

Your Project Title



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Abstract

In this paper we will be looking at how video game player visual reaction times compare before and after playing an action video game. The goal of this paper is to see if the reaction time becomes faster and if it could then benefit players to warm up and play a fast-paced action video game before their tournament or even help their overall performance during casual or ranked competitive gameplay. The idea is that playing a fast-paced action video game could improve focus and brain activity resulting in a faster reaction time, increasing performance in their gameplay allowing them to react to visual stimulus quicker.

The method of warmup for the player will be a video game of our creation, which consists of fast paced movement and different methods of movement manipulation. The goal of this game artefact is to complete the level in the fastest time possible, using the provided methods to introduce more speed and therefore introduce more focus which will be required to complete the level. Once the player plays the game for around 15-20 minutes, they will then complete the visual reaction time test once more which will reveal the results and answer the question if fast paced action video games affect the players reaction time.

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Chapter 1

Introduction

As multiplayer shooter games are becoming more popular, the competitive side of players starts to show. This means players try to do anything to gain a competitive edge against the next player. Coming onto the first game, it is important to be warmed up as it could result in a win and change the players' mood from the start and how they look at the future game matches as they continue. This is important as depending on the mood of the players, it could result in their focus and performance being affected, as lower focus results in poorer performance, which (Keith R. Lohse, 2010) talk about how changing the focus of attention can affect performance.

Other papers have already examined and compared reaction times between gamers and non-gamers, and it is generally approved that gamers have a superior reaction time compared to non-gamers as (Helena Pardina-Torner, 2018) also points this out on their paper with the data they gathered from different participants. The interest within our study is to investigate how the players visual reaction time compares before and after a warmup by playing a fast-paced action video game. If a warmup can result in faster visual reaction times, it could give players a better chance of winning their first game, as players are most likely to get matched with other players who are already a few matches in. Not only will our research help action video game players to see if they can improve their chances of winning by a little warmup, but we will also fill a knowledge gap as we're examining what short term effects fast paced action video games have to video game player reaction times and if warmups help perform better in the visual reaction time test.

The method of a warmup for the player will be a video game artefact of our creation. The game will consist of fast-paced movement in which the player will have to get through the level as quickly as possible while also avoiding enemies. The main goal is getting the fastest time possible within each of the levels. The game will have different types of moving the player, a few of which are but not limited to the familiar and original means which are the WASD keys, a weapon as well as a kick mechanic that gives the player a burst of speed in the opposite direction when used. Giving more options for affecting movement will allow the player to think about what mechanic they can use and where to improve their time which will also increase their focus whilst playing. Once the player has played for around 15 to 20 minutes, they will complete the same visual reaction time test two more times and the recorded results will be compared and studied to see if there is a noticeable difference between their before and after visual reaction time test.

The prediction for this examination is that the players during the examination will have a faster reaction time after doing the warmup, which in turn should also improve their performance in other video games as well.

Chapter 2

Literature Review

The aim of this study is to identify if a user's reaction time would benefit from playing a fast-paced action video game. The reaction time refers to how fast a person reacts to a stimulus, which could be auditory, visual or a different type of stimuli as (Aditya Jain, 2015) also discusses. The interest within this study is the reaction time to a visual stimulus and this will be recorded by the participant having to complete a visual reaction time test where the participant will first see a red colour, and once the colour changes to green, the participant will then have to react to it as quickly as possible by clicking on the screen to record how fast they react to the colour change. (Grrishma Balakrishnan, 2014) explains why visual reaction time may be important in certain everyday activities such as driving. This reaction time test will be done before and after playing an action video game to find out if the participants reaction time has improved and to identify if this genre of video game has any short-term benefit to where the participant could use this type of video game to warm up for their first match of a video game or activity that requires quick reaction times for a competitive advantage. A study done by (Santos VG, 2014) shows that by consuming caffeine, the participants reaction time decreases and therefore correlated in higher points within taekwondo. This meant that faster reaction times could let the participant either react to the opponents attacks faster but also act upon them, and that reaction time could be a decider on who wins and losses.

1.1 Reaction Time

There are many studies which have researched the effects of action video games on video-game players reaction time. A few studies such as one by (Kingstone, 2015) as well as (Matthew W.G. Dye, 2009) have compared reaction times between action video game players and non-action video game players to find out if that genre of games has a benefit towards the reaction time speeds. Their research proved that action video game players have an advantage when it comes to comparing their reaction times between video game players and non-video game players, and both studies have provided the conclusion on which action video-game players may have greater success with response-based processes and tasks with quicker visual response requirements. While our study is based on reaction time much like theirs, the aim is more focused towards finding out if an action video game is a good warmup to increase reaction time, which if proved correct could benefit players performance in other video games. This is similar to a warmup that is done in sports

before a match or tournament to improve performance and decrease the chance of injury as (Park HK, 2018) discusses.

