INFLUENCING EMOTIONS AND INTERPRETATION:

Investigating the impact of color grading on emergent narratives in an interactive experience

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ABSTRACT

The incentive and aim of this thesis was to identify causes and correlations for methods of encouraging memorable and impactful experiences in video game. This was specifically desired in relation to guiding the mindset of players to interpret and understand content in a certain way.

The primary approach for investigating this notion was grounded on the use of color grading for the possibility of influencing the interpretation and construction of an emergent narrative relative to environmental storytelling. Thus an experiment was conducted incorporating 44 participants separated into a control and experimental group. The feelings and emotions felt by each participant was as such measured through 3 different self-assessment evaluation methods, in addition to a written interpretation.

The acquired data was compared between the groups and relative to their interpretations, which suggested a significant difference that participants were influenced and consequently that it had affected their ability to construct an emergent narrative.

However, for a more definite answer to the final problem statement, further investigation and experimentation should be applied to various archetypes, methods and styles of color grading in relation to emergent narratives and environmental storytelling in video games.

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The main inspiration and drive behind the thesis is the notion of how we as individuals can be visually influenced to interpret what we see and experience in video games or media in general. It has always been an intriguing notion how the game world and its incorporated atmospheric components manage to arouse certain sensations and feelings that set a specific tone and create a particular mindset for the narrative experience.

Additionally, on a personal level, it has been interesting to investigate how simple visual cues can guide or redirect the mindset of a player in a specific direction, or even influence them to think or behave in a certain way.

Albeit influencing players visually for various purposes are often utilized in the video gaming industry, they are not very well documented and there is little to no specific or identified strategies for doing so. Moreover, the impact of visual cues has been well documented in academia, although this notion is not as extensive in relation to video games.

The aim and research of this thesis could as such potentially identify causes and correlations for how to influence players relative to what they see and how they experience it. As such, this could also lead to the discovery of methods for encouraging more memorable and impactful video game experiences. This is specifically desired in relation to guiding the mindset of players to interpret and understand content in a certain way.

Chapter 1

INTRODUCTION

In the entirety of human history, storytelling and the notion of a narrative experience has always been very integral as a way of conveying knowledge and information or simply as a form of entertainment. Inherently, the content and manner of which narrative is conveyed correlates with the value of the narrative experience and impacts how it is interpreted by the corresponding audience.

In recent years, video games have become increasingly more effective as a narrative medium. Environmental storytelling and world building have had an ever growing role in providing the means for which a story can be told, experienced, or even emerge within video games. In addition to that, a wide range of diverse cues are commonly utilized to evoke specific emotions and to create certain mood-states that may be essential to the experience. However, there seem to be a deficiency in academia in relation to these methods, as they are either not very well documented or simply not explored in relation to video games.

As such, this thesis will present the research, design and implementation process of a video game environment incorporating narrative cues and elements implemented through environmental storytelling to encourage an emergent narrative. The prototype will be the groundwork for investigating the influence of color grading on player's interpretation of narrative cues and elements, with emphasis on an emergent narrative as the subsequent outcome. Additionally, the results will be presented, demonstrating a potentially successful influence and further discussed in relation to the measured effect, outcome, findings and implications.

Chapter 2

INITIAL PROBLEM STATEMENT

Relative to the introduction chapter, it is of interest to investigate the extent of which emotions and mood-states are evoked by color. This is in terms of the common assumption and association of hue – as a property of color – to specific feelings and emotions and how this notion can influence behavior and interpretation. Specifically, in the sense of interpretation of a narrative experience that is integrated through environmental storytelling in a video game. As such, the following initial problem statement has been formulated;

> ***" How does the overall use of color as a way of establishing mood impact an emergent narrative that is integrated through environmental storytelling?"***

Chapter 3

INVESTIGATION

3.1 INTRODUCTION

In this chapter an overview of literature on the effect of color as well as environmental storytelling, and emergent narrative will be outlined. Additionally, a section relating to examples in games within the explored topics will be presented.

3.2 EFFECT AND USE OF COLOR

Color is a perceptual property commonly measured and characterized by hue, saturation, and brightness (HSB). There is a general assumption – both culturally and in academia – that the hue of a color can stimulate feelings, evoke specific emotions, and establish mood which consequently can influence behavior. As such there is a plethora of studies on the relationship of the hue of a color and emotional influence, affirming an existing link between the two. Therefore, studies and experiments within this field, with an emphasis on its effect as an emotional stimulant, in addition to its use a tool in context of video games will be investigated.

