

Beyond Eye Candy: Real Time Visual Effects in Video Games Seen Through the Lens of UX Principles

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Figure 1: Diegetic VFX that communicate mechanics to the player in Journey.

Abstract

Visual effects (VFX) not only enhance graphical fidelity and player engagement but also play a crucial role in communicating game mechanics. VFX can be seen as an extension of the user interface (UI), as they guide players, signal events, and help them with sense making. What sets VFX in games apart from traditional UI in 2D software or interactive 3D environments (such as VR training simulations) is their frequent diegetic nature. This means they are often embedded within the narrative and space of the game world. While traditional UI can also be diegetic, VFX have a unique ability to communicate with players while maintaining a high level of narrative immersion.

In this study, I examine several popular games selected for their innovative use of VFX, focusing specifically on the functional aspects of VFX in game design. Based on this analysis, I propose an analytical framework using three key UX principles to categorize and understand the role of VFX in games. This framework aims to facilitate more effective discussions among game developers and UX researchers, providing a new lens through which to view and analyze the functional aspects of VFX in game design.

1. Introduction

Visual effects (VFX) play a crucial role that extends far beyond mere aesthetic enhancement. While VFX contribute significantly to the user interface (UI) of a game [ZF22], particularly when embedded within the game world, they have been largely overlooked in academic studies focusing on user experience (UX) in games. Often, these effects are relegated to the category of "juice" or "polish," [HGDVA19] rather than being recognized for their integral role in shaping gameplay mechanics.

The video game industry traditionally discusses VFX from artistic (like anticipation, weight, timing), phenomenological (like fire, rain, sparks), and technical (like particle effects, cloth simulation, post-processing) perspectives. However, there is a notable gap in examining VFX through a UX lens. Although game developers intuitively understand that VFX provide valuable feedback to players and directly contribute to gameplay, there has been little effort to dissect their precise functionality in the way that UI elements are analyzed in the UX community.

This oversight is significant for several reasons. Firstly, developing a more precise vocabulary to describe the functionality of VFX in terms of UX principles would provide developers with an additional perspective beyond the artistic, technical, and game design aspects. This could prove invaluable when iterating over the overall design of a VFX. For instance, rather than simply acknowledging the need for better feedback on a magic spell's range, designers could more precisely discuss how the "constraints" of the spell need to be clarified or whether the "signal-to-noise ratio" is appropriate for the VFX in its context.

Secondly, this approach would equip UX researchers with a standardized vocabulary to further explore and discuss the understudied area of real-time VFX in games. Consequently, software applications like training simulations or interactive media with narrative elements could benefit from the unique ways games integrate UI elements into their stories.

While UX research has highlighted the importance of user interface (UI) design in games [ICK*15], the specific role of visual effects (VFX) in enhancing user experience remains underexplored. This paper aims to address this gap by introducing three well-studied UX principles and applying them to various VFX, demonstrating how these effects precisely contribute to player experience. By providing concrete examples of VFX and explaining their relationship to UX principles, I hope to offer a new lens through which the functional aspects of VFX can be discussed and analyzed, complementing existing technical and artistic categorizations.

It required careful consideration to select UX principles that not only meaningfully categorize VFX but also provide practical value to VFX artists, UX designers, and game designers alike. From the dozens of UX principles available, I have distilled our focus to three in Section 3, that I believe offer the most insightful and applicable framework for understanding the role of VFX in game design. In the same section I selected innovative examples. In section 4 I discuss limitations and an outlook for future work.

2. Related Works

2.1. Diegetic Concepts in Games

This paper analyzes VFX situated in the diegetic space of video games. The concept of diegesis, originating from film theory, was coined by Étienne Souriau in the 1950s. In film, diegetic elements are those that exist within the narrative world of the story. For instance, if music is playing from a record player visible in a scene, it is considered diegetic, whereas background music added for dramatic effect is non-diegetic.

Erik Fagerholt et al. applied these concepts to game UI [FLB09], expanding the framework to include four categories: diegetic, non-diegetic, spatial, and meta. Diegetic elements are embedded in the game world and part of its narrative, such as Mario growing taller in Super Mario Bros to represent gaining an extra hit point. Spatial UI elements exist in the game world but are abstract or not part of the narrative, like health bars floating above characters in World of Warcraft. Non-diegetic elements are completely separate from the game world, such as menu overlays. Meta UI elements, while not part of the game world, share its narrative - for example, rain

droplets on the screen when a player runs through rain, despite the "camera" not being part of the game's story.