A study done by (Vikranth R. Bejjanki, 2014) carried out an experiment which the participants had action video game training from around 5-6 hours a week and 50 hours of training over 9 weeks. The results of the training show that within their provided tasks, the trained participants were able to perform better. Although within our experiment, the player will only have around 15-20 minutes to play an action video game, our interest is to find out if that period of gameplay makes the player respond faster to the provided visual reaction time test. A study done by (Rosser JC Jr, 2012) showed that warming up in a video game helped surgeons perform better during their surgeries due to increased levels of adrenaline and therefore increased heart rate which improves focus due to a more efficient intake of oxygen.

A study done by (Li Li, 2016) who tried to find out if video games can improve visuomotor control and if they could be used for training to perform daily visuomotor-control tasks. They found that within their third experiment, training players with an action video game called Unreal Tournament, increased participants performance within certain tasks that required great visuomotor control. They also saw an increase in their participants mean performance within Unreal Tournament which the kill + death ratio increased by 82% from the start of their training to the end of their training which was around 5 or 10 hours of play. It would be beneficial to study if even smaller amounts of time like 15-20 minutes could bring some positive results towards the player reaction time performance which our study aims to find out.

Most of the available studies which focus on action video games and their impact on player reaction times have more of an interest in the long-term effects of action video games. (Sushil Chandra, 2016) also experimented with training participants with action video games to examine how their reaction times and performance are affected by long term training, from one to two months. Their study has also shown that the reaction times and performance do improve from action video game training, but do not mention any short-term effects towards performance. Completing this research would fill the research gap and provide more answers to how our reaction time and performance is affected by action video games.

2.1 Aims & Objectives

One of the main aims of the study is to find out if playing a fast-paced action video game helps the player warm up and if it improves their visual reaction time. The idea is to ask the participants to complete a visual reaction time test two times before playing the video game artefact provided, and after 15-20 minutes of playing the video game, ask the participants to complete the same visual reaction time test two more times. This should return the performance results of the participants which participants will then complete a questionnaire and forward their before and after reaction time results, which will allow us to examine the results and devise a conclusion depending on the gathered information. The goal of the project should be achievable as the goal is quite simple which is to get before and after visual

reaction times of the participant and compare to get the answer we're looking for. Once a conclusion is produced, it will be clear if fast-paced action video games could be a good warmup tool to improve their reaction time if they're just jumping on the computer and want to ensure they are at their best performance. To reach our goal in a timely manner, we set ourselves smaller deadlines which made it clear on how much time and effort the project will take, and the Gantt chart was a useful way of tracking that, it not only outlined how long the project objectives should take to complete, but what should be worked on to achieve the final goal within the provided deadline.

Chapter 3

Requirements Analysis

To reach our set goal, we had to make a video game artefact which stimulates the player in a way where they have to think about their every move and their actions to complete the level but also keep the player on edge with obstacles such as enemies to give consequences if the player is too slow. As the goal is to finish the level as fast as possible, the player has no other objective but to focus on what actions they take to improve on their time which therefore should improve the players brain activity potentially increasing their visual reaction time which our goal is to find out if it does.

To reach our research goal, we also had to create a simple but effective way of collecting the user information. This was achieved by creating a simple questionnaire where the participant passes their results which they will get from the visual reaction time test, and the results can then be easily used for appropriate calculations to devise a conclusion. This was a conscious decision as to let the participants spend more time with the actual game rather than make the participants sit through a tedious questionnaire. This will be less likely for the participant to be taken away from the effect of the fast-paced action video game and to get a more accurate results from the participants.

3.1 Research Requirements

As the literature review mentioned above, the research around the player reaction times topic mostly focuses on the long-term effects of playing fast-paced action video games and it is quite difficult to find anything about the short-term effects of playing this genre of game and its effect on the players reaction time. Knowing such information would be beneficial to competitive video game players around the

world as figuring out a way to make a warm-up fun and entertaining could make it become a part of their routine and therefore improve their performance in other similar style video games. We believe that our research would fill the knowledge gap and improve the understanding of the effects of how fast-paced video games affect player visual reaction times. It is also important for us to inspire others that are interested in this topic to potentially add on to our research as well as the main goal is to contribute to the gaming and research community.

For our artefact to induce any effects towards the user's reaction time the game has to be engaging and mentally challenging. This means that the artefact should be challenging to complete with obstacles throughout the level to make the participants think about where they should go and on how they should avoid those obstacles. The artefact environments should also have multiple pathways to make the user find different options of traversing through the environment to potentially find faster routes. Different implementations of movement mechanics can also be added to let the participants have options of how they want to move throughout the environment. This could either be using a weapon which thrusts the user in the other direction on even objects around the environment which when interacted with affect the player state. An example of this could be an explosive, which when interacted with would help propel the player to either get up on a platform that may not be normally reachable or give the player an opportunity to avoid obstacles quicker.

