How Psychology Affects

Difficulty Choice in Games

Contents

[1. Introduction 2](#_Toc7521100)

[2. The Wider Topic 3](#_Toc7521101)

[2.1 Factor model 3](#_Toc7521102)

[2.1.1 Openness to Experience 4](#_Toc7521103)

[2.1.2 Conscientiousness 4](#_Toc7521104)

[2.1.3 Extraversion 4](#_Toc7521105)

[2.1.4 Agreeableness 4](#_Toc7521106)

[2.1.5 Neuroticism 4](#_Toc7521107)

[2.2 Self-Determination Theory 4](#_Toc7521108)

[2.2.1 Competence 5](#_Toc7521109)

[2.2.2 Autonomy 5](#_Toc7521110)

[2.2.3 Relatedness 5](#_Toc7521111)

[2.3 Engines of Play 5](#_Toc7521112)

[2.4 Ethics of rewards 6](#_Toc7521113)

[3. Tools, Techniques, Technologies 7](#_Toc7521114)

[3.1 Development Methodology 7](#_Toc7521115)

[3.1.1 Agile 7](#_Toc7521116)

[3.1.2 Waterfall 7](#_Toc7521117)

[3.1.3 Spiral 8](#_Toc7521118)

[3.1.4 Method Used 9](#_Toc7521119)

[3.2 Data Analysis Method 10](#_Toc7521120)

[3.2.1 Method Used 10](#_Toc7521121)

[3.2.2 User Groups 10](#_Toc7521122)

[3.2.3 Limitations 10](#_Toc7521123)

[3.3 Data Collection 11](#_Toc7521124)

[3.3.1 Personality Questionnaire 11](#_Toc7521125)

[3.3.2 Mapping the Results 12](#_Toc7521126)

[3.4 Design 12](#_Toc7521127)

[3.4.1 Challenge 1 12](#_Toc7521128)

[3.4.2 Challenge 2 13](#_Toc7521129)

[3.4.3 Challenge 3 14](#_Toc7521130)

[3.4.4 Challenge 4 14](#_Toc7521131)

[3.4.5 Challenge 5 15](#_Toc7521132)

[3.5 Development 15](#_Toc7521133)

[3.5.1 Challenge 1 16](#_Toc7521134)

[3.5.2 Challenge 2 16](#_Toc7521135)

[3.5.3 Challenge 3 17](#_Toc7521136)

[3.5.4 Challenge 4 17](#_Toc7521137)

[3.5.5 Challenge 5 18](#_Toc7521138)

[4. Analysis of data 18](#_Toc7521139)

[4.1 The Data Gathered 18](#_Toc7521140)

[4.2 The Results 19](#_Toc7521141)

[4.3 Conclusion 20](#_Toc7521142)

[5. Personal Analysis 21](#_Toc7521143)

[6. References 22](#_Toc7521144)

[7. Bibliography 22](#_Toc7521145)

[8. Appendix 24](#_Toc7521146)

# Introduction

Research into the effects of player psychology in video games in an area that has seen a variety of research, exploring the different areas and effects. Research such as that done by (VandenBerghe, 2016) and (Bartle, 1996) shows that there has been interest into the player psychology for many years now, though the data that comes out often focuses onto the topics such as the effect of violent videogames.

This research project aims to investigate the effects that different player psychology affects decision making when presented a reward at the cost of challenge. This will use established data such as player types and taste maps to analyses the decisions made by users in the test environment. The test environment is to be measuring the decisions that are made by the play and their progress, while the progress is not the key information in this research it does provide additional information on what happened in the play session.

The user groups for this project will comprise of a varied level of skills and interest in video-games and ideally have a group size of at least 20 participants, this will provide a sufficient coverage of the different player types established in other works such as (Bartle, 1996). These player types will then be analysed against the methodology best suited to find what correlations can be seen across user groups.

If successful, this research will help form an understanding of what type of reward used to encourage players to try different or difficult content. The rewards used in this research will vary from challenge to challenge, as to see the effect of varying reward levels. This is as while a section of players may enjoy the low risk challenge, once there is a potential loss for them then the motivation changes.

