Game Difficulty and the effect it has on Player Experience

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***Abstract*—In this paper, we discuss how having a standardized difficulty for games will heavily impact the overall player experience. We first show how this is a problem in the game development industry and why this is an important subject of research. Next, a literature review is presented to show the validity of the research and potential solution. Then, we propose a solution to this problem by conducting a simple experiment in a small game with a few standardized difficulties. Through some analysis of surveys completed by the participants of this experiment, we came to the conclusion that the vast majority of participants heavily preferred the most difficult mode, And have seen a significant correlation between the difficulty and our game, and the overall player experience. We argue that this correlation is significant enough for further and more in-depth analysis and that there is significant room for future research on this subject.**

***Index Terms*—Player Experience, Game Difficulty, AAA Development, Indie Development**

I. Introduction

Difficulty in Video Games has been a tough subject for many developers. A significant amount of players demand difficulty options for new games. The issue with this request is that with varying difficulties, the enjoyment and overall player experience are put at risk. 'Difficulty in Videogames: An Experimental Validation of a Formal Definition' states "Scaling the difficulty of the player's goals, and precisely setting the pacing of difficulty all along the game, is thus a crucial part of game design. A good game design provides the right difficulty slope." [3] This paper goes over the overall difficulty factors in games to try and find a precise slope and determine optimal difficulty settings. This is a very important set of research in the scope of game development as it will not only increase player enjoyment but also increase budgets and profits for games if the findings are significant. The video "Game difficulty" [2] goes over many of these problems in greater detail with specific examples.

When a game is too easy, it can feel like a chore to play; all challenging aspects can be lost which ruins the overall intended experience. Many critically acclaimed games such as Halo: Combat Evolved suffer from this dilemma. In Halo: CE there are 4 difficulty settings: easy, normal, heroic, and legendary. On easy and normal, the enemies have horrible detection, do minimal damage to players' health, and make the game feel incredibly clunky and unrewarding for players. On the other hand, on the legendary difficulty, the game is so incredibly difficult all risk versus reward aspects are lost and players are left with a game that feels way too punishing to be the intended experience. The sweet spot in this example is the heroic difficulty. When starting the game, a player is presented with difficulties, for Heroic difficulty the developers state "Heroic difficulty, you will feel challenged. This is the way the game is meant to be played." If the developers had already came up with an ideal difficulty, then why are they offering these watered-down versions of the game to players? This is the main issue that this kind of research is dealing with, Developers feel forced to comply with the demands of casual gamers and by doing so, put the player experience and storytelling of these fantastic games at risk. The proposed solution is to completely remove the ability to change difficulties, and to have all players have an experience tailored to them.

II. Difficulty in Video Game Development: A Literature Review

Difficulty in game development has been a frequent challenge for many developers. Prior studies have come to the same conclusion when it comes to difficulty and the impact it has on rewarding experiences. "The challenge a game provides to players is connected to what makes the game fun. Games that are too easy become dull and uninspiring over time. Similarly, games that are too difficult are not encouraging either. Creating a balanced challenge for players is a daunting task." [1] In this study, the writers conducted an experiment consisting of 31 participants, each playing 2 separate versions of a fighting game, and were asked to evaluate their difficulty and enjoyment. The study came to the conclusion that there is a "flow" line between difficulty and boredom where the ideal enjoyment level lies.

Another great paper in the field of game development difficulty called "Difficulty in Videogames: An Experimental Validation of a Formal Definition" comes to a similar conclusion, claiming "Difficulty scaling is indeed about properly setting up these obstacles. Scaling the difficulty of the player's goals, and precisely setting the pacing of difficulty all along the game, is thus a crucial part of game design. A good game design provides the right difficulty slope" [3]

"Real-time Game Adaptation for Optimizing Player Satisfaction" a study from Georgios N. Yannakakis in the university of Malta has conducted a very interesting experiment. They had participants play a game called "Bug Smasher" which is similar to games found in old arcades. The user will see a panel on the ground light up and will need to step on the panel to increase their score and to "smash the bugs". The study came to the following conclusion "In 28 out of the remaining 37 games (75.67 percent), adaptation on difficulty improved the entertainment value regardless of the static game's generated entertainment value". [8]

As one can see, this is a massive area of research. This kind of research opens up huge opportunities for Indie and AAA game developers, allowing them to not only make more money but to produce higher quality games and experiences to be enjoyed by the players in this multi-billion dollar industry. "Sixty-five percent of households own a device for playing video games." [5] and "According to a 2016 survey 155 million Americans play games regularly (more than 3 hours a week), a figure very close to half of the population." [10] With a majority of people having access to Video Games There is a significant opportunity to have a serious impact with this kind of research.