The artefact also has to have other elements that complement the gameplay. One of these elements include a fast and upbeat soundtrack to improve on the game experience as to not make it feel empty but also make it react to player movement state to not make the music feel repetitive. This can be done either by slowing down the soundtrack when the player is not moving in the pace required or adding an effect to encourage the player to keep moving at a faster pace. Another element should be an effect that changes the state of the screen, such as adding camera shake to help translate to the player on how fast they're going which in turn improves on the player feedback. A particle effect can also be used such as streaks of wind moving past the player once they're moving at a faster pace to improve player feedback. Adding such elements can definitely have an effect on how the player moves throughout the environment and hopefully promote the player to keep moving at a faster pace to then improve on their performance and visual reaction time. (Hicks, 2020) also studied on why game "juiciness" is important for player experience and explains how it impacts the player experience during gameplay.

Chapter 4

Design & Methodology

4.1 Project Management

Before starting development, it was important to lay out the mechanics of the game as well as find a way to introduce time management as to make sure that the final results are gathered and submitted by the correct deadlines. At first a simple document was created outlining and highlighting what mechanics the game will need to have; this eliminates guess work and makes creating the prototypes more efficient as well as easier. It was also important to know how long certain mechanics and other parts of the project would take to create and implement so a Gantt chart was created. The Gantt chart outlines the estimated time for completion of objectives. This can also be used to create smaller deadlines for submission which helps with time management which can be seen in Figure 1. This is helpful as it is generally hard to visualize when a certain elements and tasks of the project should be completed by, and a Gantt chart helps to make this clear.

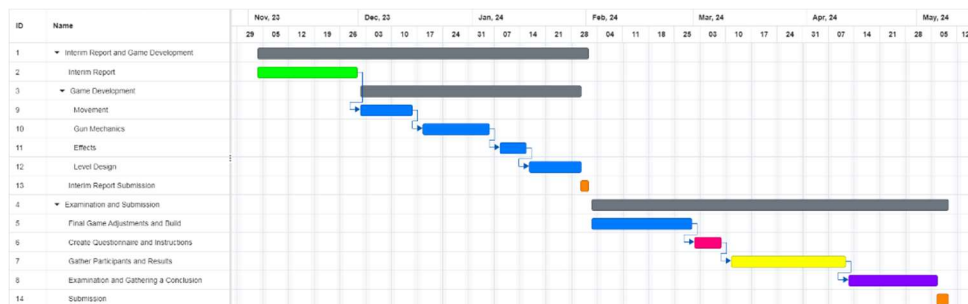


Figure 1- Gantt chart outlining the estimated time for completion of project objectives.

A paper prototype was then also made as it is the easiest way to put down some ideas quickly with illustrations without much planning needing to be done. Creating a paper prototype is easy and efficient as it is possible to draw and erase without much effort or problem solving, whereas creating something within a digital or software form would be time consuming compared to a paper prototype. A book by (Snyder, 2003) also talks about benefits and the uses of paper prototyping and explains how much cheaper and more efficient paper prototyping is compared to other forms of prototyping. The paper prototype outlined on what mechanics should be included as well as how they would work within different levels which could be seen within Figure 2.

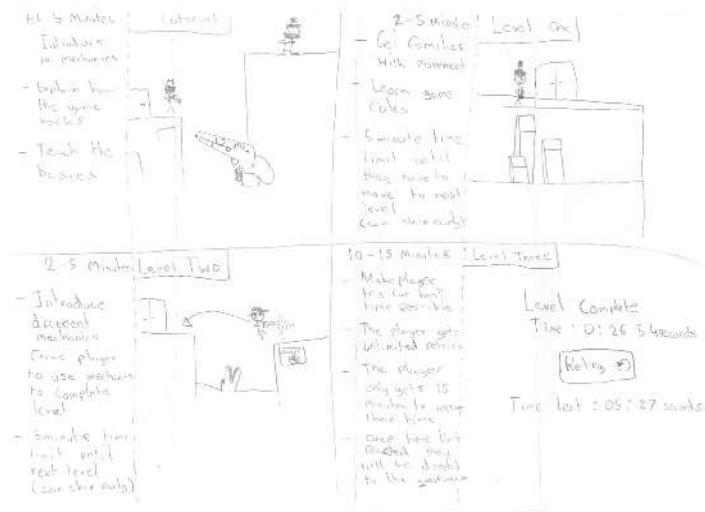


Figure 2 – First paper prototype outlining needed mechanics and simple ideas of level design

To ensure that the project is heading in the right direction and sufficient progress is made, weekly meetings were held with the project supervisor to discuss the current state of the project and what the plans of the project are in the future. The meetings were crucial for feedback as they helped with discovering flaws with the project and potential issues that could affect the results of the study carried out. Consistent meetings are a good way to not only stay on top of the project but also receive quality feedback to be able to modify the done work as you go. A study done by (Iman Attarzadeh, 2008) explains some of the practices within project management that could lead to failure such as poor involvement within the project and lack of planning.