In a study on synesthetic association of color and emotion conducted by (D'Andrade & Egan, 1974) it is stated that color basically is a predictor for emotions, though two explanations are given for this phenomenon. The first being connected to an individual's cultural background that may have created a link between specific colors and emotions. And the second being contextually based, where different modalities are associated i.e. the color perceived and the emotion felt, which created the link. As a side note, the results in this study also indicated that the two sample groups had a very similar patterns of color-emotion associations despite being culturally diverse. Additionally, a second finding of the study suggests that the emotional associations of color and emotion are not primarily related to the actual hue, but rather correlating to the brightness and

saturation values of that color. Meaning that a color's emotional association can basically be perceived differently with different saturation and brightness values.

More so, (Valdez & Mehrabian, 1994) and (Plutchik, 2001) identify that basic human emotions can be linked to specific colors (e.g. Anger-Red, Joy-Yellow, Surprise-Light blue). Though as an interesting observation, these associations are not solely based on the color's hue but also on its brightness (e.g. dark green, light green etc.). More so (Valdez & Mehrabian, 1994) state that out of the three properties of color (i.e. hue, saturation, and brightness) hue has the weakest relationship to emotion.

Additionally in the same context, (Joosten, van Lankveld, & Spronck, 2010) investigated whether the use of colors in video games could stimulate a player's emotional response, where colors associated with certain emotions were used. Concluding that this notion is plausible but that it has a more profound effect on novice and inexperienced players than veteran players as they rely more on visual cues, relative to the findings in (Jørgensen, 2008).

Furthermore, (Jalil, Yunus, & Said, 2012) analyze a great number of color studies within various disciplines to highlight the Impact of environmental color on human behavior. In their review color is defined as the easiest mean to alter the characteristics of a given environment, in addition to influence not only behavior, but also decision making, health and more, as a subtle stimulant. Some of their interesting points include time as an important factor, as it may take a while for an individual to be effected by the perceived colors. More so, they point out that based on their sources, personal color preference may have a significance on how an individual respond to color, in addition to cultural background and upbringing. In addition to that, it was also revealed that brightness has a positive effect if it is to the individual's liking. However, they also argue that many of the previous color studies focus on few prominent colors and that they essentially indicate inconsistent and unclear color effects, where for example the same hue can have both negative and positive effects, hinting that the effect(s) may be contextual.

To end, (Tulleken & Bailey, 2015) classify color as an influential tool to create emotion and to emphasize function in the context of video games. Moreover, the uses of color (hue, brightness, and saturation) are described as follow;

3.2.1 Emotions

In relation to emotions, one of the examples given includes a single scene that based on the color palette used, evoke a certain emotion and reflects a distinct mood (Figure 1).

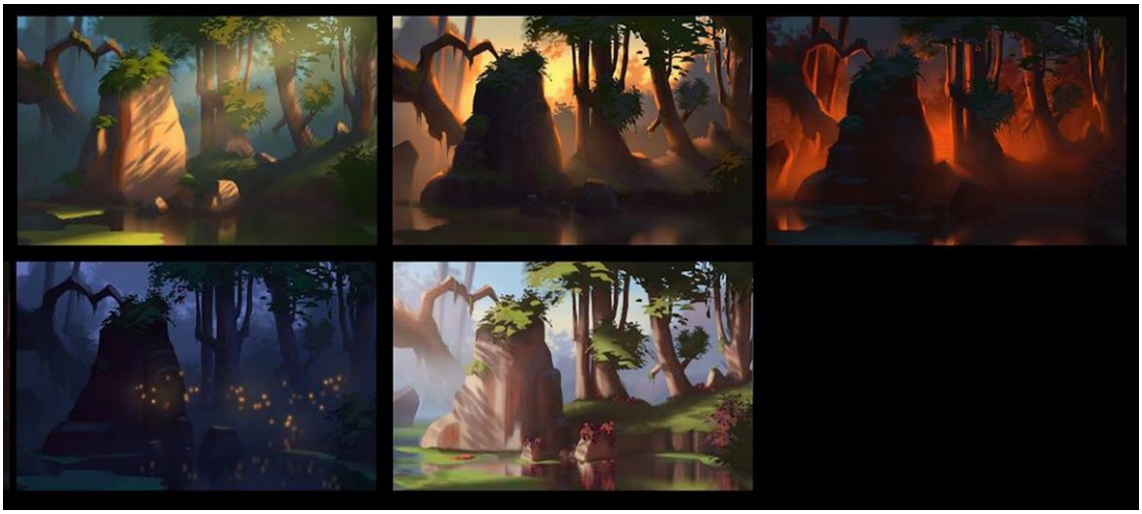


Figure 1 Various atmospheric environments constructed with different colors (HSB) to set a distinct dominant mood.

