Embodied Damage Indicators in First-Person Shooting Games

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Abstract. We present an exploration of how first-person shooting game damage indicators – those that leverage the first-person, in-the-action perspective – impact gaming experience and immersion. We compared a traditional *red flash* mechanism that only indicates that an injury was taken, a less common *paper doll* mechanism that indicates where the character's body was injured, and our original *x-ray* mechanism that indicates the character's specific injuries via realistic-looking X-ray snapshots. These form points on a continuum from abstract information (injury was received) toward simulating the experience of receiving an injury. We conducted an exploratory study, and present the results on how the indicators impacted various aspects of gaming experience.

Keywords: affective ludology, gaming experience, immersion, first-person shooter, damage indicator

1 Introduction

In first-person shooter games players perceive and interact with virtual worlds through the eyes (first-person graphics), ears (spatially-situated sound), and body (movement capabilities) of a virtual character that partakes in high-action shootouts and melees against other virtual characters: the player sees the character's hands holding a gun in front of them as if the hands were the player's. A design point of this genre is to emphasize the first-person playing experience, and games often attempt to integrate this into all components of gameplay to improve immersion: for example, when opening an in-game menu a character may look at their personal computer be-

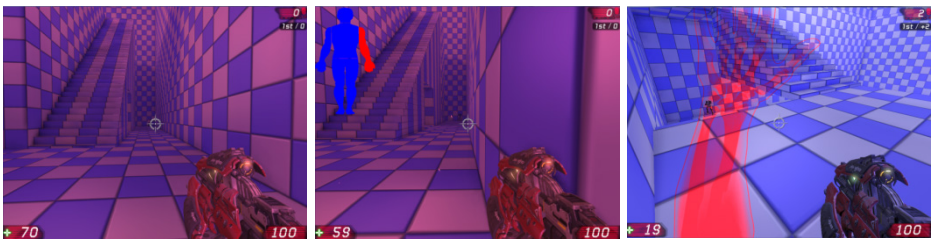

Fig. 1. We compared the three indicators: a *red flash* (left) indicating an injury was incurred, a *paper doll* (middle) with red flash providing further information on where the character was injured (in the right arm), and an *X-ray* (right) showing that the character was hit in the left arm.

fore the menu opens (e.g., as in FutureMark's Shattered Horizon, where the character looks at their "glove computer"), several popular franchises do not give the character a voice or a face, and even give the player control during storyline cut-scenes, to enable the player to feel as if they were the one acting (e.g., as in the Valve Half-Life series). The aspect of gaming experience that we focus on is the damage indication mechanism: how the game indicates to a player that the character has been injured.

While creating a first-person experience by controlling what a player sees and hears, and how they move, is practical, it is less feasible to cause pain or feeling sensations to a player when the character receives an injury such as getting shot or falling from a large height. As such, to improve immersion, games need to attempt to replicate some aspects of getting an injury without actually causing pain; for example, temporarily losing focus, knowing which body part was injured, or knowing how severe the injury was. In this paper, we explore how damage indication methods that provide more injury-related information impact player experience and immersion.

We focus our damage indicator exploration on the player's emotional and cognitive experience of gameplay as a central point of design and analysis, rather than other metrics such as task efficiency or effectiveness (e.g., through game high scores or best times) – an approach termed "affective ludology" [8]. From this perspective, building player immersion and a sense of presence in the virtual world (sometimes categorized as total immersion [2]) is an integral part of a successful gaming experience. Thus, we designed our exploratory study and selected damage indication methods surrounding the idea of player immersion.

2 Related Work

Damage indicators are an integral component of many video games, and have a long history with a great deal of variation. The traditional approach in first person shooter games was to represent character health using abstract, unrealistic systems of health points, where receiving an injury reduced the number of points, and points could be recovered through collecting health-related items such as first-aid kits (as in ID Software's Wolfenstein and Doom franchises). This relates to the somewhat stoic term *damage indicator* itself, which is more a description of harm to a machine or object than an injury to a person.