4.1.2 Risk Management

Although you can plan to manage your time, some risks can occur whilst in development or even whilst gathering participants as well as gathering their results which can then increase the time it takes to achieve some of the specific objectives. This means that assessing and preventing the risks is important which could then help decrease the time the risks take up or prevent them completely which (Davide Aloini, 2012) talks about how risks assessments can help with confidence in achieving project objectives as well as other benefits of risk assessment within a project environment.

There are many risks that the project could encounter, one of the main risks we are considering are the participant feeling some type of nausea or sickness as well as headaches. This may occur if the movement within the artefact is delayed, the camera shake is making the screen shake too much or if the movement doesn't seem to respond to user input properly resulting in confusion and therefore could cause a headache as movement does not feel familiar or unresponsive. The participant may also feel nausea or sickness due to unnecessary effects that may be added to the video game artefact, therefore it is important to choose these effects properly to enhance the users experience instead of hindering it. This may cause delays to the

development of the project as well as the artefact will need to be modified before continuing and the current participants will need to be notified that a new version of the artefact has been created, meaning that participants as well as development time will be wasted to something that could be prevented.

Another potential risk may be that the artefact could be anxiety inducing. This could be because of the gameplay being too fast for some participants, which in turn does not allow the user to try and complete the level in their own time. This can easily be avoided by making a timer that goes up instead of going down which would imply that the user needs to complete the level in a certain time. This will give the player time to think about their actions within the game instead of being frustrated by not being able to complete the level because of unnecessary time constraints. This is also a risk that could take time to fix and address as explained in the previous example.

Last but not least, another risk that could occur within the study is participants being dishonest with their results when completing the questionnaire as to appear to have a faster reaction time than they actually got. This is an issue as if incorrect reaction times are given then the study will be harder to reach a conclusion to as the results given by the participant are dishonest and therefore invalid for the study. To avoid this issue, the participants will be informed that the results they provide will be completely anonymous and will be almost impossible to trace back to them, this will hopefully deter the participants from dishonesty as they will know that no one else but them will know their results to the tests. All these risk management techniques should hopefully bring in correct results and make all the time spent on the study justified.

4.2 Software development projects

Although the artefact created is simple and only required one developer, it was still important to pick a development methodology to increase the efficiency of the artefact's development process even though a single developer was needed. The Scrum development methodology was used as it allows for fast development but also great flexibility within development. The development consisted of short sprints of designing certain features and objectives which can be seen within the Gantt chart provided previously in Figure 1. The Scrum methodology doesn't require to have real-time communication between team members which fits the development cycle of the artefact as only one developer was responsible for the development. (Hidalgo, 2019) mentions through the interviews how the Scrum methodology is best fitted for teams of smaller sizes. Using this methodology allowed for quick implementations of the artefact features and allowed for quick testing and feature improvements before moving onto another feature. This was repeated following the methodology until the artefact was ready to be used for data gathering.

To create the artefact, multiple software toolsets were considered for the development process of the video game which the main options were either Unreal Engine or the Unity Engine. In the end it was decided that Unity will be used as the developer had more experience in that game engine as well as the C# programming language which the Unity Engine uses. This would mean less time would be taken up learning the UI and programming language of the game engine and more time would be spend actually developing and would see more progress in a shorter period of time. This then allows for more mechanics and therefore a more full gaming experience. This therefore should benefit the study as the player has more to focus on while playing which should then have a bigger effect on the final performance and reaction time speeds.

The advanced hardware used for the creation of the artefact was an important factor in the efficiency of development process as it meant that the game engine would experience the least number of crashes possible and quicker load times would be possible. This then allows the developer not only to have a peace of mind knowing that they will not lose good progress from unexpected crashes, but also know that they can expect the game engine and intensive tasks within the game engine to be loaded and done more quickly. Regular backups were also necessary to negate the risks of losing progress or have the ability to revert back to a previous backup in case there are unexpected errors. (Appleman, 2004) also discusses on why backups are important even in daily lives and personal computers. The version control application used was GitHub as it allows for quick and easy management of the backup but also allows to download all the files required to continue development on a different machine if required. GitHub has a lot of servers meaning that it would be almost impossible to lose the saved data unless its GitHub's fault. (Emil Tsanov, 2014) also explains why you would want to use companies and their servers to back up your data.