In the same framework, color grading is characterized as a fast and easy method of adjusting entire color palettes for the purpose of increasing, decreasing or simply setting a specific mood in video games (Figure 2).

Figure 2 Applied color grading for the purpose of adjusting or altering the look and feel of a scene.

3.2.2 Branding

Branding through the use of color, as it is described, makes a game recognizable in addition to conveying its intended audience. For example, nuanced colors are often used in realistic games, whereas casual games tend to use brighter colors (Figure 3).

Figure 3 Google image search of FPS games vs. Casual games representing the common color usage relative to genre.

3.2.3 Visual Hierarchy

Though the environment of a video game fundamentally forms a natural hierarchy of importance, color (HSB) is argued to support this process in becoming visually clear. Hue, saturation, and brightness can each be used as tools for indicating importance in video games, in addition to guiding the player's visual focus (Figure 4, Figure 5, and Figure 6).

Figure 4 Visual hierarchy created through the use of brightness as seen in Limbo.

Figure 5 Visual hierarchy created through the use of saturation as seen in Portal.

Figure 6 Visual hierarchy created through the use of hue as seen in Drift Stage.

3.2.4 Progression

Another use of color in video games is to give players a sense of progression, indicating either change in time, space, or otherwise. This notion is often utilized for day and night cycles, or simply for transition in different levels or areas of a game (Figure 7).

Figure 7 Use of color in level progression visualized through the use of color as seen in Journey.

3.2.5 Mechanics

Color is also used as a mechanic in video games where players utilize color(s) to solve puzzles or simply advance further in the game and more (Figure 8).

Figure 8 Use of color as a mechanic to progress from one platform to another as seen in the game Hue.

3.2.6 Signifiers and Identifiers

Alternatively colors in video games can be used for differentiating various elements, in the form of Identifiers, or to indicate their properties, in the form of Signifiers. Identifiers are often used in grouping or separating elements in a video game. This is especially evident in versus games such as Team Fortress 2 to identify friend from foe (Figure 9).

Figure 9 Use of the colors red and blue as identifiers for differentiating between players in Team Fortress 2.

Signifiers on the other hand, signal or rather convey a specific property or information about a given element in video games. The Mirror's Edge series for example utilizes this notion by having objects that help progression colored in red (Figure 10).

Figure 10 Use of color to signify property (progression/path in this context) in Mirror's Edge.

3.2.7 Content variation

A very simple and cheap use of color in video games can be seen for content variation. Basically color is used to give a sense of variety and to make the same content appear visually distinct. This method is used to in a sense "create" more content, often in relation to the Identifier method, where the same object, model, or alike can be reused with a different color to appear different.

Figure 11 Example of content variation (characters) through the use of color in Mortal Kombat.

Based on the initial literature review, it is possible to assume that there is indeed a relationship between perceiving color(s) and arousal of associated emotions and feelings. However, it is evident that these associations can be contextual in addition to being culturally rooted. Furthermore, it should be noted that color as a perceptual property has a more prominent effect in terms of saturation and brightness as opposed to the actual hue. More so in the context of video games it is also important to recognize that color is used for many purposes and that it is simply one of many means of which players can be influenced to achieve a desired mood-state. Therefore, in context to the problem statement, creating an atmospheric environment that establishes a dominant emotion should be set in focus.

3.3 ENVIRONMENTAL STORYTELLING

As it is implied by the term, environmental storytelling (ES) is the notion of conveying information through various cues in an environment that may hint at underlying themes and ideas. As such, relevant literature within the field will be investigated to gain a better insight on the subject and practices.

A considerable amount of literature on ES pays particular attention to the views of (Carson, 2000) who writes about ES in context of video games through lessons he has learned from designing theme parks. One of his core arguments is that story elements should be infused into the physical space so that it conveys the story. Essentially establishing a causality between what can be seen and what may have happened in terms of narrative and spatiality.

(Jenkins, 2003) takes this notion further and describes how game design can become a narrative experience, based on Carson's framework. He particularly comments on how ES creates the preconditions for an immersive narrative experience, basically pointing out the potential of ES as a means of creating narratively-compelling spaces.

Likewise, (Fernández-vara, 2011) defines an environment as a bridge between narrative and game. She mainly builds on the previously acknowledged concepts and proposes a more refined concept of ES in the form of Indexical storytelling, where a story is told through placement and exposure of indices which are open for player interpretation.

