depth of field."

4. "The spectator discovers the "framing" when he or she suddenly understands that an unseen space has been "hidden" by the camera."

5. "The spectator experiences (imagines) an Absent One located "in place of the camera" in the unseen, hidden space."

6. "The spectator discovers a "signifying Sum," the meaning(s) of the filmed event; he or she discovers that cinema is a closed discourse."

7. "The spectator experiences the "haunting presence" of the Absent One within the unseen, hidden space in relation to the image."

8. "The spectator discovers the Absent One in the next shot (a reverse field showing the previously unseen space)."

9. In a new picture, the viewer encounters what was predicted in the original picture. At the same time, he or she recalls what was once seen in the original picture.

Aside from describing how suture works, Branigan identifies another aspect through which *depth of field* is critical in cinematic design. He tells us that for André Bazin, the lens, "acted upon by reality", should respond in the position of the missing viewer, but mostly in forms which follow the rules of human senses. Two of the filmmaking strategies advocated by Bazin were "deep focus" in onscreen space and "lateral depth of field" in the activation of offscreen space." Both strategies support each other and help to merge the two critical pillars of Bazin's pieces dealing with "profilmic and postfilmic realities beyond the image" (Branigan 2013, 78). When describing his major conceptions of the camera, Branigan sees the "camera as agent for a postfilmic viewing situation." As a theory of narrative, the "perceiver sees A as he or she would see B." This conception of the camera only works with the lateral depth of field. Its most crucial storytelling quality is that it acts as a "reproduction of human perception" (2013, 95).

2.3. Depth of Field in Videogame Environments

Game consoles and computers employ embedded three-dimensional special effects boards – commonly known as video or graphics cards - and can use external 3D equipment – like VR headsets – to improve depth of field across game spaces (Wolf 2012, 642). 3D game spaces typically work with a cartesian coordinate system with three axes (*x*, *y*, and *z*). The z-axis represents depth. If we follow the examples of photography and film, we cannot represent the lack of *depth of field* effect in the x and y axes, as those are always in focus. However, the presence of this effect in games is a reproduction which tries to mimic what we see in optics and is not native to videogames. We can observe this simulation occur differently from how it does in the physical world.

Throughout their formative days, game environments were mostly portrayed from either a side or top point of view. This absence of z-axis complexity was primarily due to technical limitations. The introduction of greater-resolution raster graphics made it possible to depict entities from different perspectives, giving more scale to the sequences. For instance, *Zaxxon* (1982) presents items "in the world from an isometric perspective." This form of isometric drawing point view denotes a three-dimensional space without any "vanishing points, giving all three dimensions equal importance." To express the illusion of depth, "video games made use of most of the types of perspective typically seen in technical drawings" (Wolf 2012, 270).

2.4. Depth of Field Across Multiple Videogame Spaces

Egenfeldt-Nielsen et al. (2015) argue that formal elements like depth of field are as essential as gameplay. They are not just "mere window dressing, eye candy providing an enticing way of interacting with the actual game beneath" (129). How a game environment is set out is connected to its appearance. "Geography, representation, and gameplay are interrelated" (ibid.). In *Moon Patrol* (1982), the player explores the planetary terrain for extraterrestrials as space-age structures are scrolling along. Those constructions do not possess a clear in-game impact; for example, they do not obstruct a player's progress nor give them shielding. In reality, formal and aesthetical elements often specify the mechanics. The visual design should usually be selected for its capacity to facilitate the gameplay mechanics (Egenfeldt-Nielsen et al. 2015, 129). Depth of field mainly contributes to the mood of the game, offers the feeling of filmic framing, and lets the game's world feel realistic.