There is a more recent movement toward providing realistic mechanisms of indicating that the player's character has sustained an injury. One approach is to hinder the character's (and thus the player's) senses to simulate the loss of concentration or ability associated with feeling pain. Some games block the player's vision with a red tint or splashes of blood on the screen (such as with Activision's Call of Duty). Hearing can be muffled to show a high level of pain, for example by having ringing ears or the character's heartbeat pound loudly, blocking out other sounds. The player's mobility can also be diminished (as in Ion Storm's Deus Ex) by restricting speed or smoothness of movement. The growing popularity of such techniques in industry speaks to their success, which is why we select this direction for our research: we use the sensory-inhibiting red flash and extend the approach with our new X-ray indicator

that aims to further increase the player's impression of pain by presenting *where* the character was injured (for example, in their leg, arm, or torso) in a graphic way.

In addition to simulating pain, some games provide additional injury-related information to the player that the character, in the actual situation, would be aware of. For example, showing where an injury came from (e.g., behind or to the side) using a directional blood splash or simple arrow (as in 343 Industry's Halo 4). In only one game we are aware of (Ion Storm's Deus Ex) body-part information is provided to the player: a paper-doll cutout of the character is placed in the corner of the screen, and when an injury is taken the corresponding body part flashes red like an electronic indicator. Our X-ray damage indicator likewise shows which body part is injured, but aims to focus on presenting it in first-person fashion that encourages immersion rather than an abstract point-like diagram representation.

We found very little work in the research community on different first-person shooter damage indication methods. Rather, related work targets the problem of how to evaluate and understand a player's affective experience during gameplay (i.e., affective ludology [8]). Evaluation of a person's affective state, and correlating it with measures of immersion and enjoyment, are still active research problems with various facets ranging from qualitative analysis of written questionnaires and interviews [3], applying heuristics [4], administering subjective questionnaires [1], or using a whole range of biometric and psychometric assessment methods [9]. We draw from this work and apply some of these methods in our study.

3 Damage Indicators

Our three damage indicators were the red flash, paper doll, and X-ray mechanisms:

We created a simple red flash indicator which tinted the player's screen red when an injury was incurred, with the opacity of the tint proportional to the severity of the injury. This served as a common baseline to compare against the other indicators as it still hindered the player's vision but did not provide any additional information about the injury incurred (**Fig. 1**, left).

Second, we implemented a paper doll indicator that was a middle ground between the red flash and the X-ray, where a cut-out silhouette of the character was provided in the top-left of the screen (similar to Ion Storm's Deus Ex). This provided the player with information about where the character was injured by flashing the associated body part red when the injury was incurred as well as a background red flash (**Fig. 1**, middle), where the flash brightness and fade-out function was the same as with the whole-screen red flash.

Third, we present a novel damage indication method that provides details on where the character was injured by displaying X-ray images of the injuries to the player. When the character sustains an injury the player's screen gains a semi-transparent red X-ray film overlay of which body part was injured: head, torso, left arm, right arm, or legs (**Fig. 1**, right, and **Fig. 2**). The opacity of the film depends on the severity of the injury, from faint for a small injury, to near opaque for a severe injury. As this indicator is a new contribution, we spend a little more time to explain our design rationale.

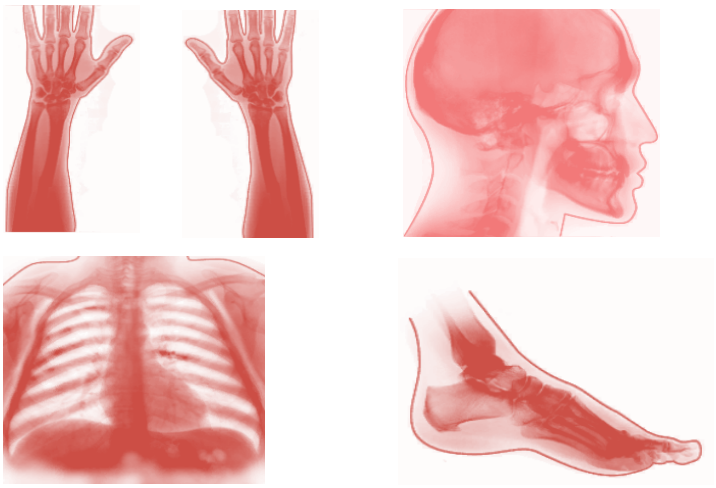

Fig. 2. The X-ray films used to show injury – left and right hands, head, torso, and foot.