While VFX can fall into all four categories, this paper focuses specifically on diegetic and meta VFX. These categories are of particular interest as they represent unique ways that video games integrate UI elements into their narrative and game world, distinguishing them from other media forms.

2.2. VFX impact on player experience

Hicks et al. provide valuable insights into the impact of diegetic VFX, which they term "juicy" elements, on player experience. Their study, comparing versions of a game with and without VFX, found that these elements generally enhance perceived game quality and enjoyment. Contrary to concerns about cognitive overload, juicy elements did not negatively impact player performance and sometimes improved it [HGDVA19]. However, the study's limitations in visual complexity compared to commercial games suggest a need for further research.

2.3. Frameworks for Categorizing VFX

Misztal et al. proposed the Visual Delegate Generalization Frame (VD-frame), categorizing VFX into Depth, Abstraction, and Control [MS22]. While providing a structured approach to classification, it doesn't directly relate to established UX principles, indicating a gap our research aims to address. Zhou et al. explore parallels between game VFX and data visualization techniques, identifying three main categories of VFX uses: drawing attention, representing mechanics, and signaling events [ZF22]. While their work bridges game design and data visualization, suggesting potential applications in data analysis interfaces, their proposed categories don't align with established UX principles either.

2.4. Practical Industry Insights

Two notable Game Developer Conference talks provide industry perspectives on UX, VFX and game design. Grissom introduces a framework for categorizing visual effects along a spectrum from practical to symbolic, aligning with diegetic and spatial concepts respectively [Gri18]. Brown's talk offers practical insights into applying UX principles in game design [Bro18], though it primarily focuses on level design and non-diegetic elements, which are less relevant to our study of diegetic VFX.

3. Three UX principles for VFX

This study aims to investigate how VFX in video games contribute to user experience beyond mere visual embellishment. To address this question, I developed an analytical framework based on three established UX principles: Signifiers, Constraints, and System Status. These principles were chosen for their distinctiveness, interdisciplinary relevance, and established foundation in UX design, aligning closely with fundamental game design concepts such as Zimmerman's Operational Rules. The analysis focuses on a range of popular games from both AAA productions and indie developers, selected for their innovative or representative use of VFX as

extensions of the UI. In the following subsections, I will first detail the methodology used to develop this framework. Then, I will explore each UX principle in depth, providing examples from games such as Dark Souls, Journey, and Death Stranding to illustrate how VFX embody these principles. This approach aims to offer insights into the functional aspects of VFX in game design and their potential impact on player experience.

3.1. Method

In this study, I aimed to investigate how visual effects (VFX) contribute to the user experience in video games, and in which ways they communicate to the player beyond mere visual embellishments. To address this question, I developed an approach that combined setting specific requirements for analytical lenses. I then also examined dozens of games to identify common patterns in VFX usage and determine which UX patterns would be most suited. The requirements for the UX lenses were as follows:

1. Distinctiveness: To create distinguished categories with minimal overlap between each other. VFX should only rarely belong to more than one category equally. For example, UX principles like "visual feedback" or "coherence" were discarded as they can be inherent in almost all VFX.
2. Interdisciplinary relevance: The UX principles should correspond to concepts from game design, as the lenses I wanted to create should be useful not only for UX research but also for UX design in game development. If concepts can't be intuitively understood by other disciplines and have no meaningful correspondence in their respective discipline, their usefulness for interdisciplinary collaboration might be reduced.
3. Established foundation: The UX principles should be well-studied and used in practice.

In considering game design concepts, I recognize that rules are the most fundamental and important aspect of games. Eric Zimmerman's work on game rules, particularly his concept of Operational Rules, proved especially relevant. These rules influence player behavior (relevant for UX) and are visualized (relevant for the art of VFX), making them a crucial point of intersection between UX principles and game design.

Based on these requirements, I select three UX principles as analytical lenses: Signifiers, Constraints, and System Status popularized by Nielsen [Nie94] and Norman [Nor24]. These principles not only fulfill the requirements but also offer distinct perspectives on the functional aspects of VFX.

To apply these lenses, I select a range of popular games from both AAA productions and indie developers. The games are chosen for either their innovative examples of VFX as extensions of the UI or as common examples that many games share. This selection spans productions from recent years, ensuring a contemporary perspective on VFX usage in game design.