Spacewar! (1962) is a multiplayer game in which opponents (usually) view the game world through the same display. Events occur on a basic *xy*-axes system. That is in contrast with 3D representations, that often have depth, just like actual life. Player warships can travel in either of the cartesian coordinates. Still, they cannot travel downward or upward "away from the plane, in a two-dimensional space battle, which is equivalent to a space battle carried out on a game board, but not realistic in any way" (Egenfeldt-Nielsen et al. 2015, 130). The ships in *Spacewar!* do not scroll, and players are continuously in the same position on the display. Therefore, the viewpoint can neither shift nor pursue either of the ships. The games that scroll have traditionally included multiplayer action titles like *Golden Axe* (1989), *Gauntlet* (1985), and *Double Dragon* (1987). In those games, it is beneficial for players to travel in unison (Egenfeldt-Nielsen et al. 2015, 130).

It should be noted that sometimes the *mediated space* lacks depth in some objects and locations due to a limitation known as *draw distance*. In three-dimensional gameplay, entire objects often unexpectedly appear in the frame. It happens because of the inadequate configuration of the drawing regions. It can also happen due to a lack of processing capacity, which does not allow the machine to show some elements unless they are near and essential to play (Imagine Media 1996, 32). Draw distance should not be confused with the *depth of field* effect.

We also note that, like many games from the 20th century, some modern games do not take advantage of state-of-the-art visual assets and effects, like *depth of field*. Often, the lack of advanced graphics is not owed to the absence of expertise or designer abilities but due to artistic intentions.

3. Results of the Analysis

3.1. Depth of Field in Film

As reviewed, the lack of depth in a field, which manifests through blur, is not native to videogames. It imitates film and photography. As such, we looked at the different types of usage of the depth of field effect in film in order to verify if its analogue counterparts — simulations of the effect with comparable results — are used in videogames. It also allowed us to demonstrate the presence of types of depth of field that are exclusive to the videogame medium, or the lack of that presence.

In film there are six categories of usage of depth of field for artistic effect: *Deep Focus, Shallow Focus, Soft Focus, Rack Focus, Split Diopter, and Tilt-Shift* (Dunham 2020). The *Deep* focus technique leads to images that have a vast depth of field. When this happens, none or almost none of the framed objects are blurred or out of focus, regardless of their distance to the camera. Examples of notable films that make extensive use of *deep focus* are *Nosferatu, Eine Symphonie des Grauens* (1922) and *Suspiria* (2018). Deep focus images give greater depth perception to a spectator, enabling complex activities to be displayed on several planes.

Shallow focus is a practice that leads to a minimal depth of field. When a shot has a *shallow focus*, one of its planes is focused whereas the remainder planes are blurred. Shallow focus is usually employed to accentuate a specific aspect of a scene above others. Filmmakers often reference a blurred segment's stylistic appearance as bokeh (Mamer 2013, 19-20). Instances of notable movies that make extensive use of shallow focus are *La Règle du Jeu* (1939) and *Polytechnique* (2009).

Soft focus often occurs due to a defect in lenses, culminating in hazy pictures. In pictures with a *soft focus*, the outlines of surfaces are not precise nor plain, and objects appear as if they are shining. It leads to pictures with an otherworldly style. Examples of notable films that make extensive use of soft focus are *The Sound of Music* (1965) and *The Saddest Music in the World* (2003).

The *rack focus* relates to a moment in which a lens' focal point is adjusted while shooting a scene. This change might expose a vital detail or signify a significant shift in the story. It helps the filmmaker place significant importance towards one point and then shift the focus to some other. The British anthology film *Aria* (1987) contains various short films that make extensive use of *rack focus*. Among them, we highlight *Un ballo in maschera by Nicolas Roeg and Rigoletto* by Julien Temple.

The *tilt-shift* technique is based on the application of camera motions that adjust the direction or location of lenses regarding the photographic film or camera sensor. Its usage makes humans, vehicles, and structures appear as if they are dioramas. It is also used to adjust the perspective of tall structures such as skyscrapers. Examples of notable films that make use of tilt-shift are *Shadow-boxer* (2005) and *A Serious Man* (2009).