The goal of our X-ray indicator is to improve immersion, which can be defined as the player's sense of presence in the game world, controlling a character as if it were themselves [2, 5]. We emphasize and build on the character's first-person embodiment and the player's interaction with it. Not only does our X-ray technique hinder senses to simulate the effects of pain (by hindering vision), but by obscuring the player's vision with an X-ray film, we bring the injured body part to the forefront of player attention and concentration. We selected an X-ray rather than, for example, clothed body parts, to further create the impression of an injury; we believe that an X-ray is violent and visceral (e.g., as discussed by Norman [10]). As a violent, prominent visual cue, we anticipate that our indicator will help mold the player's sensations, thoughts, and feelings to mimic what the character may be feeling, helping to increase the emotional and cognitive gameplay experience [8] and thus sense of immersion [5].

Thus, the three indicators form points on a range from less immersive design (red flash), more immersive intention due to providing first-person information (paper doll), and yet more immersive design due to the nature of presentation (X-ray).

4 Study

We conducted a study to investigate how damage indicators used in first-person shooters impacts gamer experience and immersion. Our leading goal is to explore, compare, and contrast how players interact with and react to the various indicators, and thus we take a primarily qualitative approach to our exploration.

We implemented a first-person shooting game using the freely available Epic Games' Unreal 3 first-person engine, on a desktop PC, and participants played game levels using the three different indicators and completed various self-report questionnaires. The game control scheme has the non-dominant hand using the W, A, S, and D keys to walk (W is forward), and the dominant hand to use the mouse to control the looking of the character. Weapons are fired using the mouse buttons. This is a stand-

ard control scheme for PC first person shooting games. The game used a simplistic point-based health system, where the character starts with 100 health and dies when the health reaches zero (restarting the level), where injuries to the character decrease the health. As our study is regarding the damage indication method, and not the damage system itself, we accepted this as a baseline and kept it constant across conditions.

Overall in the study we emphasize various aspects of gamer experience and immersion, and we do not consider how an indicator can help a character play more effectively or competitively (play better); some commercial indicators incorporate additional game information (such as direction to the enemy) for this purpose. Such goals are quite different than ours, and integrating gameplay information into immersion-building indicators remains an interesting future direction of work.

4.1 Study Design

Our main variable was the damage indicator used to indicate character injury to the player: red flash, paper doll, and X-ray.

Our primary means of inquiry was by administering participant self-report open-ended questions, where we qualitatively analyze responses to characterize participant response and interactions. We asked several open-ended written questions regarding general comments and how each indicator impacted the enjoyability of the game, and included such questions as "if your character walked into the room right now, would they have anything to say to you?" to probe about player-character relationship, and "what part of your character's body was hit most often" to investigate if the damage indicator impacted how people thought about the damage their character was receiving (we did not record which parts were hit so this is for qualitative analysis only). These were asked per condition, after each condition. In addition, we administered an open-ended post-test questionnaire that inquired about the participants' overall experiences and preferences regarding the damage indicators used.

In addition, we applied a range of quantitative measures to broadly explore gamer experience and to serve as additional support to our qualitative analysis. We asked the participant to rate "*how you felt* when your character took damage" and "how you think *your character felt* when taking damage." For this we used a standard model of affect from psychology (Russel's circumplex model of affect [11]) that plots emotions on three dimensions: arousal (low to high energy), valence (negative to positive emotion), and dominance (low to high potency), and a standard research instrument (the Self-Assessment Manikin [7]) that uses pictographs to represent the three dimensions and enables people to easily rate affective response. We also administered the Game Experience Questionnaire (GEQ) [6], a self-report questionnaire for players designed and tested to measure various aspects of player immersion and enjoyment, among other things, via a series of Likert-like questions on 5-point scales, and added two additional questions regarding player's perception of the character strength, asking how "tough, resilient" they felt the character was and how "strong were the enemies," and finally asked them to rank how much they liked the particular damage indicator. These quantitative questionnaires were administered immediately after each condition, before the open-ended ones, as we felt they would be more sensitive.

Tasks and Methodology.
We recruited 14 participants from our local university population (age 18-32, M=25.0, 13 male, 1 female) to participate in the roughly 60 minute study. Participants were paid $15 CAD for their time. Part of the recruitment requirement was that participants had to have experience with PC first person shooting games and the common "WASD+mouse" scheme we implemented.