Another goal of this paper is to showcase varied examples of how VFX function as UX/UI elements in games, offering UX researchers from outside the gaming industry insights into elegant design solutions. By analyzing 32 games across various genres, I

aim to provide a comprehensive view of eight VFX usage in modern game design.

My analytical process involved an examination of each game, identifying and categorizing VFX elements according to the three UX lenses. I documented examples of VFX usage, noting how they aligned with the principles of Signifiers, Constraints, and System Status, and how they contributed to the overall user experience.

3.2. Constraints

Constraints in user experience design are elements that limit user actions, guiding them along specific paths and preventing incorrect interactions. [Nor24] By restricting choices, constraints simplify interactions and ensure users perform only allowable actions within a system. In game design, these constraints closely align with the concept of Operational Rules, as popularized by Eric Zimmerman. Zimmerman argues that rules serve to restrict and stylize players' actions, directly shaping player behavior within the game world [SZ04]. Indeed, without limits or rules, there would be no game - it would devolve into either pure, unstructured play or simply mirror reality.

Interestingly, constraints not only define the boundaries of gameplay but can also foster creativity. Studies have shown that humans often find it easier to be creative within defined limits [Tro16]. This seemingly paradoxical relationship between limitation and innovation suggests that constraints, while limiting on the surface, are actually fundamental to what makes games enjoyable and engaging.

In the context of video game visual effects, constraints manifest in various ways, serving both functional and aesthetic purposes. They can guide player attention, communicate game rules visually, and enhance immersion by providing intuitive, in-world limitations. The following examples illustrate how VFX can effectively embody the principle of constraints in game design, simultaneously restricting player actions and enriching the gaming experience.



Figure 2: In *Ghost of Tsushima* a wind VFX is used instead of a map to point to the next destination.

Ghost of Tsushima's wind mechanic (figure 2) exemplifies how UX constraints can enhance gameplay while maintaining immersion and cultural relevance. Players navigate this feudal Japan-set game not via mini-maps or waypoints, but by summoning directional gusts of wind. This mechanic constrains navigational information to a general direction, encouraging exploration and environmental awareness. The wind's visualization through moving foliage

preserves the game's aesthetic, limiting UI elements to diegetic expressions. Players must periodically reactivate the wind, creating a temporal constraint on guidance. This approach aligns with Shinto beliefs, where natural elements like wind are considered to have spirits, thus immersing players in the game's spiritual world. The designers could have implemented a spatial arrow pointing the way, but this would have lacked the simplicity and coherence achieved by the wind VFX. By thoughtfully implementing these constraints, the mechanic transforms limitations into a compelling feature that enhances player experience, demonstrating how UX design can simultaneously address functional needs, cultural authenticity, and immersive gameplay.

In Diablo 3, a fast-paced action role-playing game, when enemies prepare a bomb-like attack, the game briefly telegraphs the target area. First bright ice shards appear, that then emit a blue circular VFX on the ground indicating the attack radius before the attack occurs. This mechanic constrains player behavior in several ways. It spatially defines danger zones in two animation phases, limiting safe areas. Also it imposes a temporal constraint by giving players a short window to react. Interestingly, Blizzard's VFX designers initially implemented this highlight to appear after the attack, indicating where it had occurred. However, they later changed it to appear before the attack, allowing players to react preemptively [Lov13].

This adjustment demonstrates how refining UX constraints can significantly impact gameplay. By providing advance warning, the mechanic constrains player actions through informed choice rather than punitive damage, enhancing both the game's fairness and the player's sense of control.

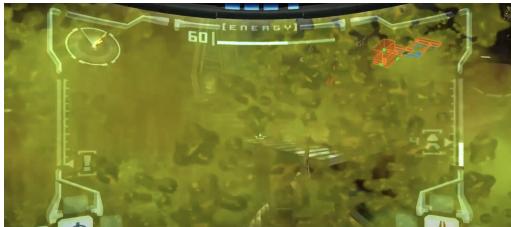


Figure 3: Metroid Prime, Samus visor is covered forcing her to retreat.

When the avatar in Metroid Prime, Samus, is hit by a certain type of enemy, a slime-like substance partially covers her visor (figure 3), obscuring the player's view. This VFX constrains the player's experience in multiple ways: it directly limits the field of view, forcing players to slow down or retreat when they were too careless or impulsive in their offense; it creates a temporal constraint as players must wait for visibility to be restored or find ways to clear the visor; and it directs attention to the visor itself, reinforcing the player's connection to Samus and her suit's systems which is a key part of the narrative. The slime VFX is unevenly distributed and translucent, allowing the player to still see a bit of the game, but not enough to fight, unless they are very skilled.