The challenges are designed to be not only balanced but also covering a different aspect of gameplay that can be found in other games. These will be aspects such as: a player’s memory, reaction time and avoidance, problem solving in the form of a puzzle, patience and strategy, and finally adaptability in combat gameplay. These aspects will ensure that no individual skill set can be used to complete the challenges, providing a fair as possible environment for those who not only play a varying amount of games, but also varying genres.

# The Wider Topic

## Factor model

The “Five Factor Model” was proposed as a theory to measure personality traits through using five factors of behaviour, created by Tupes and Christal (1961/1922) (McCrae, R. R., & Costa, P. T., Jr. (2013)). The five factors of this theory are openness, conscientiousness, extraversion, agreeableness, and neuroticism. This model is derived from the pre-existing “Sixteen Personality Factor Questionnaire” which was the model used. This model was broken down to their primary traits as (Cattell, 1957) stated that traits have a multi-level, hierarchical structure. This meant that they could be condensed down and more specific, eventually forming what is used today.

### Openness to Experience

Within the “Five Factor Model” the user’s openness to experience is a measure that reflects their willingness and their interest in exploring. This is seen as a balance between curiosity and caution, though this is also seen reflected in other behaviours such as being seen as a creative driven individual, opposed the other end of the scale seen as data-driven individuals.

### Conscientiousness

This facet of the “Five Factor Model” is a measurement of an individual’s organisation or discipline. Those who are highly conscientious are seen to be highly organised and self-disciplined, while on the other end of the scale the low conscientious individuals are more care-free and flexible with their time.

### Extraversion

Extraversion measures the level how outgoing an individual is, the more extraverted the more likely an individual is to be seen having high sociability. If the individual is more of introverted, then they are likely seen as difficult to talk to or reserved. We see this in day to day lives as extraverted people are often the most vocal and take positions of high visibility.

### Agreeableness

This measures an individual’s compassion and co-operation with others. Those with high agreeableness can be seen to be trusting and kind, while those who have a low level of agreeableness are seen as non-compassionate or agnostic.

### Neuroticism

This is the measurement of an individual’s vulnerability to emotions such as anxiety, anger, and other unpleasant emotions. Those with a high neuroticism are seen to be nervous or easily emotionally hurt, while on the other end those who have a low neuroticism are seen to have emotional stability or a high level of confidence.

## Self-Determination Theory

This theory was proposed first by (Ryan & Deci, 2000) as a theory of motivation to support the natural intrinsic tendencies to behave in a manner that is most beneficial for the individual. This research has been compounded by a large collection of scholars from around the world (selfdeterminationtheory.org, 2019). This theory has become a meta-theory, comprising of 6 sub-theories, each of which address a facet of motivation or personality.

Specifically, to video-game theory, the “Self-Determination Theory” has been used to examine the motivational factors in the attraction of video-games (Ryan, Rigby, & Przybylski, 2006). This theory is presented as the “Player Experience of Need Satisfaction Theory (PENS)” which uses three key focuses of competence, autonomy, and relatedness. Each of these have an impact as follows:

### Competence

This factor we see as the want to control the outcomes of an event or to experience mastery of a game. This can be seen in competitive games where individuals who don’t have the extrinsic motivation of players such as e-sports professionals but continue to invest hours into a game where their reward is the mastery. Games aim to strike a balance with this, favouring the easy to learn, hard to master difficulty curve.

### Autonomy

This is the desire for a player to have choices that they can make and the impacts that has on the game around them, be that in the game world itself or character customisation. Users want to create something that

### Relatedness

Relatedness is the want to interact with or be connected to others. This is approached differently in many games, but this is best seen through systems such as leader-boards, rankings, and communities. This is as the individual needs that connection with others, either from a social view or to see their competence relative to others.

## Engines of Play

The “Engines of Play” is a theory worked on and presented by (VandenBerghe, 2016) at the Game Developer Conference. This takes different look at motivation as it incorporates time into the equation. This was created to be targeted at the video game industry to identify “Taste-maps” which can used to help determine what the individual would likely be interested in when looking for a game (VandenBerghe, 2016).