To start off the artefact design process, a simple document was created to figure out what mechanics would need to be present to help the player increase focus as well as have some sort of positive effect on their reaction time speeds. This was an important start to the project and the artefact creation process as it then allowed to move on straight to prototype creation and because most of the mechanics were known, all the prototype needed was to touch on how these mechanics would interact with each other and the level design. For the prototype creation process, a decision was made to use the paper prototype method as it makes it quick and easy to put down ideas while also being able to modify the prototype with hardly any time wasted. The advantages of using a paper prototype are that it allows for quick iteration and pen and paper is cheap and readily available as well as familiar to use while other prototype methods like a digital prototype for example would require a toolset that may cost money as well as require setting up and learning that toolset. (Snyder, 2003) also explains the advantages of using paper prototyping and why it's a better idea than using digital tools.

Once developing the artefact, vast amounts of testing was done by the developer to make sure that the game and each individual mechanic had the correct feel the previous prototyping decisions and supervisor meetings were mentioning. (Maneela Tuteja, 2012) explains about how testing is important in software development and why it should never be skipped to make a successful software system. Acceptance testing was done to make sure that the artefact was delivering on all the mentioned requirements and all the mechanics interacted with each other correctly before moving on to the data gathering process. Lastly, performance testing was carried out to make sure that every single machine that runs the artefact can handle the game and its environment. Performance testing was an important step as poor performance of the artefact could then affect the user performance and therefore hinder player performance rather than improve it, which wouldn't be ideal for the study and would make the data inconsistent and unusable. Performance testing allowed to find areas within the environment that would make a cut in the game performance and improve on those areas to have a more consisted frame rate. This therefore improves on the gaming experience and lets the player focus more on the gameplay rather than the factors that are affecting their gameplay. As (Elaine J. Weyuker, 2000) also explains, performance testing is important to figure out how software systems will react to the older hardware that may struggle with that system and how the performance bottlenecks could be avoided through performance testing.

4.3 Research involving human participants

The study requires to gather data about the players reaction time performance before and after playing the given video game artefact to identify and answer the hypothesis of if playing a fast-paced action video game can affect the users reaction time to a visual stimulus and therefore improve their performance in other video games, this would then answer if a fast-paced action video game can be used as a warmup before playing their competitive game title to improve their advantage. This means that the research will need to involve human participants and therefore will involve a participant recruitment process which will then be able to be used to answer the main question and hypothesis of how fast-paced action video games affect player reaction time.

The participant recruitment process took place within personal direct messages through the Discord direct messaging app. This was deliberately done as to recruit participants that already have some type of competitive game experience as other first-person shooter games would translate and feel familiar while playing the artefact. This means less time would be spent getting familiar with the inputs and could go straight into playing. The research is trying to answer if the artefact would have any effect as a warmup towards the player visual reaction time performance which would then translate into better performance in other competitive games. Therefore, gathering data and recruiting participants that do not play any competitive action video games would not be useful towards the study as that's not what the research is trying to answer.

While recruiting human participants, it was necessary to make sure that ethical procedures had been followed and therefore ethical approval was needed to continue with the project and its research. Favourable ethical approval was received from the LEAS ethics team. The ethics application approval took longer than expected which left around two weeks for the participant recruitment process and before the final deadline for the research needed to be submitted. The recruitment process took place right after the ethics approval was received and for every single invited participant, a direct message was sent explaining what they would have to do if they decided to participate and that they can complete their participation whenever they have free time, trying not to force anyone and not make them feel like they have to do it.

A Participant Information Sheet was sent to every single participant which explained what they are required to do and that their participation will be anonymous, also mentioning that if they have already participated, they cannot back away anymore as their data is completely anonymous and would be almost impossible to trace back and delete the data they have submitted. The Participant Information Sheet also included the link to the questionnaire which they have to provide consent within before continuing with their participation. If the participant ticks 'no' to the consent questions their submitted data will not be used within the study. The build version of the video game artefact was also sent to the participant so they could play the video game and submit their data.

A meeting with the project supervisor was held to discuss and find out what the research would need to look like to fill the knowledge gap. The discussion resulted in figuring out that the research will be most beneficial with a quantitative recruitment of participants, and that the submitted reaction time results and data will be used for later calculations and the average change in participant reaction times. To see any significant changes towards the average change in participant reaction times, a great data set of information would be needed to be able to see relevant differences in the averages and to be able to make a significant impact to fill the knowledge gap with the research found.

Once all the participant questionnaire data has been received which will be two data sets of the before reaction-time and two data sets of the after reaction-time. These data sets were then used to find the average reaction times of participants before playing the video game, average reaction times of participants after playing the video game, as well as the average change from the before and after. These calculations then let us examine and see if any change has occurred from the before and after reaction times. This then made it possible to find if our hypothesis is correct and that fast-paced action video games are a good warmup to increase the performance of the participant reaction times to visual stimulus which would potentially transfer that performance into their competitive action video game of choice.