With the *split diopter* method, one can get a field focused in two different portions of the image, with only a slight blur between them. Such a result is suitable, e.g. for the full height anamorphic aspect ratio, that typically allows for less depth of field. Another reason most filmmakers do this is to make a scene slightly more suspenseful or obscure. Instances of notable movies that make extensive use of split diopter are *Reservoir Dogs* (1992) and *Passion* (2012).

3.2. Taxonomy of the Simulation of the Depth of Field Effect in Videogames

Given that most early videogames' presentation relied solely on two axes, they did not present any depth. In games with no depth, players can read the environment on a horizontal and vertical alignment. As there is no sensation of depth, all elements are typically in focus as there is only one practical plane. Some games made use of the parallax effect to simulate the presence of different planes. A plane in the distance might be blurred to simulate photography's lack of depth of field effect. This false sense of depth is typically referred to as occlusion. However, players cannot move towards the occluded planes, and the foreground and background planes are not connected. As such, we consider that there is no depth. Instances of videogames that exhibit no depth are *Super Mario Bros* (1985) and *Mega Man Zero* (2002).

We might think of *deep focus* as the default mode of presentation of the depth of field in three-dimensional games. Such happens because the blurring of a scene to emulate *shallow focus* only appeared much after the inception of 3D games as a post-processing effect. Nevertheless, the concept's description is the same – a scene in which all elements in all planes are focused. However, we believe that a distinct terminology should be used for videogames, as this is the de *facto* depiction of depth. As such, we propose the term *standard depth*. This term designates a videogame scene in which there are no post-processing effects emulating film's effects of depth of field. It should be a clear-cut scene in which everything has the same depth of detail. Exceptions are made for elements that lack detail due to *draw distance*. Examples of videogames which vastly present *standard depth* are *Half-Life* (1998) and *Halo*: *Combat Evolved* (2001). Like film's *deep focus*, videogames' *standard depth* allows players to read all elements and planes. Its use can be attributed to artistic intention or lack of need or thought of the *depth of field* effect.

Like films, videogames also make use of the *shallow focus* aesthetic. The effect is simulated as a post-processing effect in three-dimensional game engines. Its result is analogous to what we see in film – a scene with a too narrow depth of field – and we believe that the nomenclature can be the same. The effect is easily observed when a scene presents planes that are blurred. Videogame designers can use this as a mechanic that invites players to focus their attention on specific elements on the screen, as is done in film. This option can be made due to those elements' importance to the diegetic narrative or impact on players' actions. In some videogames, the *shallow focus* effect can be manually activated by players in a game's menu. This activation can be useful to some

players of first-person games. It allows them to focus on specific elements while ignoring everything else. Instances of videogames that exhibit *shallow focus* are *Ridge Racer V* (2000) and *Titanfall 2* (2016).

Videogames also make use of *soft-focus* as an effect for visual impact. Like in film, it can give a scene a dreamlike aesthetic to a scene or highlight a character. However, in videogames, the *soft-focus* effect is also frequently used to highlight or obscure certain graphical qualities in a scene. For instance, some developers apply the effect to scenes when they make use of new graphical technologies, to highlight their achievement. In the opposite direction, some designers use it to cover characters that they might consider having a low polygon count. Some videogames which vastly present *soft-focus* are *The Legend of Zelda*: *Breath of the Wild* (2017) and *Shadow of the Colossus* (2005).

The presence of an effect analogous to film's *rack focus* can be found in videogames quite frequently as well. It is mainly observable in cinematic cutscenes. Nevertheless, some videogames also use it during gameplay. Its primary use is for changing the focus from the elements in one plane to the ones in another. It is also used when videogame designers intend to make their work appear more comparable to film's traditional cinematography methods. Most players' cultural backgrounds usually include high familiarity with cinematic artefacts, especially Hollywood's filmmaking style. As such, this effect seems natural to them, thus helping them navigate and read a scene. Instances of videogames that exhibit *rack focus* are *Alien: Isolation* (2014) and *Death Stranding* (2019).