This model uses a combination of the “Five Factor Model” and the “Self-Determination Theory”, as they both hold weight over the player’s motivation. The player’s motivation is found to be pulled by that of the “Five Factor Model” on discovery of a game, as a player then engages with the game, their motivations for playing it progress, as with more time spent playing, the novelty of a game that matches their taste will begin to fade. This version of the “Five Factor Model” does not contain the category “Neuroticism” as there is not a similar aspect of a game’s design that would be appropriate to fit this scale (VandenBerghe, 2016).

Once a player has a time investment into a game this point is where the “Self-Determination Theory” begins to have a stronger influence. This is due to the content of the game, and if it meets the player’s three core needs of competence, autonomy, and relatedness. Though should a game begin to no-longer fulfill these needs, then the player’s motivation to continue naturally decreases.

The aspects of the self determination theory apply to the individual opposed to the specific game. When a player creates the experiences of competence, autonomy, and relatedness, it remains with the individual as an experience that they can call back on and of which they will feel fondness to if the experience fulfilled the needs set out by the “Self-Determination Theory” (VandenBerghe, 2016).

The downside of the Engines of Play model is that it is a non-perfect design (VandenBerghe, 2016), this is as it does not take into account the effect of the players emotions. Discussed by (VandenBerghe, 2016) is another model which focuses onto the emotions. “The 4 Keys 2 Fun” is specifically targeted towards the emotions that drive decisions in the realm of video-games. Though this is a valid model it is also a much more complex model as can be seen in Appendix 3. This model is not directly useful for this specific research use as the games themselves as the focus of this research is to understand the motivational psychology behind reward choice. For that reason, even with the missing element the “Engines of Play” is a strongly viable theory on which to analyse data.

## Ethics of rewards

The ethics of reward systems in games has come under scrutiny from not only the players but governing bodies who deem some methods to be a form of under-age gambling targeted at younger people in hopes to gain as much revenue as possible. The evolution of “Loot Boxes” has been a major driving force for this, causing the purchase of such items to be banned in specific countries such as Belgium (Gerken, 2018).

Loot boxes have been implemented in multiple ways, with varying degrees of reaction from players, as they provide harmless cosmetics in some games, while others provide a strategic advantage, which becomes questionable as these are purchasable for real money.

The success of this reward system is due to how closely its effect is tied to gambling rewards. When the player opens the loot box the table of contents is often understood, meaning that a player will be looking for individual high value items. This build-up that is seen in the loot box reveal is all in aid of building up a large dopamine hit for the player. This sudden level of dopamine encourages the player to repeat this action (Rester, 2019).

It is not only loot boxes which use the sudden release as a way to increase the value of the reward. This same tactic is seen throughout many genres of games, most of which are ethical as it keeps the distinct line between the excitement of the reward, and the potential to gamble real money. This method can be seen in games such as World of Warcraft, where the reward for defeating an enemy is hidden until the player goes to pick up the item. This can equally build up as much dopamine due to the rarity of items in large games, where players can be found searching for an item for extreme lengths of time.

This is offset by reducing a player’s accessibility to an item, where they may potentially only have a single chance per week per character. This extended period of time does still cost a player real money, though is more ethical due to the paths a player can take to increase their own chances at no extra cost.

Finally, another method used to engage players in the reward system is the “loot explosion”. This can be seen in games such as Borderlands, where there is the random potential for a loot explosion to occur, surprising the player and showering them in rewards of varying quality. While there is the potential that a loot explosion may not benefit a player, the instant surprise and excitement that is experienced is enough to mimic the same level of dopamine found through other methods.

# Tools, Techniques, Technologies

## Development Methodology

### Agile

The Agile methodology was formed in 2001 by a collection of 17 software developers with the goal of streamlining development practices and reducing an emphasis on inefficient procedures such as heavy documentation and meetings (Conrad, 2018). As a collective these developers presented a manifesto along with the Twelve Principles of Agile Software. The core values of this manifesto are that: Individuals and interactions over processes and tools; Working software over comprehensive documentation; Customer collaboration over contract negotiation; Responding to change over following a plan (Beck, et al., 2001).

At first glance the Agile methodology might not seem especially applicable to the development of this research application, though the core of its utility for this development situation is the SCRUM framework on which it works around. The scrum framework allows for a collection of tasks to be allotted into a “sprint” (Scrum.org, 2019). Due to the nature of this development as it is a collection of challenges with the research data thread throughout this framework can be used to organise the challenges into their own sprints. This would allow for clear information on tasks that need to be completed and have an immediate visible track of if development is on track for the deadline.