These views are further supported by (Jongeneel, 2013), who highlights that there are numerous ways to classify, define and practice ES depending on the approach, and that these approaches consequently result in an deep and immersive game-world. He also outlines eight common applications for which ES can be utilized (Figure 12), of which creating emotions and presenting a living world can be given as examples. Furthermore, he states that ES is essentially a way of telling an incomplete story in which the player needs to actively interpret, and that ES is a form of storytelling that fundamentally incites participation, constantly connecting and reminding the player of the story.

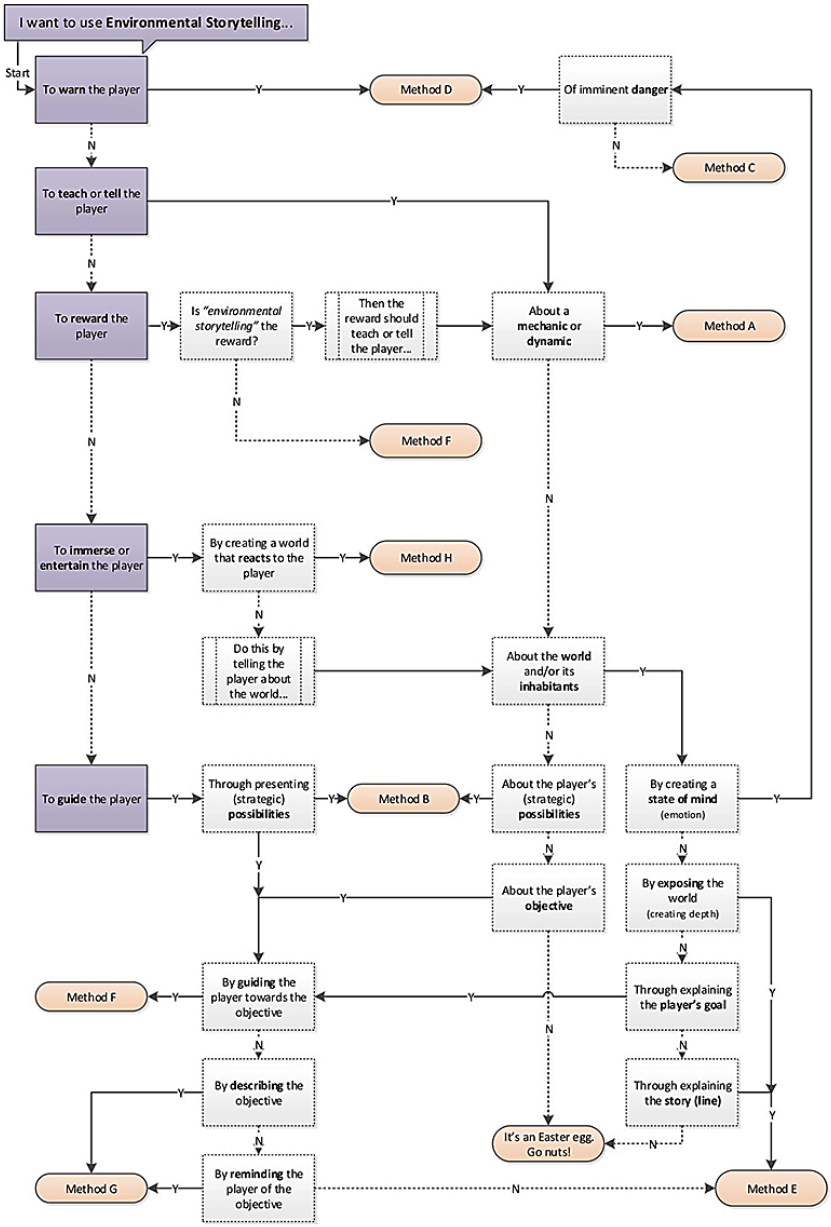


Figure 12 Methods of incorporating environmental storytelling for various purposes.

Grounded on the characterization of ES as well as its portrayed uses in the reviewed literature, it would be reasonable to believe that ES plays a relatively significant role in providing both factual and emotional context to a player. Meaning that through ES players are essentially provided with a particular state of mind, as to how to feel and think, as well as the means to both comprehend and interpret a narrative or create one of their own. In relation to the initial problem statement however, this means that in ES color functions as a cue to provide and supplement emotional incitements.

3.4 EMERGENT NARRATIVE

Emergent narrative (EN) is a form of narrative that is created through the interactions of an individual that is not pre-authored. It is the notion of an emerging story as the consequence of the interaction of an interactor within an interactive medium that is unique to the individual at that particular time. However, studies within this subject will be explored to gain further understanding on the matter.