III. Approach

A. Experiment setup

We proposed that game difficulty had a significant impact on player enjoyment and experience. To test our hypothesis we conducted a simple experiment. The first step was developing a simple game with limited difficulty factors. We needed to develop a unique game as opposed to using an existing one for a few different reasons. Mainly, we needed to avoid bias from using existing titles, and developing something that our participants had not played before. We also needed as much control as possible over the variability in difficulty, otherwise, results may be skewed. Our approach for this experiment had a few separate factors including target variety, target depth, and target size, and color. This was done in the game engine Unreal Engine 5 developed by Epic Games. This engine allowed me to create a 3d environment and gameplay using c++ and the Unreal Engine blueprint system. The game consisted of a first-person environment with three separate target ranges. The first range having targets of all the same size and color, with no depth(distance from the player) and set spawn locations was our control variable. This was done to have a baseline difficulty or our "easy" mode. The second target range had a few more variables with varying target depths and randomized spawn locations for the targets. The third and final range had all the changes from the previous difficulty plus a small target size with solid blue color. Fig. 1 is a screenshot of how the game looks when played with difficulty modes 1 and 3(2 was not added in the screenshot because it can be visually indistinguishable from difficulty number 1 and may have caused confusion).

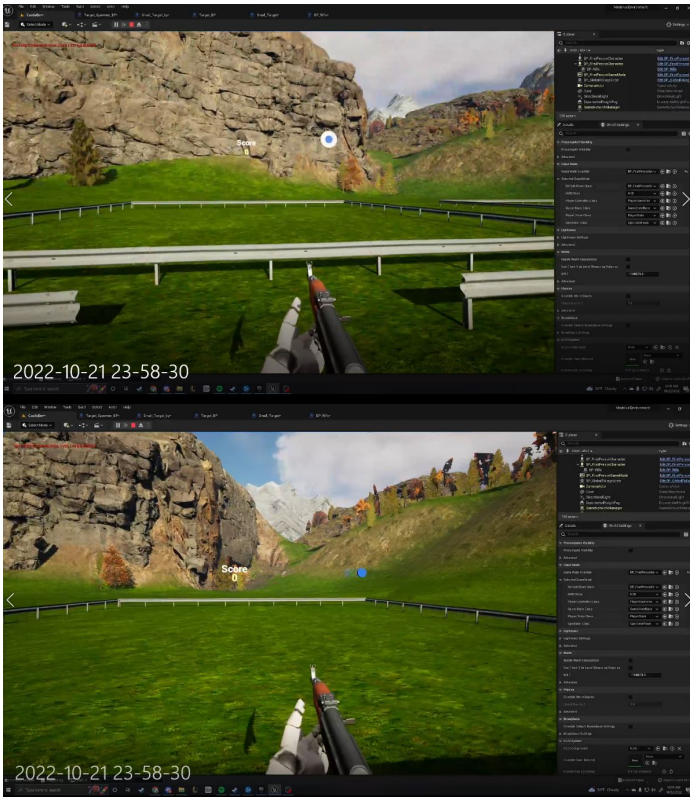

Fig. 1. Screenshot of game Difficulty 1 and 3

B. Participant Demographics and Evaluation

There were a total of 15 participants that took part in the experiment. All of them were college students from the age of 18-25. Most of them spend a moderate amount of time per week playing video games (an hour or more). 13 out of the 15 participants were men, and 2 were women. Participants were also required to have a computer with a decent graphics card and sufficient ram capable of running the game.

To evaluate user experience we developed a simple survey based on many other similar ones in the field of game development and difficulty evaluation. This survey consisted of many questions all on a 1-10 scale in the format: How enjoyable was difficulty X, How difficult was difficulty X, What was your score in difficulty X, etc. There were also some questions on player demographics, and experience playing video games.

C. Running the Experiment

The experiment consisted of a few primary stages, including the instructions provided to the participants which are outlined below:

- Install the game using the link provided, Be sure to check your system requirements to determine if you are eligible. The game requires at least 4 Gigabytes of ram, and in most cases, a simple graphics card equal to or greater than a 1050Ti.
- Take some time to familiarize yourself with the controls and environments of the game. Pick up the gun and become familiar with the projectile physics to ensure that the experimental ranges are not affected by unfamiliarity.
- Approach each range and begin to shoot the targets, you will be timed for 1 minute. At the end of the time, record your score in the provided survey for each range.
- After completing all the courses and filling out the score section of the survey, finish the survey and answer all questions honestly.