The down side of using this approach is that it requires the initial plans to be developed on estimates of time which requires the developers to understand the problems clearly if an accurate estimate to be formed. This holds issues as incorrect estimates can quickly de-rail a project, in the end costing more time to be consumed as the timeline must then be re-evaluated.

### Waterfall

The Waterfall model is “Sequential Development Model” which has been presented in multiple formats and iterations. The first iteration named the “Waterfall Model” is written by (Bell & Thayer, 1976). The approach the waterfall model takes is a step by step approach where each stage must be completed before progressing to the next (Bell & Thayer, 1976). The core stages of the waterfall model include: Requirements, Analysis, Design, Coding, Testing, and Operations. These stages have seen changes over time to introduce better practices and to remove flaws such as including testing more often throughout the project opposed to only after development.

Due to the structure of this methodology the major benefit is that it allows for rapid iterative design early in the development cycle, before coding begins. This then benefits the coding portion of the cycle as all design decisions would be already settled, allowing for more efficient development, and potentially a more structured design. The benefits of the Waterfall model apply in an ideal situation where there is not the potential for design requirements to change later down the line, though to a lot of development scenarios this is not common practice.

For the development of this project the Waterfall model is less applicable due to the iterative nature of the project and the varying factors that could change throughout. Due to the varying time availability during the progress of this project it its more beneficial to remain agile to ensure development is efficient as possible.

### Spiral

The spiral model, proposed by (Boehm, 1988) was an evolution of the Waterfall model, which saw refinements and adjustments while applied to large government software projects. This model benefitted ///over that of the Waterfall model due to having multiple stages to evaluate, investigate alternative approaches / technologies, and create prototypes. In the paper (Boehm, 1988) raises that existing Waterfall models should easily be able to integrate into this new methodology.

Using this methodology provides benefits by allowing for repeated testing, alongside designated periods of design and development. This keeps a clear workflow especially in situations of large quantities of developers working on a project, of which it was designed around. For a project such as this, the benefits are no greater than that of the Agile methodology, though with more routine as to when testing occurs, opposed to testing throughout development.

Unfortunately, this model has a large amount of data analysis and documentation, which for this specific development is not beneficial due to it being to gather data opposed to developing an end product for client or mass consumption.

### Method Used

The final methodology that is best for the development of this project is a partial agile approach. The benefits of this method allow for rapid iteration of challenges, and the structural order of separating each challenge into their own sprints. Elements of the agile methodology are not needed as they were not applicable to this specific development, such as daily scrums.

By having a consistent pattern of design, develop, and test throughout each sprint this should allow for clear decisions to be made early on, while also having the flexibility to return to previous designs and adjust for design decisions.

The downside of agile methodology in the development of this project is negated to an extent, this is due to the project being solo development, therefore issues such as time estimates, and the cohesion of the final product do not have as such great of on an impact. This is as the project is developed with one vision in mind, therefor the time estimates will be based off the individual’s rate of work.

## Data Analysis Method

### Method Used

The method most applicable to this research project is the “Engines of Play” theory, as it already has strong roots in the games industry behaviours. In addition to this the “Engines of Play” takes the most relevant and applicable theory practices from both the “Five Factor Model” and the “Self-Determination Theory”. Due to creating specific game to be able to test and collect this data only the “Five Factor Model” variant used in this model will be used research into the “Self-Determination Theory” would require a pre-existing game where the users have invested time already.

### User Groups

The user groups for this research are comprised of a variety of individuals with a range of experience playing games, ranging from those who are new to games, to those who play regularly every day. The ideal user group size will be of at least 20 users, this is as any fewer and the ability to detect trends in player behaviour.

As the key data from the user groups is the results of the questionnaire and the choices made, there is no need at this stage for any specific user group variations as long as the group as a whole has a diverse spread of ability and taste.

### Limitations

In this research there are specific limitations imposed such as resources and time which would allow for a much longer and comprehensive look at player motivation using a combination of pre-existing games and a game developed such as in this research. By having the resources and time to be able to carry out this scale of data collection then it would be possible to not only map the discovery phase of the “Engine of Play” theory, but also allow for analysis of affinity stage where “Self-Determination Theory” is the leading motivational driving force (VandenBerghe, 2016).