In opposition to film, the simulation of the *tilt-shift* technique's appearance has been widely adopted in videogames. Its inclusion can be found equally during gameplay and cutscenes. The most frequent use of this effect in videogames is either to make a scene seem like part of a diorama or to portray delusion or delirium. It is also used for conveying information on the player character's status. Regarding the latter use, it can be exploited to indicate that the character is low on health, is inflicted with physical or mental ailments, or is using special powers. Examples of videogames which vastly present a *tilt-shift* effect are *3D Dot Game Heroes* (2009) and *The Witcher 3: Wild Hunt* (2015).

At the date of writing, we could not find any cases of videogames that make use of a technique analogous to film's *split diopter*. We believe that such is the case because the technique is used to circumvent lenses' physical limitations in film. Such limitations do not exist in virtual cameras. Since its use in film is contained, video game designers have likely not attempted to emulate its aesthetic appearance. As the effect is little sought-after, individual players can be unfamiliar with it. However, this is a hypothesis that we were not able to test. In a bibliographical search, we also found no information regarding this result.

In preparing the present article, we evaluated the various case studies we have played in recent years. Our heuristic argument results in the belief that there are no other simulations of the depth of field effect observable in the videogame medium. One can argue for a different taxonomy if one analyses videogames that make use of technologies such as 3D displays, dome-based video projection environments, head-mounted displays, holography, or augmented reality. However, we believe that the effect must be studied independently with those technologies. This analysis must be taken into account in future studies. In consideration of the preceding, in Table 1, we summarise our results.

Table 1. Taxonomy of the various types of simulation of the Depth of Field effect in videogames.

Classification	Principles	Comparable to Depth of Field in Film
No Depth	» No sensation of depth. » All elements are in focus. » Prevalent in 2D games.	None
Standart Depth	» The default mode of presentation in 3d games. » All elements in all planes are focused. » No post-processing effects emulating a lack of DoF	Deep Focus
Shallow Focus	» Narrow depth of field. » Most planes are blurred. » Allows players to focus on specific elements.	Shallow Focus

Soft-Focus	» Hazy image quality. » Gives a scene a dreamlike aesthetic. » Outlines of surface are not precise.	Soft-Focus
Rack Focus	» Change of focus between planes. » Helps players navigate and read the environment. » Observable during cutscenes and gameplay.	Rack Focus
Tilt-Shift	» Makes artefacts look like dioramas. » Blurs the borders of the screen. » Useful for conveying information to the player.	Tilt-Shift

4. Conclusions

In this paper, we adopted an approach comprised of the models of research in art and design established by Christopher Frayling (1993) and research in videogames by Ashley Brown (2015). We found these methodologies to be particularly relevant for studying the depth of field in videogames since several video games from different generations have been played by us. We contemplated a combination of three reference books as the basis for our case study selection. This combination supplied us with a broad and diverse sample of suitable videogames to be studied in our essay. We used the texts of Rusel DeMaria (2019), Brian Wardyga (2019), and Klaus Sachs-Hombach and Jan-Noël Thon (2015).

In film there are six categories of usage of depth of field for artistic effect: *Deep Focus, Shallow Focus, Soft Focus, Rack Focus, Split Diopter,* and *Tilt-Shift*. We studied the categories present in film and then examined whether they remain present in videogames. We discovered one category unique to videogames – *No Depth* – and one unique to film – *Split Diopter*. We identified six categories

in video games: *No Depth, Standard Depth, Shallow Focus, Soft-Focus, Rack Focus,* and *Tilt-Shift*.

With *No Depth*, a ubiquitous category in 2D videogames, the traversable environments lack depth as only one plane is navigable. *Standard Depth* is the standard way of displaying graphics in 3D games, and each plane is well-defined. There is depth but no emulation of photography's lack of field effect. When the *Shallow Focus* effect is used, scenes have a limited depth of field. Nearly all planes stand obscured, which lets players concentrate on aspects of the focused plane. With *Soft-Focus*, environments typically have a fuzzy picture quality. The contours of surfaces are not detailed, which provides them with an otherworldly visual experience. *Rack Focus* is an effect that is discernible through cutscenes and gameplay. It allows for a shift of players' attention between different planes, helping them traverse and understand the environment. With the *Tilt-Shift* effect, environments resemble dioramas. The effect distorts the screen's boundaries, allowing developers to communicate crucial information in the screen's centre.