In the context of video games, EN is closely tied to the actions of a player within the game-world which generates a character-based narrative relative to the experience offered by the game, which is independent of a pre-authored narrative. (Jenkins, 2003) confirms this by stating that EN is not pre-structured or pre-programmed, but rather takes shape through gameplay. He also points out that game environments implementing this form of narrative are designed to be rich with narrative potential, essentially allowing the players to construct their own story. Which in a sense denote ES as a foundation for which the player can become subject to an EN.

More so (Louchart, Swartjes, Kriegel, & Aylett, 2008) state that EN as a form of narrative can only take place if the interactor is actively participating and has been given the means to participate relatively freely within the narrative environment. Suggesting that non-linear approaches to be more ideal, in addition to the need for some form(s) of interaction as well as player incentive as a precondition for an EN.

Additionally based on (Louchart et al., 2008) explanation, (Schoenau-Fog, Bruni, Khalil, & Faizi, 2013) describe that EN is character-centered, where story emerges from the role played by the interactor. It is highlighted that EN as a form of narrative is often applied through the use of AI, rule-based interactions, and intelligent agents and the interaction with them in relation to none-playing characters (NPCs).

In summary, these studies indicate that an EN only emerges from interaction by a participating individual. Additionally, contrary to traditional forms of narrative that employ some extent of authorial intent – conveyance and expression of an author's ideas or interpretation of that idea – video games utilizing EN allow the player to create

a story centered around their own ideas and interactions based on their gameplay and experience within the game-world. As such EN is very powerful, engrossing, deeply personal, and unique to each player and playing session. Consequently, the narrative experienced only ever has meaning to the individual(s) experiencing it at that time. This also implies that an EN may not be controllable and heavily relies on the player and the player only, provided the resources are present. However, this issue may be circumvented through a linear approach to limit unique experiences and outcomes without appearing so while also allowing for an EN.

3.5 EXAMPLES FROM GAMES

Relative to the initial problem statement, this section will take a look at the overall use and effect of a color's hue, saturation, and brightness in environmental storytelling to establish an atmosphere and evoke certain feelings and emotions in a number of video games. However, as it is the norm to utilize a mixture of various forms of cues to emphasize a certain mood or feeling (e.g. ambient sounds, music, and etc.) the visual cues will primarily be taken into account.

3.5.1 Bioshock Infinite

Released in March 26, 2013, Bioshock Infinite is a first-person shooter video game by (Irrational Games, 2013). The majority of the game takes place in the fictional floating city of Columbia in 1912.

The game has a very detail rich environments which help in setting the mood and also tell a story. If thoroughly explored, the environment paints a bigger pictures and provides much information to the player, which is further complimented and emphasized through the color palette and lighting.

As the game progresses and the story is slowly revealed to the player, the game shifts its tone and mood in accordance to the narrative, which is visually noticeable. Whether the player finds him or herself in the vibrant and colorful city streets of Columbia that evoke the success and pride of its citizens (Figure 13), or in the dark and unnerving bars and alleyways in the residential area of Shantytown that portray the hardship and

despair of its residents (Figure 14), the player is always affected on a multisensory level that helps in driving the narrative further.

Figure 13 Players first introduction to the vibrant and colorful floating city of Columbia.

Figure 14 Players introduction to the cold and gloomy bars and residential areas of Shantytown.

Bioshock Infinite's attempts of creating environments that evoke certain emotions and setting a distinct mood through their color palette, environmental storytelling and narrative is very evident. All throughout the levels the player is met with multisensory

cues and elements that provide the player with the means to fill in the blanks of the narrative or to speculate and create one of their own.

Figure 15 Use of cold, dark and low saturated colors to make the player uneasy.

Figure 16 Use of warm, bright and saturated colors to make the player excited.

In summary, the color palette supplements the narrative by contextually amplifying what is being narrated, this is apparent through the deliberate use of saturation and brightness which make the player uneasy through cold and dark (Figure 15), and excites the player through warm and vibrant colors (Figure 16). In addition to that, the ES in Bioshock Infinite significantly impacts how the narrative is both experienced and felt emotionally.

3.5.2 World of Warcraft

World of Warcraft is a massively multiplayer online roleplaying game (MMORPG) developed by (Blizzard Entertaintment, 2004). The majority of the game takes place on the fictional planet of Azeroth, where the player essentially takes on the role of a novice hero or heroine on a quest to overcome many obstacles in their path to glory.

The game has an overwhelming multitude of diverse zones that incorporate distinct environments with a complementary atmosphere, and a narrative experience(s) that is supported all throughout the zone.

Figure 17 Regency era inspired, cold, gloomy, and rainy streets of Gilneas convey negative emotions.