Another limitation faced which is tied to the resource availability is the access to test groups, the current method is to gather a collection of individuals and working to ensure that there is an even distribution on player experience Though if there was access to a much larger quantity of users then these users could be pre-questioned as to form test groups representing each of the four player types (Bartle, 1996). Not only would this allow for the most efficient review of data but also would allow to specifically look for differences and their reason within each of these four types.

## Data Collection

This research requires a collection of data from two key parts, this being the questionnaire in which data will be gathered to map an individual’s tastes against the chosen analysis theory, and also the decisions made by the player. The results of the player’s gameplay will also be collected, this is as to potentially gain additional insight into unaccounted factors such as the impact of failing a challenge on the next choice. This data is gathered by a file which is stored in a convenient location containing all relevant data for the research.

### Personality Questionnaire

Collecting relevant and accurate data through the questionnaire is key to the success of this research. To create a fair and ethical questions to accurately map the individual’s taste-maps in accordance with the “Engine of Play” theory (VandenBerghe, 2016) there is two approaches that work best. This is to either have four questions each represent the different factors taken from the original “Five Factor Model”, or to display the axis of the taste-maps as their own scale.

By using the two measurements of each of the four facets of this first allows for a cleaner design and more accurate information. As this is research is targeted into video-games it is important to not only distinguish the meaning of the scale so that it is understandable, but also taking into account the varied understanding of video-game jargon.

### Mapping the Results

The results gathered from the questionnaire will be used to create a taste-map for each user. This is as the taste-map will provide an insight into what types of games a player prefers; this data can then be translated into an understanding of what type of sub-category of player they fall under. These categories are discussed in (Bartle, 1996) as players fall into four types, achievers, explorers, socialisers, killers. While these types are common in MUDs or more recently MMOs, the same personality types carry through to single-player experiences as the players interaction with the world around them can be defines into these same groups. In a single player scenario killers, achievers, and explorers are likely to act in a similar manner, while without other players to socialise with the socials still have the ability to act as normal though often through an alternative source such as a forum. This does not however mean that the individual will have the same personality type when placed into a multi-user environment.

The results of these taste-maps will then be compared against the results from the gameplay session of other players who’s taste maps showed a similarity in their player type. With the players categorised into the different personality types trends in the decisions should appear, taking into account the player experience with video-games.

## Design

When designing each challenge, the focus was to ensure that each one focuses on a different aspect of gameplay and to be as fairly balanced as possible. By using an agile approach to development this allowed for iterative design throughout the design and development cycle, which was key for ensuring the challenges met the criteria.

The first design decision was to lay the foundation of each challenge by finding a consistent play style. This was integral to the flow of the challenges and the usability, as with gameplay mechanics objectives changing in each scene it was important to provide the player with a sense of grounding. The most suitable approach for this was to maintain a player character with a consistent control scheme and have a consistent art theme.

### Challenge 1

The first challenge was designed to be focused on memory, this led to two potentials for gameplay, the first being colour recognition and the latter being pattern recognition. Pattern recognition had more variety for the gameplay potentials from initial design iterations. This led to the decision to create a path which would appear from dissolving tiles, not only would this have more development substance but also is a simple mechanic for players with varying ranges of ability.

The design of the path went through multiple design iterations including a period of research into how many steps is considered difficult for a game of this type. After this research it was evident that the challenge difficulty would be nearly impossible, therefor needed redesigning.

Compared to the initial design the final version of the challenge difficulty was significantly easier to complete and understand. The difficulty comes with the scale as research found that a only a few turns are required to make the difficulty but the amount of steps required is the leading difficulty factor to account for during design. This design change lead to one third of the path being removed which then became a much more acceptable level of challenge.

### Challenge 2

The focus of this challenge was to test the player’s reaction time and quick thinking. This specific challenge held issues as creating a challenge which can be fair to a variety of skill levels, especially in video-games where hand eye co-ordination is one of the key skills of advanced players. The first stage of this design was to break down what interactions require the quick thinking, this included situations such as standard reaction time tests, or avoiding objects coming at the player.