Participants were given an overview of the experiment, an informed consent form to carefully review and sign, and then a pre-test demographics questionnaire.

Participants first played a sample level with no damage indicator to ensure that they were familiar with the control scheme and the game goals (to collect orbs). Following, the participant played three different levels using the three different damage indicators. The order of the indicators was counterbalanced across participants. We included three different level designs to counteract boredom, and the same three levels were given in the same order across participants; level counterbalancing was not necessary as the level design was not an independent variable, and the indicator counter balancing resulted in a balance of indicator and level combination. Before starting each level the damage indicator was clearly explained using visual aids, and after each level the post-condition questionnaire was administered. Finally, at the end of the experiment participants completed the post-test questionnaire.

5 Results

We performed qualitative analysis on written feedback from the questionnaires, via cycles of open and axial coding, with our results presented in the themes below.

Injury information was appreciated. Most participants explicitly commented that the additional information was useful:

> "I was happy to know exactly what part of the 'character's' body was damaged" – P5, X-ray
>
> "[Paper doll is] better than the [red] flash indicator because it shows where you really got hit" – P10

And reported that it also added to the game experience:

> "[The X-ray] is actually enjoyable as it reminds you the character is getting hurt and you should move" – P7

These comments were evenly split between the X-ray and paper doll conditions. Only two participants stated that they felt the information was not necessary:

> "In this game it does not feel critical to know where I was hit since it is all about avoiding damage altogether so I didn't have much use for the info" – P1
>
> "In this game showing the part of the body damaged makes no sense" – P11

We further counted how many participant responses to the question of where their character was most often hit provided body-part information, and found that 6 participants reported body parts for red flash, 13 for paper doll, and 13 for X-ray.

Realism. There was an overall theme of participants talking about the indicators in terms of realism and how this made them feel. This was particularly common with the X-ray indicator:

> "[X-ray is] more 'scary' I get this small electric shock whenever I get hit, the flash feels like I am losing and getting a lot of damage" – P10
>
> "X-ray is superior in terms of gaming experience" – P12
>
> "X-ray damage indicator seems more true and realistic" – P3

But participants talked about all indicators in terms of feeling and realism:

> "[Paper doll] damage indicator is good but it doesn't reflect the real feelings of damage" – P2

And often compared indicators to others in such terms:

> "[X-ray] indicator seems more realistic than the paper doll one" – P3
>
> "X-ray gives almost real feeling. Red flash has the feeling but not that much… Paper doll has good measurement but less feeling" – P2

And in particular, all participants who preferred the red flash discussed it in terms of realism when they were asked to compare to others:

> "I like red flash indicator the most. Because it makes me feel the pain." – P7
>
> "I think the red screen damage indicator had the most effect as making you feel as the one hurt. It was the most immersive for me." – P8

Some noted that, rather than being a good thing, increased realism hindered their game play experience:

> "Actually, I don't like [X-ray]. Seems like I am injured and it causes me de-motivated and worried." – P8
>
> "X-ray gives a great deal of information, but I felt bad for my character." – P5

And that their choice of damage indicator may depend on their relationship with the character:

> "I will prefer [paper doll] if I don't have to care about my character" – P5

Dialog with the character. We analyzed participant response to the question of "what would your character have to say to you" in terms of comments that described injuries to the character, as an indication of how much the player was thinking of the character's health and wellbeing. We found that 3 participants discussed in such terms for red flash, 1 for paper doll, and 6 for X-ray, saying things such as

> "how many times will I have to die for you?? Be more careful!" – P2, X-ray

In all cases, participants only gave such feedback for one indicator, and said more generic things for others such as

> "good job, you were fast and skillful, but your aiming needs practice" – P11, red flash

Lack of paper doll salience. There was a great deal of complaint regarding the visibility of the paper doll indicator. Some did not even use it:

"I didn't notice the [paper doll] damage indicator" – P5

"I barely noticed [the paper doll], actually :P" – P13

For those that did use it, many reported that the location was too in the periphery

"Although it is a nice touch to know what part of the body is hurt I found it disturbing to have to look to the corner" – P7

And that this impacted game play:

"It is hard to move your eyes away from the fight to the body icon" – P1

And even immersion:

"I felt that looking at the corner to know what part of the body is being hit disconnected me a little from the character. It felt more like it was a doll than I playing. It was less immersive." – P7

Some offered suggestions for improvement to combat these issues:

"I'll make it blink each time it is damaged" – P6

"Make the paper doll on the side" – P12

X-ray occlusions. Even though the X-ray indicator was translucent, many people complained that it was visually obstructive:

"This [X-ray] indicator makes it easy to see where you were hit, but it feels like someone is trying to occlude my screen" – P1

"[The X-ray] blocks the whole screen. It is difficult to see" – P6

Especially when the character was hit in several places at the same time, when the templates would overlap:

"When multiple parts were being hit the X-ray indicator was difficult to interpret" – P7

And that this impacts how they can play the game

"When I am getting hit, due to the [X-ray] image of the hitted part, the screen got blurred so hard to target" – P9

"Annoying, it's hard to see enemies behind [the X-ray]" – P11

One participant noted that although they found it somewhat harder to understand, they still prefer the X-ray in some ways:

"The paper doll looks more easily understandable, while the X-rays are appealing" – P4

Many provided suggestions for how to improve the indicator, providing insight into the problem:

"Must be less flashy and colorful" – P11

"I'd try to make the X-ray image smaller and not interrupt vision" – P6

And some participants recommended a hybrid indicator of the paper doll and the X-ray, to maintain the information but perhaps improve the problems of both (not salient, and occluding).

"Maybe a combination of both the X-ray and paper doll would be more comprehensive. Like whole body skeleton." – P4

"[X-ray] was good, maybe it will be better if it is a little bit smaller and the borders of the screen also turn red" – P5

5.1 Quantitative Results

We performed statistical analysis on our numerical data, and found no significant effects on the affective model response (the SAM instrument), or the Game Experience Questionnaire. The only significant result was that the damage indicator had a significant effect on how strong participants perceived the enemies in the given trial (Friedman's ANOVA due to non-normal data, $\chi^2(2)=6.067$, $p=0.048$, mean ranks: red flash=2.32, X-ray=2.04, and paper doll=1.64). Although post-hoc tests with Bonferroni adjustment did not reveal further effects, this suggests that enemies were perceived as being weaker for paper doll than for red flash, with the X-ray perhaps somewhere in the middle.

The responses to the post-test question on preference yielded 3.5 participants for paper doll, 4 for red flash, and 6.5 for the X-ray (0.5 is used when a tie was specified).

5.2 Discussion

Participants clearly reported that the additional injury information reported by the X-ray and paper doll indicators was useful and caused participants to think more about their character's body, and their reports strongly suggest that this information, and how it was presented, contributed to their immersion: they used emotional terms like "scary," often explicitly said that things "felt" a certain way, and reported often in the first person, e.g., "I got hit" and "I got injured" instead of referring to the character. They also explicitly related the indicator to the "feeling" of receiving an injury, and for both indicators, talked a great deal more about character injuries than they did with the red flash. Finally, this finding correlates with how participants found enemies to be stronger with the red flash and weaker with the others, suggesting how the immersion can relate to quality of play or even perception of such.

One unexpected result was that immersion may actually hinder gaming experience, rather than improve enjoyability (as was suggested previously [2]): some participants found the interaction to be too real in the X-ray case, which made them feel bad for their character and guilty, and some found the pain-type immersion to be demotivating. Our hypothesis on this finding is that given our checkerboard unrealistic virtual world with futuristic energy guns, participants may have approached the game expecting a clean, abstract shooting game. The realistic, violent X-ray images may have introduced an emotional element that the players were neither seeking nor expecting, creating a negative experience. Thus this suggests a possible caveat to the immersion and enjoyability relationship, where the form of immersion should match well the design of the game. We believe that this particular example highlights where a simple change, such as a damage indicator, may be enough to introduce this problem.

The results of our new X-ray indicator were encouraging. There were many signs of immersion: participants used affective language, talked about feeling the pain, and talked more about their character's injuries in comparison to the red flash. In addition,

a majority share rated the X-ray as their favorite, there was a great deal of positive feedback, and participants wrote more about the X-ray indicator than the others. While we must attribute some of this to the novelty of the indicator, as we believe the idea is original and players have not seen anything similar before, our results do show that the indicator was at least not disliked in general, and that people were happy to play with it.