For example, the Regency era inspired dark and gloomy streets of Gilneas, set an ominous and discomforting tone. The cold and dark colors, in addition to the aesthetics of the environment, create a feeling of danger looming at every turn which is further emphasized through narrative and player interaction (Figure 17). Although the narrative (i.e. the narrated story) in of itself can be interpreted as such, the environment and the visual componants of lighting and colors has a deep influence which is further supported by the musical score.

Figure 18 Lush rainforests, stone spires and imposing temples of the Jade Forest convey positive emotions.

The lush forests and stone peaks of Jade Forest on the other hand, is heavily inspired by Chinese geography and culture. This is emphasized by the imposing vistas and the environments vibrant colors that essentially evoke a calm and comforting atmosphere (Figure 18). The indigenous inhabitants of the zone, architecture as well as the environment wholly support this mood and sense of Zen, despite the central narrative experience revolving around the conflict between two factions and the dominance of the newfound territory.

Figure 19 Comparison of development in and impact on atmosphere through color and environmental storytelling.

However, the zones in world of Warcraft tend to be dynamic and occasionally throughout a zone or even in relation to story progression, the setting changes its tone and atmosphere to accommodate a certain mood (Figure 19). With these changes the player is visually exposed and compelled to experience certain feelings and emotions.

The use of color's all three dimensions in synergy with the ES provide the mindset and means for the player to interpret the narrative experience and possibly comprehend it in full.

Similar to Bioshock Infinite, World of Warcraft greatly utilizes color as one of its toolsets to evoke certain emotions and set a specific mood that is apparent in their environments. This notion is also very supplimentory to the environmental storytelling and the narrative experience. However it is quite interesting that even without the narrative experience – which in this case is specifically referring to the narrated story – each location does give a distinct impression and tells a unique story on its own simply through the details of the environment and the colors associated, which create an atmosphere and set a mood that delivers on each zones fantasy.

What there is to take from these examples are that video games in their essence try to influece our senses on a multisensory level, meaning that many diverse toolsets (e.g music, ambient sounds, lighting) are used in connection to form a desired impression. Another noteworthy take is that more often that not the same environment is reused under different circumstances (lighting, color palette etc.) relative to the narrative progression (Figure 19). This means that the same environment or scenery, albeit altered to accommodate for the narrative, can at times feel very different in how they are seen and experienced. In bioshock infinite the vibrant and colorful streets become gloomy and dark further into the story giving another impression and highlighting the change in story. The same goes with world of warcraft, where the same zone can undergo changes as the player progresses in the storyline to portray their influence on the environment.

3.6 CONCLUSION

Based on section [3.2], it was established that color-emotion association relative to hue as a property of color is a plausible notion. Though it was further argued that the emotional association with a specific hue is effected by a number of factors, such as saturation, brightness, context, culture, and even personal preference. More so it was emphasized that to achieve a prominent outcome, all three properties of color – hue, brightness, and saturation – should be taken into consideration. In this context (Jalil et al., 2012; Joosten et al., 2010; Tulleken & Bailey, 2015) provide insight for using color in video games, in addition to framework and method of testing.

Moreover, section [3.3] defined environmental storytelling as a method of spatially conveying factual and emotional context to the player, in addition to being a means for comprehending and interpreting a narrative. Additionally, the prominence of environmental storytelling as a prerequisite for emergent narrative was argued, which should be set in focus. More so for the purpose of implementation the method(s) for arousing an emergent narrative, encouraging involvement, and creating a specific state of mind, presented in (Carson, 2000; Jongeneel, 2013) should be taken into consideration.

Furthermore, in section [3.4], emergent narrative was argued to be the product of the interactions of a participating individual, and a powerful and engrossing form of narrative that is deeply personal and unique. It was also debated that influencing emergent narrative through the use of color may be problematic, subjective, inadequate, and perhaps even arbitrary as the experience would always be unique to each individual. However, (Schoenau-Fog, 2015) provides a potential solution for this problem through a linear approach by fixating the order of events that the player(s) can experience, which should be investigated.

As the aim is to influence players' interpretation of narrative content by influencing them emotionally, the given game examples in section [3.5] could be used as inspiration and a point of reference for achieving an adequate outcome. More so, the concept of creating an atmospheric environment and color grading should be investigated.

Chapter 4

LITERATURE REVIEW

4.1 INTRODUCTION

In this chapter further investigation based on literature on atmosphere, color and emotions in video games will be conducted. Additionally, various methods and techniques of environmental storytelling relative to emergent narrative will be looked into. Finally, a simple experiment to determine the impact of a cold and a warm color grading setup will be presented.