Designing this challenge for the standard difficulty did not present many issues as it would be a straight forward run avoiding objects coming towards the player. On the other hand, creating an alternative that would provide a fair challenge for experienced players was harder task. This required iterations on a variety of ideas including simple changes such as faster or more objects, though this quickly became unfair as the reaction window became too small. The final solution to this issue was to keep the player in the situation longer and force them to use the full width of the passage, this was done by the addition of persistent obstacles which created a winding path forcing the players to be in uncomfortable positions.

### Challenge 3

The design for this challenge was the most complex to put together as its focus was on problem solving and puzzles. This required research into varying approaches to puzzles as with a great variety to choose from these was a lot of iterations of different forms of puzzles.

The initial design was to create a simple escape the room which required the player to interact with different objects in their environment, potentially finding a clue for a previous object they had interacted with. The branching design of this made it the most interesting but too large of a scope for this development. It also held the issue of potentially being very confusing to players and not providing them with the ability to learn from their mistakes, as being lost would only result in either staying lost or eventually finding the solution.

The next design was to work with a physics puzzle, similar to that found in games such as Portal, this would not only provide players with the information they would need to solve the puzzle up front but would be down to execution to solve. This design also suffered from an issue developing for a harder difficulty as each problem would be similar to solve and pose little challenge.

Finally, the best design took aspects from what was developed for the physics puzzle but applied to a Sokoban puzzle, which requires the player to push cubes into a designated spot. This was a simple mechanic which would work for both difficulties as when designing for the harder difficulty it would only require a more challenging layout. The choice to not include the option for one cube to push another was in favour of being able to design more straight forward puzzles.

### Challenge 4

The objective of this challenge is to test a player’s strategy and timing, the best type of gameplay that matched this criterion is a stealth challenge. Designing this challenge was the most straight forward due to familiarity with stealth game mechanics and the variants in which they can be used.

With this knowledge the challenge was designed to have a core mechanic of avoiding the light from scanning security cameras. This simple mechanic allowed for quick iterations in the layout and pacing of the challenge.

Designing the hard challenge went through a few iterations due to finding a fair balance of difficulty and avoiding introducing additional complex mechanics. This led to using pickups to lock the player into the challenge and force the player into difficult situations.

### Challenge 5

This challenge tests the players ability to defend and defeat enemies which spawn in various waves. Designing this challenge was the most straight forward as it removed the element of a player character. This decision was made due to the limitations on how to approach combat with the existing player animations.

A key design decision of this challenge was to have a shared power source between each tower, this would provide players with a more dynamic approach to tower defence compared to the standard approach seen where once placed a tower must stay. By also having this dynamic control throughout the challenge they can recover mistakes without being too heavily punished.

## 3.5 Development

During the development the objective was to add small improvements and maintain a usable codebase. Due to the design decisions made at the beginning of this development the initial three challenges were created in a single scene where the player was to easily move between each challenge.

This posed a technical problem which was not expected as not only did it break the objective of creating a uniform aesthetic but also lead to difficulties and confusion with the player as to the changing control schemes. While having a persistent character to keep the player grounded in the experience, by having quick changes to the camera to adjust for each challenge the player was being forced out of gameplay as suddenly the positioning and speed would be drastically different.

The solution to this issue was to take the existing developed challenges and to separate them into their own instances. This made future development much easier due to the individual instances as there was no potential to interfere with previous challenges settings.

### 3.5.1 Challenge 1

This challenge proved to be simple to execute as for proof of concept it was possible to simple disable the mesh renderer on an object that is not the path then enable after the given time. This was unsatisfying from a technical perspective as there were other options to explore.

This led to using one of the latest features of Unity Engine named “Shader Graph”, this provides a method similar to visual scripting where nodes can be connected to create shaders. The shader developed uses an exposed variable to lerp the alpha clipping. This was layered over a Perlin noise map as to provide the pattern as the object dissolves. This takes advantage of another feature new to the Unity Engine which is prefab variants, the prefab variant allowed for quick setup of a non-path tile and whenever making changes to the original prefab the changes would replicate down to the variant, ensuring that they were at all times identical.

An issue arose with the collision detection for the original design, though after the rework had been completed to separate each challenge out into an individual component then this allowed for much more finer tuning within the scene.