Players can sometimes actively clear the visor, adding a layer of resource management. This single VFX element thus serves as a UX constraint and an immersion-enhancing feature.

3.3. Signifiers



Figure 4: The fire VFX symbolises safety and is embedded deeply in the narrative of Dark Souls.

While Constraints limit actions, Signifiers indicate what actions are possible in a given environment. They act as cues or signals that guide the user on how to interact with the system or specific elements within it. They help users understand affordances —what actions they can take and where they should direct their attention. The visual design of a die invites the player to throw it, while the numbers constrain the player in their movement range if they symbolize how many fields you can move. This is how Signifiers also tie to Operational Rules and Game Design.

In the unforgiving and atmospheric world of Dark Souls (figure 4), known for its extreme difficulty and sinister tone, the rare save points are symbolized by warm bonfires. While most of the game is shrouded in dark hues, these bonfires stand out as beacons of hope. The bonfire's slow and calm animation contrasts with the typical threatening depiction of fire in games, providing a sense of sanctuary in the otherwise dangerous world.

The game's overarching theme revolves around the cycle of fire and darkness. Bonfires are directly tied to this theme, symbolizing the remnants of the First Flame, which is central to the game's lore. They serve as checkpoints where players can save their progress, replenish their health, and restore their resources. This mechanic is seamlessly integrated into the lore, as resting at a bonfire also causes enemies to respawn, reflecting the curse of the undead and the cyclical nature of the world.

Bonfires also serve as points of connection between players. The ghosts of other players resting at bonfires remind players that they are not alone in this harsh world. The choice of a bonfire, rather than any other form of save point, ties deeply into these themes, making it a fitting and meaningful element within the game's narrative.

From a UX perspective, the bonfire in Dark Souls exemplifies the use of VFX as signifiers. The visual and interactive design of the bonfire communicates safety, rest, and connection, guiding players intuitively through the game's mechanics and narrative. This integration of VFX as signifiers enhances the player's experience by aligning visual cues with the game's thematic and functional elements.

In the game Another World, the charging animation of the energy ball serves as an example of a very simple signifier that is used in more complex forms also in many other games. As the player holds

the charge button, the energy ball's animation becomes increasingly dynamic and active, visually indicating its growing power. This active animation implicitly invites the player to continue holding the button, suggesting that the longer the charge is held, the more potent the energy ball will become. This use of VFX as signifiers effectively communicates the potential outcome of the player's actions without the need for explicit instructions, which is part of the explorative aspect of the game.



Figure 5: *Sniper glare in Battlefield 2042.*

In Battlefield 2042, the sniper glare (the light reflection from a sniper rifle in figure 5) functions as a signifier, influencing the decisions of both the sniper and their target. For the player being targeted, the glare provides a clear visual cue, signaling immediate danger and prompting actions such as seeking cover or evading the sniper's line of sight. This signifier ensures that the player is aware of the threat and can respond accordingly, without directly restricting their actions. For the sniper, the glare acts as a constrain, encouraging careful positioning and strategic decision-making, as their location could be revealed. In designing the sniper glare, considerations like visibility, timing, and intensity ensure it serves its purpose without overwhelming the player, providing just enough information for quick reactions. As a signifier, the glare balances gameplay by guiding both players' behaviors, enhancing tactical depth without imposing hard constraints.

3.4. System Status



Figure 6: *The scarf in Journey visualizes how long the player can fly.*

In game UX design, System Status is crucial for providing players with immediate feedback and ensuring they understand the game's current state. This principle delivers direct responses to

player actions, such as a button press resulting in a visual cue or loading indicator, confirming that the input was received. System status also reflects dynamic information, such as health bars, cooldown timers, or objective markers, which update in real-time as the player progresses through the game. Additionally, this feedback is contextually relevant, helping players understand their current position in the game world, the status of tasks or missions, and what actions they should take next. By offering clear system status, games reduce player uncertainty and keep them informed of ongoing processes, ensuring a smoother and more intuitive gameplay experience.