We believe our results summarise all the categories of the simulation of the depth of field effect present in video games that use conventional display devices. Such devices consist of two-dimensional TVs and monitors. However, we acknowledge that future studies must analyse the effect in different display technologies. Such technologies include 3D displays, dome-based video projection environments, head-mounted displays, holography, and augmented reality. Such an analysis might lead to a different taxonomy.

References

Alinder, Mary Street. 2014. *Ansel Adams: A Biography*. New York, USA: Bloomsbury Publishing Plc.

Branigan, Edward. 2013. Projecting a Camera: *Language-Games in Film Theory*. Taylor & Francis.

Brown, Ashley. 2015. "Awkward: The Importance of Reflexivity in Using Ethnographic Methods." In *Game Research Methods*, 77–92.

Clearwater, David A. 2011. "What Defines Video Game Genre? Thinking about Genre Study after the Great Divide." *Loading... The Journal of the Canadian Game Studies Association* 5 (8): 29–49.

DeMaria, Rusel. 2019. *High Score! Expanded: The Illustrated History of Electronic Games*. 3rd ed. CRC Press.

Dunham, Brent. 2020. "Ultimate Guide to Camera Focus: Understanding Depth of Field." StudioBinder. July 27, 2020. https://www.studiobinder.com/blog/types-of-camera-focus-in-film/.

Egenfeldt-Nielsen, Simon, Jonas Heide Smith, and Susana Pajares Tosca. 2015. *Understanding Video Games: The Essential Introduction*. Taylor & Francis.

Frayling, Christopher. 1993. *Research in Art and Design*. Royal College of Art.

Heath, Stephen. 1981. "On Suture." In *Questions of Cinema*, 76–112. London: Macmillan Education UK. https://doi.org/10.1007/978-1-349-16579-7_3.

Hunicke, Robin, Marc LeBlanc, and Robert Zubek. 2004. "MDA: A Formal Approach to Game Design and Game Research." *Workshop on Challenges in Game* AI, 1–4.

Imagine Media. 1996. "Draw In." *NEXT Generation,* 1996.

Mamer, Bruce. 2013. *Film Production Technique: Creating the Accomplished Image*. Cengage Learning.

Nitsche, Michael. 2008. *Video Game Spaces: Image, Play, and Structure in 3D Game Worlds*. MIT Press.

Oudart, Jean-Pierre. 1977. "Cinema and Suture." *Screen* 18 (4): 35–47.

Sachs-Hombach, Klaus, and Jan-Noël Thon. 2015. *Game Studies: Aktuelle Ansätze Der Computerspielforschung*. Herbert von Halem Verlag.

Salvaggio, Nanette. 2009. *Basic Photographic Materials and Processes*. Focal Press/Elsevier.

Sengün, Sercan. 2015. "Why Do i Fall for the Elf, When I Am No Orc Myself? The Implıcatıons of Vırtual Avatars In Dıgıtal Communıcatıon." *Comunicação e Sociedade* 27 (0): 181.https://doi.org/10.17231/comsoc.27(2015).2096.

Stroebel, Leslie. 1999. *View Camera Technique*. Focal Press.

Wardyga, Brian J. 2019. The Video Games Textbook: *History • Business • Technology*. CRC Press.https://doi.org/10.1201/9781351172363.

Warren, Lynne. 2005. *Encyclopedia of Twentieth-Century Photography*. Taylor & Francis.

Wolf, Mark J. P. 2012. *Encyclopedia of Video Games: The Culture, Technology, and Art of Gaming*. Greenwood.