4.2 COLORS, ATMOSPHERE, AND EMOTIONS

Affecting emotions through subtle stimulants that impact behavior and instantiate a specific mindset is often utilized through colors in environments (Jalil et al., 2012). This notion is also commonly utilized in games to set a specific emotional tone that is associated with perceived colors (Joosten et al., 2010). However games that have emotional impact tend to have a strong atmosphere, and this is in essence what gives a video game character and makes them memorable (Kasavin, 2012). As such this section will provide an overview of methods and requirements for evaluating and implementing an atmosphere with a dominant mood.

4.2.1 Colors and Emotions in Videogames

When emotions and related sensations are incorporated into video games, it is important to measure the impact and outcome of the employed stimulants on the participants. The approach and method(s) for this purpose, used in (Joosten et al., 2010) relating to influencing player emotions using colors, will thus be further investigated.

The aim

Grounded on prior research describing emotions in videogames as the main incentive for play, the study investigated the notion of evoking specific emotions relative to

certain associated colors based on the color-emotion association framework created by (Plutchik, 2001). The study attempted to outline the relationship between perceiving specific colors and emotions experienced in terms of valence (i.e. the intrinsic positivity or negativity to an event, object or situation) and arousal (i.e. the state of being proactive or reactive to stimuli, both physiologically and psychologically).

Limitations

In the framework of their research, Joosten et al. argued that the researched and recognized effect(s) of color on emotions are generally limited to a few colors. Thus only four colors were utilized in their study, each supposedly corresponding to a different basic emotion. Additionally, the colors were implemented in the form of colored ambient light in the video game environment, essentially manipulating the background color.

More so, Joosten et al. also stated that the research on the effect of colors on emotions in video games generally is very limited as the use of colors to influence emotions is viewed to be outside the scope of research.

Experimental setup

For the purpose of testing and analysis, two methods were used in this study to measure the extent of which colors influenced emotions. The first method employed a Self-Assessment Manikin (SAM) for collecting emotional responses in terms of valence, arousal, and dominance. As such this method was used after each stage where the participants were exposed to a color to get an indication for the player's current emotional state. The second method used was simply a questionnaire asking the participants about the overall experience with the prototype.

Shortcomings

In relation to the experiment conducted as well as the discussion segment, there are several shortcomings that should have been addressed for further work and iterations. First and foremost, the color-emotion association based on Plutchik's framework is not contextually appropriate. Meaning that the context of which Plutchik setup the

association was simply through color perception and the consequential emotional sensation, whereas the use of color in the context of the videogame used is supplementary and perhaps even subtle in comparison to other stimulus involved. Secondly, due to the nature of video games the performance of the player in relation to the goals, challenges, and rewards provided, the player may also be influenced emotionally by them, which should essentially have been taken into consideration in terms of intensity. Lastly, it is important to note that the choice to implement colors by illuminating the background with colored ambient light may have been an incorrect approach. Where color grading as a method for example could have provided a better outcome.

Based on this study, the following requirements have been deemed relevant for use and should thus be considered for implementation;

1. **Prolonged playtime for stimulant(s) to cause an effect**

The duration of the experiment or the play session appears to be significant as the emotional stimulant may take time register and to even influence the player. Additionally, once the player is influenced, the effect may take time to manifest.

2. **Balanced gameplay experience that is not distracting**

For the purpose of testing, the content of the game should be designed in a manner that is not emotionally overwhelming or perhaps even distracting; it should also not be genre specific and feasibly as neutral as possible. This is so the player does not get preoccupied with other matters in such a degree that the stimulant does not register or influence due to this interference. In contrast, the stimulant should not be too subtle or too blatant in implementation.

3. **Non-intrusive evaluation method through SAM**

The SAM method could prove to be a suitable for measuring the player's emotional state after being exposed to the stimulant, especially in terms of arousal and valence. This is to indicate a general impression for the player's emotional standing based on their experience. As such, this subjective evaluation method should be used in collaboration

with a questionnaire to indicate possible correlations between player's arousal and valence values and their narrative interpretation of their experience.

4.2.2 Environmental Color Impact on human behavior

To gain further insight into the effects of environment's color and methods of evaluation, the extensive review by (Jalil et al., 2012) of 40 previous color studies rooted in a number of disciplines was explored. In their review, Jalil et al. analyze the methods and findings on how environmental color influences and subsequently impacts behavior. More so potential scientific approaches for measuring possible influence on behavior is highlighted. As such these findings and methods are of importance in order to gain a better overview for subsequent testing and experimentations.