Chapter 5

Implementation

To make sure that the video game artefact would be sufficient enough to support the study and the research, the developer made sure that every interaction with the environment and the mechanics worked perfectly together. This is important not only for the user enjoyment but also for gathering the most correct data possible as a game where the player doesn't have to think about every one of their actions will not stimulate the player enough to make an impact on their reaction time performance.

5.1 Game Physics

To make the game as stimulating as it possibly can be, we needed to make sure that the movement inputs and the general physics of the game were up to par as well as fast without much delay. Translating fast inputs from the player to game movement was necessary as any delayed movement would interfere with the player enjoyment and potentially introduce frustration which would negatively impact their performance and focus. The frustration could result in pushing the player away from the game and therefore break their immersion, which keeping the player immersed would be necessary for the research.

The Unity Engine has a physics system that was incorporated in the making of the player movement, but the physics engine doesn't allow for much customisation only allowing to change elements such as weight, friction, drag, and how much force can be applied to the rigid body. To make a responsive movement system, this was not enough as the movement always felt either sluggish, too quick or didn't allow for specific movement which made the game hard to play as the movement system didn't do as you would expect it to.

To fix this issue, a customisable movement system was made within the script which still uses the rigid body physics that are included in the Unity Engine, but different multipliers are applied to the movement where for example if the player is in the air, their change of direction will be slower as there is no contact with any of the environment to be able to push off. Additionally, adding multipliers such as how fast the player stops when they let go of any input or how far they slide while crouching made the movement more customisable and therefore allowed to create

a comprehensive and satisfying movement system to where it compliments the game and makes the gaming experience way more enjoyable increasing player immersion.

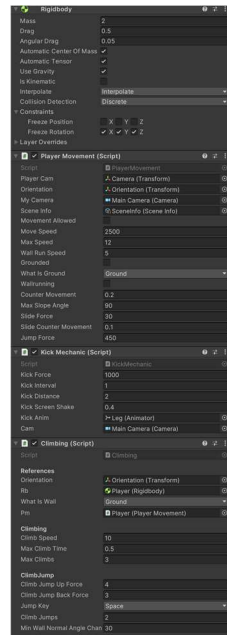


Figure 3 - Showcasing customisable player movement in the Unity inspector

Although the movement system was done, the game was still missing something which was being able to use the walls to the player's advantage. Adding a wall climb mechanic was the next step to not only allow the user to progress forward, but also give them options to traverse vertically to either avoid obstacles or find different paths to improve on their speed through the level. The wall climbing works by checking if the player is looking at the wall and how far they are from the wall, once they look in a certain angle of the wall and are close enough to it, they will start climbing. The climbing only works for a couple of seconds and once the time is up, they will start descending. To avoid the descension the player is then able to jump off the wall to another wall which the climb timer will reset. This can be repeated 3 times until the player isn't allowed to climb anymore which they have to return to ground to let the climb counter reset. This implementation stops the user from indefinitely climbing and abusing the mechanic which would make the mechanic less mentally stimulating as the player wouldn't think about finding ground before losing their climb ability.

The climbing mechanic is quite simple as it only has a ray cast which is shot from the players camera view that constantly checks if the player is currently looking at a wall or not. If the player is looking at a wall and is close enough, an upwards force is added to the player which therefore makes it seem like the player is climbing the wall, if the ray cast does not detect a wall anymore, or the player is on their third

climb, the climb mechanic stops working to where the player will then need to return to ground to reset the climb counter back to 0.

5.2 Other Movement Mechanics

To increase the number of ways of affecting player movement, as the prototype stages mentioned, adding weapons as well as a melee kick that affect player movement by adding force in the opposite direction that the player is looking makes the movement more complex and allows for more route discovery and quicker ways of progressing through the levels. The kick and shooting mechanic both have delay between each use as to not allow the player to abuse it and gain too much speed to where it is unfair and overpowered to where different mechanics wouldn't be used as much.

The kick mechanic works by using a ray cast and detecting if the player is looking at an object which is also close enough for the kick range. The kick range is necessary to make sure the kick is also not overpowered and that it can only be used within range. Once the player is within range and an input is passed, a kick will thrust the player away from the object kicked which gives the player opportunities to get up higher quicker or thrust themselves towards another object such as a wall, this then allows both the kick and wall climb mechanic to interact with each other for smoother movement.