Xenakis, Ioannis, and Argyris Arnellos. 2014. "Aesthetic Perception and Its Minimal Content: A Naturalistic Perspective." *Frontiers in Psychology* 5 (September): 1038. https://doi.org/10.3389/fpsyg.2014.01038.

Yeromin, Mykola, and Igor Charskykh. 2018. "Universal and Specific Codes of Cultural Context in Audio-Visual Media: Collision and Mutual Enrichment in International Technology-Enhanced Language Learning." In *Cross-Cultural Perspectives on Technology-Enhanced Language Learning*, edited by Dara Tafazoli, M. Elena Gomez Parra, and Cristina A. Huertas-Abril, 68–82. IGI Global.https://doi.org/10.4018/978-1-5225-5463-9.

Works Cited

Adams, Ansel.
1944. *Mount Williamson, Sierra Nevada, from Manzanar, California*. United States: The Ansel Adams Publishing Rights Trust.

Altman, Robert, Bruce Beresford, Bill Bryden, Jean-Luc Godard, Derek Jarman, Franc Roddam, Nicolas Roeg, Ken Russell, Charles Sturridge, and Julien Temple.
1987. *Aria*. United Kingdom: Miramax Films.

Atari Games.
1985. *Gauntlet.*
United States: Atari Games.

Bruckman, Clyde, and Buster Keaton.
1926. *The General*.
United States: United Artists.

Bungie.
2001. *Halo: Combat Evolved*.
United States: Microsoft Game Studios.

CD Projekt Red.
2015. *The Witcher 3: Wild Hunt*.
Poland: CD Projekt.

Coen, Joel, and Ethan Coen.
2009. *A Serious Man*.
United States; United Kingdom; France: Focus Features.

Creative Assembly.
2014. *Alien: Isolation*.
United Kingdom: Sega.

Daniels, Lee.
2005. *Shadowboxer*.
United States: Teton Films.

De Palma, Brian.
2012. *Passion*.
France; Germany: Ascot Elite Entertainment Group.

Guadagnino, Luca.
2018. *Suspiria*. United States; Italy: Amazon Studios.

Inti Creates.
2002. *Mega Man Zero*.
Japan: Capcom.

Irem.
1982.
Moon Patrol.
Japan: Irem.

Kojima Productions, and Guerrilla Games.
2019. *Death Stranding.*
Japan; Netherlands: Sony Interactive Entertainment.

Maddin, Guy.
2003. *The Saddest Music in the World*. Canada: Metro-Goldwyn-Mayer.

Murnau, F. W.
1922. *Nosferatu, Eine Symphonie des Grauens*. Germany: Film Arts Guild.

Namco.
2000. *Ridge Racer V.*
Japan: Namco.

Nintendo EAD.
1985. *Super Mario Bros*.
Japan: Nintendo.

Nintendo EPD, and Monolith Soft.
2017. *The Legend of Zelda: Breath of the Wild*.
Japan: Nintendo.

Renoir, Jean.
1939. *La Règle Du Jeu*.
France: The Gaumont Film Company.

Respawn Entertainment.
2016. *Titanfall 2*.
United States: Electronic Arts.

Russell, Steve.
1962. *Spacewar!*
United States: Steve Russell.

SCE Japan Studio, and Team Ico.
2005. *Shadow of the Colossus*.
Japan: Sony Computer Entertainment.

Sega.
1982. *Zaxxon*. Japan: Sega.

Sega.
1989. *Golden Axe*.
Japan: Sega.

Silicon Studio.
2009. *3D Dot Game Heroes*.
Japan: FromSoftware.

Tarantino, Quentin.
1992. *Reservoir Dogs*.
United States: Miramax Films.

Technōs Japan.
1987. *Double Dragon*.
Japan: Taito.

Valve.
1998. *Half-Life.*
United States: Sierra Studios.

Villeneuve, Denis.
2009. *Polytechnique.*
Canada: Alliance Films; Remstar.

Wise, Robert.
1965. *The Sound of Music.*
United States: 20th Century Fox.