Participants who did not like the indicator primarily cited the obstruction of vision, noting how they felt it simply got in the way of gameplay rather than enhanced it; it made some feel mechanically hindered instead of being injured. This is an important point to note, as the obstruction was a deliberate design decision intended to simulate the loss of senses when in pain. This tells us that designing the obstruction of senses has to be tactfully done to fit well within the game; as one player said, to them the X-ray felt as if someone is trying to block their vision, and was not a part of their character's experience. In this case, although the X-ray films were as transparent as the red flash and thus not technically more obstructive on the per-pixel level, we believe that the contrast created between the X-ray image and the un-tinted background was what created the distraction. For future work, we will test the X-ray film with a red flash at the same time, similar to how the paper doll works.

Similarly, the paper doll was generally a success with participants rating it favorably, and there were many signs that the information it provided improved realism. Many complained about the physical obstacle of having to shift their focus from the action to the corner of the screen, and that this was disturbing and hindered their experience. We note that we expected that the paper doll would be less immersive than the X-ray due to the abstract nature of the information, but in reality, it was the lack of information integration into the play that primarily caused the issue.

One broad result of our study is that players were very conscious of their affective gaming experience, and took their feelings and sense of immersion into strong consideration when discussing, reporting on, and evaluating the damage indicators. This awareness suggests that players are aware of the importance of affect and immersion, and this was particularly useful as their feedback provides valuable insight into how various aspects of damage indicators impact their experience. Although we concede that some of the questions asked (e.g., on the Game Experience Questionnaire) may have primed the participants to respond in this way, we believe that the sheer amount of emotion and immersion related response, and the detail provided, is a product of how the participants see gaming and is not primarily from our experiment design. Thus moving forward, we can reasonably expect players to be able to comment and reflect on immersion and gaming experience.

Finally, we comment on our lack of quantitative results. It is not entirely clear why our instruments did not register effects, but from observation of conducting the studies, we believe that this is due to the individual and personal nature of preference for gaming experience. Our results tend to be clustered around groups that, for example, like the graphic X-ray or rather prefer a simple, uncluttered design, making our approach of searching for average effects across participants invalid. With follow-up results supporting this hypothesis, it may be interesting to investigate if players could

customize their damage-indication method the same as they can customize control scheme or difficulty level.

6 Recommendations

From our analysis and results we propose the following recommendations for future related research and development :

Damage Indicators have a Strong Impact on Gameplay and Immersion – Small damage indicator design changes can have a large impact on player experience and immersion, so consider this aspect of game design carefully.

Immersion has Many Dimensions – Increasing immersion in ways that clash with the game design may have negative experience effects, e.g., as some participants found our X-ray to be too realistic.

Players can Reasonably Discuss Aspects of Immersion – We found participants to be clear and insightful regarding their own experiences of immersion and gameplay, supporting self-report as a useful information source for future studies.

7 Future Work

As suggested by participants, one way forward may be to consider how to combine the X-ray and the paper doll indicators to mitigate problems of both. The paper doll can be moved away from the corner of the screen to remove the required attention shift, while the X-ray can be made less salient (and perhaps combined with a red flash) to reduce the obstruction.

One important direction will be to investigate which hidden factors confounded our quantitative exploration. We intend to explore, for example, ways of classifying player preference and play style, and investigate how this may correlate with damage indicator preference. Such research would further shed light into players themselves.

Our overall approach to both designing and analyzing the experiment was to take a focus on immersion, using existing and modern tools (such as the Game Experience Questionnaire) for investigation. Moving forward, we intend to extend further into core psychology, investigating how information processing theory and more thorough theories of immersion can inform our analysis and understanding of how participants engage damage indicators.

8 Conclusion

In this paper, we presented an exploratory study on how damage indicators in first-person shooters can impact immersion and gamer experience. We developed an original damage indication method (the X-ray indicator), and conducted a controlled study

that highlighted many of the trade-offs and benefits of various aspects of indicator design, and provided a great deal of insight into how players may interpret and react to such indicators. We hope that this initial work in investigating damage indicators for games, specifically first-person shooters, will help spawn follow up and more detailed exploration in the area. Clearly, how players are informed that their character is injured is important, and we believe there is a great deal of research to be done in this area.

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