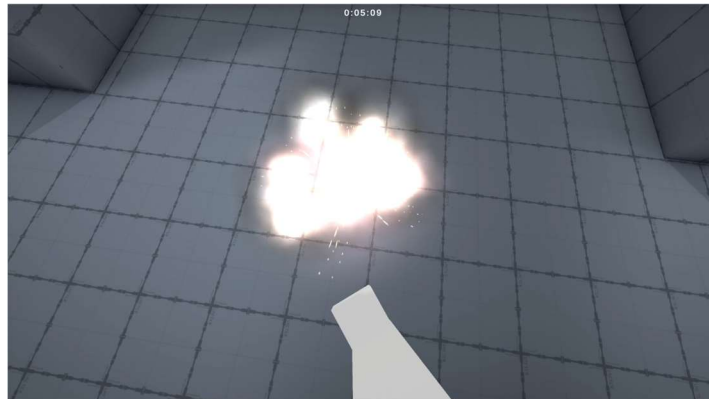


Figure 4 - Image showing the kick mechanic interacting with an explosive object

The weapon mechanic works similarly to the kick although an object is not needed to be around the player to be able to use the thrust as it uses the “recoil” of the gun as a real gun would have to apply thrust. The weapons have unlimited ammo as to make the weapon act more like a tool rather than a killing weapon, although enemies still react to bullets so the weapon can still be used for its main purpose.

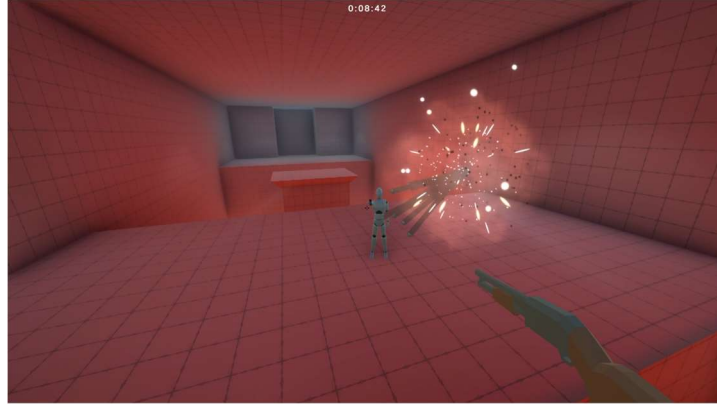


Figure 5 - Showcasing the weapon being fired towards an enemy

5.3 Obstacles

Following the prototype further, an introduction of the enemies was the next step. The introduction of enemies allows for a natural obstacle that the player has to avoid or take care of without making it seem like different obstacles were introduced to make the player be forced to stop. This also meant that the enemies needed to have a natural feel to them, which consisted of making the enemy look at the player position, as well as point the hand and weapon at the player so it looks and feels like the enemy is trying to aim at the player.

Making the enemy rotate towards the player position is simple as the Unity Engine provides a function called the “LookAt” function which rotates the object towards position you provide it, which the player position would be given to the LookAt function. The only issue is that the enemy will fully rotate towards the player's position, which means even if the player is above the enemy. To fix this we do not pass the LookAt function the y axis of the player which eliminates the y axis rotation. The enemy body parts are then rotated individually to make the enemy seem more realistic. This is done using the Animation Rigging package which allows to move different body parts individually from a currently running animation. It is then possible to apply a Multi-Aim Constraint function to the certain body parts to be able to aim the body parts at the player. The multi-aim constraint function allows to control how far the body parts can move meaning that body parts like the spine or the neck will only be able to move a little bit to make sure that enemy movement doesn't look unnatural.



Figure 6 - Enemy looking and pointing its gun towards the player position

5.4 Environment

Lastly, the environment and the levels of the artefact go up in difficulty the more the player progresses through the levels. This is to get the player used to the game mechanics and movement as the first level requires the player to use almost every implemented mechanic to be able to complete it. The first couple of levels are straightforward as its quite clear on how to make progress, whereas the last couple of levels don't help the player with directions meaning the player has to find their own way. This is intentional as it allows the players to find their own path which lets them be creative and could let them find a potentially quicker route rather than following the intended path.

Some of the levels also have explosive barrels scattered around to assist the player to get up higher places or even skip a part of the level by gaining a speed boost as the explosive barrels act like the weapons, instead of damaging the player the explosion pushes the player away from the explosion. The environment was also made to be low detail to make sure the player focuses on completing the level as fast as possible rather than getting distracted by unnecessary details within the environment.



Figure 7 - Showcasing the simplicity of the video game artefacts level 3 environment

Chapter 6

Results & Discussion

The participants were given the reaction time test website made by the Human Benchmark website which they used to record their visual reaction time data two times before playing the video game artefact and two times after playing the artefact. The participants then record the results within the given questionnaire where they input their first and second before reaction time results and then first and second after reaction time results which then that data was used to calculate the average before and after results as well as the average improvement between the participants. The calculations and plotting of the data were done using the Excel application as its easy and convenient to input and carry out the same formula calculation for every cell containing the information.