### 3.5.2 Challenge 2

For the standard difficulty this challenge was a straight forward development, the most time for this difficulty was spent finding a natural as collision for the balls that fall down. This was as early on the balls would eventually slow down their horizontal velocity to the point of sticking to the side while rolling down. This was fixable with a force which would push the ball away from the wall on collision. This maintained a more sustainable horizontal velocity.

The choice of a flame-thrower type obstacle coming from the walls would suit the needs of the challenge design criteria. This is as it provided the longer route through the challenge and would easily be able to catch an unsuspecting player out off guard due to the balls being able to fall through the fire.

Creating the effect for the fire took longer than anticipated due to the effects on performance, as having multiple intense particle systems running at the same time began to slow the game’s performance. This being a clearly important issue to fix it became a focus for this sprint of development. By tuning down the emission of the particle system but increasing the individual size of each particle the load on the renderer was decreased greatly. This also benefitted the collision detection as should the player come in contact with the original particle system due to the quantity of collisions this would also cause a further performance problem.

### 3.5.3 Challenge 3

While the sprint for this challenge proved no major development issues this is likely due to the extensive time spend in design proofing the concept and the puzzle itself. This challenge did not require complex solutions as the objective being to push a block and have the target positions know when all are filled.

Pushing the block initially was done by using the inbuilt physics of the rigid-body, though this proved to have its own issues as this would allow players to push the cube in any direction. This was solved by locking the constraints on the cube until a player would interact with it, at that point it unlocks the specific axis of movement.

If the design was to change to include blocks pushing other blocks then this method of development would be able to be slightly adapted as to also have the cubes checking for the collision with other cube, though as per the design specification this was not needed.

### 3.5.4 Challenge 4

Development of this challenge became difficult once the introduction of the camera obstacles was in place, this was as issues with the detection of the player arose during testing.

During testing it was clear that the cameras were able to detect the player regardless of actual visibility. This was due to an oversight on the design as the approach was decided to use a collision sphere opposed to multiple ray-casts for the sake of accuracy and efficiency. The solution to this problem became to apparent that a single ray must be used between the player camera obstacle upon collision.

This change then provided other issues that arose such as the player entering the collider but the ray not being blocked by walls, this was due to the ray-cause using the centre of the player object which would be significantly higher than that of light on the ground. This would cause the ray to be able to travel over objects such as walls which were intended to stop this behaviour.

### 3.5.5 Challenge 5

The final challenge provided more option to use varied programming techniques to complete the design specification.

The initial part of development for this sprint was to create a system of placing towers, this required being able to scan over the terrain with the object and place in any available position. Checking for available positions required manipulation of layers to ensure that the sphere collider on existing towers was not triggering the occupied status of the new tower.

When creating the enemies using the scriptable object feature of Unity Engine allowed for only using a single prefab while still having the control to quickly edit values of the various enemy types. As the enemies travel along the path once they enter range of a tower this uses the collision trigger event to subscribe the tower to the enemy’s death event delegate, the opposite of which would happen upon exiting the collider. This was due to issues with the destruction of enemies and leaving null objects in the list of in range targets for the tower. By using the death even delegate the subscribed towers could appropriately handle the data clean-up to ensure there were no null objects.

# Analysis of data

## The Data Gathered

The data gathered was not enough to cover the full spectrum of player types as the full user group did not return the data before the required date, this meant that the user group was only out of 10 participants. This causes issue with the analysis as there is potentially additional factors that cannot be accounted for. With this limited data a few trends were able to be drawn which reflect differently that what was the expected result, this was

## The Results

The limited results available show specific trends between players and the difficulty chosen, what is the most clearly visible is that players begin with a difficulty choice and then continue progressing through on this difficulty regardless of success, and not interested in the rewards. This trend applies to both scenarios of players completely failing a challenge or those who had no deaths.

It can be seen that out of the 10 participants, 4 decided to play only on the standard difficulty. It is noticeable that these four are also the only participants with a low experience, ranking themselves as seen in Appendix 2. From the data seen it would lead to believe that a rating of 1 to 3 out of 5 for regularity of playing games would lead to playing the standard difficulty. Meanwhile participants whose regularity with games is above that play on the challenge difficulty for each game. The only exception from this rule is one participant, seen on Appendix 1 as user number 9, whose experience is low but enjoys a well-balanced difficulty for their game, they also decided to play through the game on only challenge difficulty.