In Thatgamecompany's Journey, the protagonist's scarf (figure 6) serves as a quintessential example of diegetic VFX embodying Nielsen's System Status principle. This elegant design element seamlessly integrates crucial gameplay information into the narrative fabric. The scarf's length and luminosity directly correspond to the player's flight capacity, growing and glowing brighter as players collect symbols, while diminishing during flight. The scarf's responsiveness to environmental factors like wind and other players further embeds it within the game world, blurring the distinction between character design and user interface. Notably, the scarf's state can nonverbally convey environmental challenges or journey difficulty, enhancing the narrative without explicit exposition. By tying the player's growing abilities to the scarf's appearance, Journey creates an emotional connection to this visual element, reinforcing the game's themes of personal growth and the transformative nature of the protagonist's pilgrimage.



Figure 7: *The rain in Death Stranding causes rapid aging .*

In Death Stranding, the Timefall rain serves as an exemplary case of VFX functioning as system status. The rain, a unique environmental feature, causes rapid aging and decay to any objects it touches, including vehicles and cargo (figure 7). This effect is visually represented in real-time through the gradual rusting and deterioration of exposed items.

From a UX perspective, this decaying visual effect operates as a system status update, guiding the player's behavior without explicitly restricting their actions. The rusting of equipment hints to the player that prolonged exposure to the rain will result in negative consequences, prompting them to seek shelter or protect their cargo. However, it remains non-intrusive, as it does not impose constraints or communicate immediacy like a signifier; instead, it subtly encourages a proactive response from the player.

The Timefall's VFX are deeply diegetic, seamlessly integrated

into the game world and narrative. This contributes to immersive gameplay, as the visual effects not only guide the player but also enhance the world-building, making the environmental threat feel both realistic and integral to the story. Thus, the decaying effect of the Timefall exemplifies how diegetic VFX can act as system status updates, guiding player interaction within the game environment while maintaining narrative cohesion.

4. Discussion

This study aimed to analyze the role of diegetic visual effects (VFX) in video games through the lens of established UX principles: Signifiers, Constraints, and System Status. By examining a range of popular games, I've identified patterns in how VFX contribute to user experience beyond mere visual embellishment. This approach has yielded several insights, but also revealed limitations and areas for further research.

Strengths and Insights

1. Interdisciplinary Perspective: By bridging UX principles with game design concepts, particularly Zimmerman's Operational Rules, I've explored a framework that could potentially facilitate communication between UX researchers and game developers. This interdisciplinary approach may contribute to more cohesive and user-centered game designs.

2. Diegetic Innovation: My focus on diegetic and meta VFX highlighted innovative ways games integrate UI elements into their narrative and game world. Examples like the wind VFX in Ghost of Tsushima and Death Stranding's Timefall demonstrate how VFX can simultaneously serve functional and narrative purposes, potentially enhancing immersion.

Limitations and Challenges

1. Subjectivity in Analysis: The categorization of VFX into Signifiers, Constraints, and System Status involved a degree of subjective interpretation. Some VFX elements could arguably fit into multiple categories, which may limit the framework's reliability.

2. Lack of Quantitative Data: My study relied primarily on qualitative analysis. Incorporating quantitative data on player responses to specific VFX elements could strengthen the findings.

3. Limited Scope: The study focused on three UX principles, but there's potential to explore a broader range of principles or further subdivisions, such as cultural, semantic, and logical constraints within the broader category of Constraints among others.

Future Directions

1. Player Studies: Conducting empirical studies to measure player responses to different types of diegetic VFX could validate the proposed framework and provide more concrete design insights.

2. Cross-Cultural Analysis: Examining how diegetic VFX are perceived across different cultures could offer insights into creating more universally accessible game designs or designs that speak to specific groups.

3. Expansion of UX Principles: Future research could explore how additional UX principles or more nuanced categorizations (e.g., types of constraints) apply to diegetic VFX in games.

4. Practical Application: Collaborating with game developers to apply these concepts in real-world game design scenarios could provide valuable insights into the practical utility of this approach.

5. Conclusion

This study offers an initial exploration into the intersection of diegetic VFX in video games and established UX principles. By examining how VFX embody Signifiers, Constraints, and System Status, I've attempted to provide a new perspective on the multi-faceted role of visual elements in interactive media.

While the immediate applications and broader implications of this framework remain to be fully explored, it opens up avenues for further research and practical experimentation in game design. As the field of interactive media continues to evolve, understanding the relationship between visual effects, user experience, and narrative could contribute to the creation of more intuitive and engaging digital experiences.

Ultimately, this study represents a starting point for a potentially valuable dialogue between UX design and game development, encouraging further exploration of how visual elements can enhance both functionality and storytelling in interactive environments.

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