The participants' surveys were then collected and data processing began.

IV. Results

The results of the experiment were very interesting. We saw a strong correlation between higher difficulties and higher player enjoyment. Our hypothesis was that the "medium" difficulty or difficulty number 2 was the sweet spot but overall that was incorrect. The ordering for enjoyment went from lowest difficulty being last place, and highest being first place. The charts shown in Fig. 2 demonstrate the gap seen between the varying difficulty across the game modes with red being "easy or 1" blue being "medium or 2" and green being "Hard or 3"

To ensure that our difficulty scale was not biased, we asked all participants to rate the difficulty of each mode as well, and we compared these to the enjoyment rating given to come up with a nice visual showing the correlation between difficulty and enjoyment in our experiment.

V. Discussion

There was a high impact on player enjoyment given the difficulty differences. This lines up with the results from all of the other research presented in this paper. Interestingly, the highest difficulty was the more preferred version which went against our initial hypothesis. This leads us to believe that the

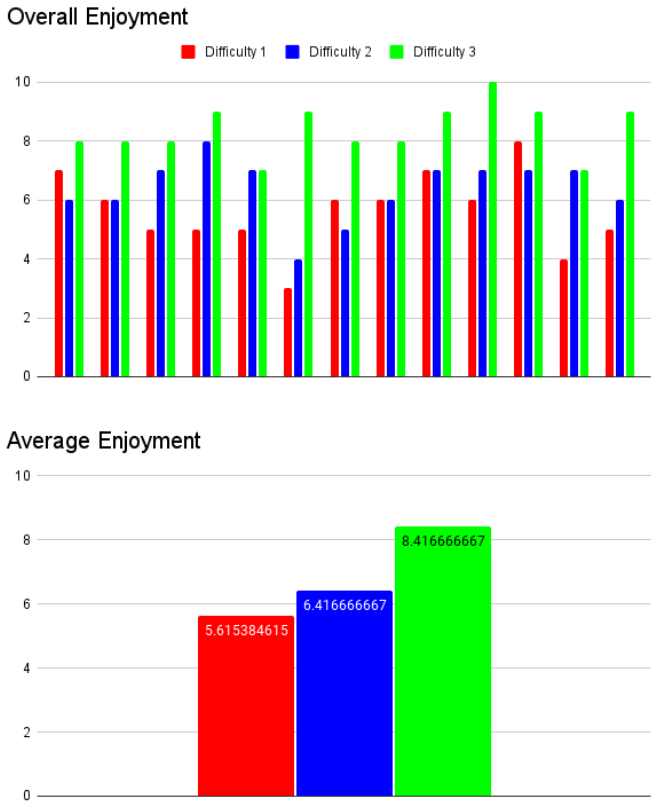

Fig. 2. Chart showing overall Enjoyment across all modes

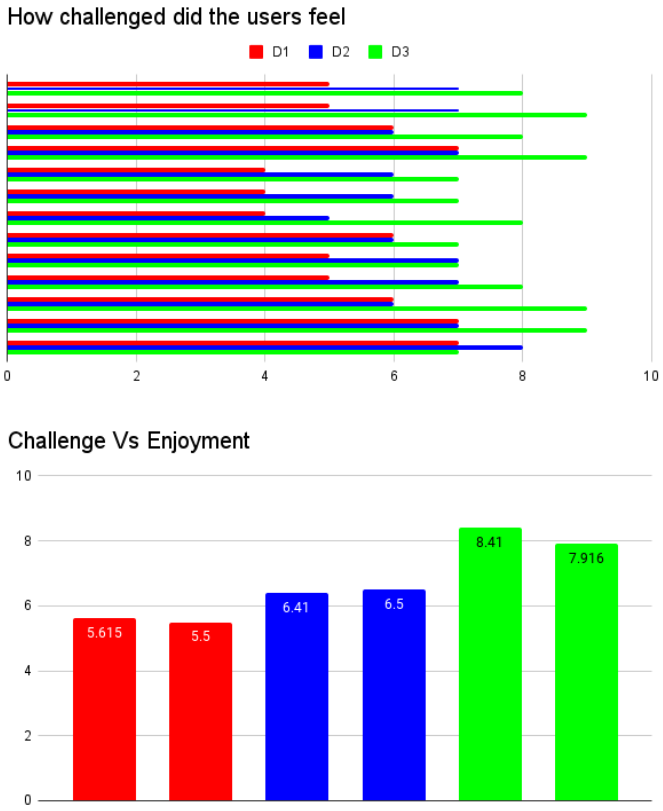

Fig. 3. Chart showing enjoyment(left) compared to difficulty(right)