While there is a trend with the difficulty choice, regularity of play, and difficulty preference, each of the participants has in some form different tastes to those who are in the same category for the difficulty choice. This appears to show that regardless of genre of game, or taste of the player, the interest in the challenge comes from a specific facet of the player motivation theory opposed to a combination of various types. This can be seen in Appendix 1 as the wide variation of taste across multiple factors of the “Five Factor Model” variant that is used by (VandenBerghe, 2016). From Appendix 2 it is also visible that the players regularity or familiarity with games is not directly tied to the difficulty choice, though it does have a strong impact on the outcome, this would need to be tested with a larger user group to ensure accuracy.

It is clear to see in the results of Appendix 1 that play regularity shares a similar trend to that of the difficulty preference, believing that these two are not mutually exclusive, though without having a larger quantity of players this would not be able to be proven and is not documented elsewhere.

## Conclusion

Overall with the limited data that is available it appears that there are potentially more hidden facets of motivation that will affect the difficulty choice that players make. From the available data collected the decision of difficulty appears to be relative to a combination of the players experience and their preference to difficult gameplay. It is unclear if this trend of draw to difficult gameplay is because of the experience with games and developing a taste over time, or if new players with a taste for difficult gameplay would also make the same decisions.

As seen in Appendix 2 the clear data that can be drawn is that individuals with a high conscientiousness rating are likely to approach challenge more willingly, this could be seen to be related to the testing of a player’s self-discipline. This also shows ties to the later impacts of the Self-Determination Theory where the ambition to master something is one of the core needs.

This drive from the Self-Determination Theory is potentially due to the Engines of Play being applied to the wider view of a player’s experience with games. The drive of the Self-Determination Theory is potentially more present in those who have been playing video-games for a longer period of time as this need to master effects expands from the single game to the broader ambition of having a degree of mastery in any new game.

Should this research be done again the key factors that would have changed would be to first use an initial gathering of participants who take the questionnaire and then 4 focus groups would be formed to represent the four types of player types found in (Bartle, 1996). These groups can then be tested against each other to see the decisions made as well as within their own group to understand potential causes of difference.

Additionally, the challenges would be much simpler and reflect the individual specific test case, such as a reaction time challenge where the measurement is the speed of input reaction to a condition such as a colour change. This would remove certain “gamey” elements out of the equation but still provide relevant data.

This research would have also strongly benefitted from being able to test on a live game where users have been invested for longer periods of time. This would potentially yield many more varying degrees of choices due not only the clearly defined game types but also the effect of player’s expectation of what a worthy reward is, which is not present in the first stages of a game’s discovery.

# Personal Analysis

I believe development of this project went well as the game created completes the specification that I set out and collects the data I need. By using the free tool Hack and Plan I was able to easily plan out my time and assign estimates. This process helped significantly during testing as the individual task could be taken from the board and set back to testing, ensuring I was aware of what needed fixing at all times.

By having this approach to testing throughout development it reduced the load of the more difficult tasks, as by using accurate as possible time estimates I was able to change focus onto different aspects of the development should one become a roadblock.

Even while using Hack and Plan to ensure the best tracking of my project there were still struggles with time management, and more of the project became put on hold as the available time to work on the research became more limited. This led to loosing track of the originally designed Gantt chart was to help with time organisation, once behind schedule it was high pressure to regain the lost time. Unfortunately, this included cutting specific features such as being able to use a database as the method of data collection, instead this was formatted into the JSON file send back by the participants.

The time management could have been improved on this by applying more “SMART” goals to the project. Sprints were planned around individual challenges as this appeared to be the best approach to these problems. Unfortunately, this cause rushing of some projects over other due to the difficulty of development. These should have been longer sprints leaving more room for testing and over run time when the estimate was too ambitious.

Overall, I believe that more could have been done to effectively make the most out of the design and planning stage, by having to redesign half of the development process a lot of valuable time was which then became a worse situation when the time available to dedicate to research was limited. This research has looked into a much larger scale research project which with the right resources and team could provide a vital look into the thought process of players.

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# Appendices

Appendix 1.

Appendix 2.

Appendix 3.