The reaction time test results received from the participants did see an improvement in the reaction time but not as prominent as expected. The expected result would have wanted to see an increase in reaction time performance within the low double digits like 10ms to 25ms whereas the average improvement only saw a small improvement of 4ms from the combined participant reaction time results. Although it is still an improvement, spending around 15-20 minutes on a warmup would want the player to see a greater improvement on their visual reaction time to make it seem worth to be used as a warmup tool. As seen on Figure 8 below, the second attempt on both before and after results, the reaction time to a stimulus is worse than the first attempt which could mean that the participant already knows on what to expect from the test and subconsciously pay less attention to the test which means a decrease in performance. The test is also really simple and not as visually stimulating as a video game would be which could therefore be another reason for the decrease in performance.

| (1) Before Times | (2) Before Times | (1) After Times | (2) After Times | Average Before | Average After | Average Improvement | |
|------------------|------------------|-----------------|-----------------|----------------|---------------|---------------------|----|
| 169 | 159 | 170 | 159 | 164 | 164.5 | -0.5 | ms |
| 175 | 151 | 171 | 72 | 163 | 121.5 | 41.5 | ms |
| 227 | 230 | 300 | 250 | 228.5 | 275 | -46.5 | ms |
| 191 | 202 | 200 | 211 | 196.5 | 205.5 | -9 | ms |
| 235 | 197 | 210 | 209 | 216 | 209.5 | 6.5 | ms |
| 213 | 193 | 185 | 171 | 203 | 178 | 25 | ms |
| 253 | 202 | 214 | 224 | 227.5 | 219 | 8.5 | ms |
| 204 | 179 | 185 | 176 | 191.5 | 180.5 | 11 | ms |
| 184 | 189 | 186 | 197 | 186.5 | 191.5 | -5 | ms |
| 207 | 184 | 190 | 180 | 195.5 | 185 | 10.5 | ms |
| | | | | 197.2 | 193 | 4.2 | ms |

Figure 8 - A table of participant reaction time results in ms

Some of the received feedback within the Discord personal messages also mentioned that the last level (level 4) was too difficult for most of the participants

meaning they either didn't know where they had to go, or some of the platforming was too difficult which got frustrating which the feedback also mentioned. As previously mentioned, frustration towards the video game could leave the player less immersed into the video game and therefore make the participant less interested and less focused for the rest of the playing time which would therefore decrease participant performance. As the artefact is also all about trying to improve on your previous time and completing the levels as quick as possible, not completing the level means that the core gameplay of the video game artefact cannot be completed by the participant and can be seen within the received results, that it affects player performance and not much improvement can be seen.

As the ethics approval for the research took a longer time than expected, the participant recruitment period wasn't to an extent as we thought it would be. This meant that only a limited number of participants was gathered which didn't allow us to carry out the study to the extent that we planned to. Although on the other hand, we are quite intrigued on the conclusion the gathered data came to as only a small number of participants was gathered and an improvement in the reaction time can still be seen. The gathered average reaction time results technically still meet our hypothesis which is that the participant reaction times will improve after playing a fast-paced action video game which is seen from the results in Figure 8. It would therefore still be interesting to either carry on further with the study or see others contribute towards the research with a greater number of participants.

The results may have also been a bit more consistent if the study carried out on the participants was done on the same device and system per every participant as some participants may have lower quality hardware which could make the game run worse and therefore make the improvement less prominent. Although the current gathered results show the real-life improvements participants got instead of the theoretical result participants could get on their devices.

Chapter 7

Conclusion

Overall, our study and research reached the hypothesis that we set out to answer which was that a fast-paced action video game would improve the player reaction time and that it can be used as a warmup before playing their competitive action video game of choice. Although the results gathered did not meet our expectations as our belief was that we would see a greater increase in participant reaction time performance. The research would have benefited more with a greater number of participants but as mentioned before, the participant recruitment period was shorter

than we wanted due to an extended wait for the ethics approval team to approve our study, we had no choice but to cut the participant recruitment period short due to a rapid approaching deadline we had to meet. This then meant our participant list was not as extensive as we expected it to be in the end, but the gathered results still provide us with an idea of how fast-paced video games affect participant reaction time and that playing fast-paced video games as a warmup can be used as a tool to improve their visual reaction time performance for their competitive action video game of choice.

It would still be interesting to either continue with the study after the submission of the research or even see other researchers continue to add to the research already done with a greater number of participants as well as different rules and parameters the participants have to follow. To continue on the study, it would be wise to make the video game a little bit easier but with greater number of levels so the participant could get more used to the movement and video game mechanics rather than increase the level difficulty exponentially. This would then decrease the participant frustration towards the later levels and would concentrate more on improving their time than trying and failing to complete the levels.

To conclude the study, we did meet our original hypothesis that we carried out our research to and found that fast-paced action video games do improve participant reaction time on average, but further work on the artefact as well as recruitment of participants would be needed to find out if the average reaction time between participants would could see a greater improvement to make the research more significant.

8.1 Referencing

This paper uses the Harvard referencing style as it allows for a better flow while reading providing a brief of what the referenced paper is about within the text but also allows for a list of all the references at the end of the paper for easy access to all the papers referenced.

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