scope of our research may not have had enough variability in terms of difficulty. We wanted to survey users with an ”Unfair” difficulty to see if we could find a good difficulty slope and the sweet spot for our small indie game but unfortunately, we may have not made it hard enough. Adding more difficulty factors in development was discussed, however, it may have messed with the small variable size and potentially influenced results. So we decided to play it safe and in doing so, may have needed to make things more challenging. The data from the experiment showed a total 33 percent increase in change in enjoyment from difficulty 1 to 3. And a 20 percent increase in enjoyment from difficulty 2 to 3.

Showing a 30 percent increase in enjoyment across modes was a much more significant result than initially expected. I suspected originally that there would be only a minimal (but still noticeable) difference between these modes. This result had me wondering if my conditions for difficulty were too low. This may be the case considering the development time of this project and I would like to do it again with vastly changing difficulty factors between these modes to determine if a certain percentage increase in difficulty could really find a sweet spot for game difficulty in the first-person shooter genre.

We also compared results from the users' given challenge level versus the enjoyment level to ensure that our difficulty levels seemed adequate. Fig. 3 shows the chart for this data. By looking at the chart we can see that the challenge level of difficulties 1, 2, and 3 were all increasing respectively. And with each increase in difficulty, there was also an increase in enjoyment across each level.

A. Threats to validity

There were a few major threats to the validity of the experiment. While it may not be possible to list all threats here, I thought it was essential to add the most important issues in this section.

- **Small research scope:** Due to this being a 1 person project, there was not adequate time to develop a large enough game to evaluate the game difficulty to the extent that was originally expected. It seemed like the game difficulty was not varied enough to see a vastly significant difference. In the future, I would like to improve on this and make many more adjustments to the difficulty and core gameplay mechanics.
- **Low number of participants:** The original goal for participants in this research experiment was 30 people. However, the criteria of running the game plus the timing of the experiment(being near finals) many people who originally signed up ended up backing out due to technical or time constraints.
- **Potentially bad survey:** The data collection method may have had a negative impact on user participation. Data collection required the user to complete the experiment and survey on their own time, this was due to the technical constraints of running the game. If I were to do it over, I would make a 2d game that is easier to run and have a more guided experience. I would also change the questionnaire to a google survey so that responses would automatically be recorded.
- **Bugs in the game:** There were a few major issues reported by the participants of this study. The largest one was a bug with the hitboxes on the targets. An issue with the collision mesh of the bullet impacting the collision mesh of the target caused hits that would normally register and destroy the target to not have any effect. By the time this bug was discovered our development time had elapsed and we were not able to fix it in time for the results without completely redoing the study.

VI. Conclusion

In conclusion, we believe that this experiment reinforces the data we have gotten from others pursuing the same studies in the field of computer science and game development. That being, game difficulty has significant impacts on game experience, sales, and overall enjoyment of video games. These difficulty aspects need to be refined to be able to produce high-quality experiences for players and the removal of game difficulty sliders would vastly improve the overall skew of player enjoyment for these titles. The research done here by itself proves that this research is worth pursuing in more detail. All of the papers cited came to the same conclusion, calling for more research to be done in this field as it is vastly important to move game development forward and to keep it from stagnating as it has in recent years.

A. Future work

For future work regarding this research, I would like to pursue technologies in game development to help further refine the playability and quality of the game presented here. Implementing more difficulties, removing bugs, and making difficulties that could be more deterministic and adjustable are a few changes that come to mind that I believe would vastly improve the quality and credibility of this kind of research. Implementing a Dynamic Difficulty Adjustment(DDA) System is also something I am very interested in applying to this research scope. 'A different approach to difficulty' "describes the concept like this "The idea of Dynamic Difficulty Adjustment (or DDA) hinges on the theory of the player's Flow State, in which the player is completely immersed, and the game's difficulty feels just right. Any more difficulty will cause frustration and break immersion. Any less difficulty and the player will quickly find boredom." [7]. Adding DLSS(Deep Learning Super Sampling) was also an option but because of inexperience with the technology, it was not a viable option.

VII. Acknowledgment

I would like to acknowledge and thank all the people who participated in this experiment, while the total number of people was way less than desired, without you this would not have been possible. I would also like to thank my Professor Farjana Eishata in the department of Computer Science at Idaho State University for allowing me to work on such a fun project. I do not get the opportunity to pursue my interests much within ISU so it was an extremely useful and enjoyable experience.

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