Findings

In terms of the nature of color, Jalil et al. state that especially in interior design, color essentially gives an environment character in a visibly dominant manner. More so they state that color is a subtle stimulant that impacts decision making and behavior amongst other things. More so they describe that color is commonly divided into cold and warm colors where they each have a different effect on individuals.

Another prominent finding in their review is time is a factor in causing and indicating influence on individuals. Meaning that the duration of which individuals are exposed to color plays a significant role as both the influence and the potential impact depend on the duration of the experiment. In other words, it takes time for an individual to be influenced by the stimulant, and the influence takes time to manifest and display any change in behavior.

Additionally, based on their analysis, Jalil et al. confirm that there are essentially very few hues that have been subject to color studies. On the other hand, there is an abundant quantity of documentation on the effects of red and blue as warm and cold colors respectively. In the same context, they discuss that individuals respond differently to colors based on their cultural background. In addition to that, the brightness of colors can contribute positively relative to the individual's preference.

More importantly they indicate that based on the reviewed studies there is an inconsistency on color's effect, where studies may at times contradict each other in their conclusions. Meaning that a given hue can in one study be associated with positive effects, whereas in another study may have negative associated effects. However, these inconsistencies and contradictory findings could very well relate to the context of which the hue is perceived, in addition to the perceiver's preference of color.

Suggestions and recommendations

Grounded on their comprehensive review of many color studies, Jalil et al. highlight significant factors that should be considered for further investigation within studies related to effects of color. Although Jalil et al. link these attributes mainly in having significant effect for colored environments on impacting learning and wellbeing, this notion can by extension be applied to video games as game environments in their nature can be considered as learning environments. As such the following factors relate to the problem statement;

1. **Prolonged duration of experiment**

Similar to the requirements defined for the previous literature [4.2.1], the duration of the experiment plays a significant role. This is essentially emphasizing the notion that the stimulant takes time to cause an effect and as such should be taken into consideration.

2. **Emotional assessment**

Assessment of emotions or rather mood-states variation relative to the experience is vital. As such, one of the emotional assessments highlighted in the review prove to be relevant in this context. The Positive and Negative Affect Schedule (PANAS) is a measure of affect obtained through self-report by the participants. However, the short form of this method (I-PANAS-SF) could be considered. This is especially due to it being more suited for general uses with limited time and when dealing with individuals who are not natively English-speaking.

4.2.3 Atmosphere in Video Games

During the Game Developers Conference 2012, Greg Kasavin held a talk on creating atmosphere in games, where he described this notion as a means for video games to make players feel a certain way or take on a specific mindset, in addition to being a means for emotional investment in video games (Kasavin, 2012). This is especially relevant as the problem statement inclines towards building an atmospheric environment that may impact the emotional tone and overall mood. As such, this concept will be examined further to gain a better insight.

What is it

Atmosphere is defined by Kasavin as a hidden layer that unifies the aesthetic qualities of a game that makes players feel a certain way. The tone for an experience can thus be established through it and the player can get a feeling for what they may be getting involved with, in addition to creating an impression in the player's mind. He also goes further to state that a video game's atmosphere helps immersion and that it triggers the player's imagination, where they go on to fill in the blanks and the spaces that are essentially missing or not presented. More so in relation to immersion he states that;

> *"When we say atmosphere enhances immersion, it raises the question of what makes for an immersive experience to begin with. I think it's fair to say that a game has immersion when it causes you to suspend your disbelief; "ok I'm in the world of the game, got it", and then it doesn't do anything to break that sensation and keeps on going. So if immersion is this delicate state that can be achieved, atmosphere is what helps to sustain it indefinitely."* (Kasavin, 2012)

Why it matters

However, in relation to atmosphere's significance and role in video games, Kasavin states that it is a great way to create an incentive for the player to play through the game as well as leaving a lasting impression on them. More so, he goes on to say that atmosphere matters when the intention is to grab the attention of the player and

introduce them into the game quickly. Furthermore, he also states that atmosphere creates investment and amplifies an emotional experience that may affect the player heavily and in a sense give them the impression that the game is greater than what it may be in actuality. However, on the other hand, he states that this notion is not so easily achieved and may not necessarily correlate with visual quality.

How to implement it

Kasavin provides a general guideline for directing the design of a video game to incorporate a strong and rich atmosphere. Although much of this falls to the intended tone and theme of the video game, the following contribute towards creating an atmosphere which should be considered;

1. **Integrating an emotionally intense experience**

Building a strong atmosphere with a dominant emotional tone, often incorporates an emotionally powerful experience which can sets the general direction and give an impression for the overall experience. However, in the context of prototyping, the experience should be designed to be ambiguous so that it may be interpreted either negatively or positively by the participants, given the circumstances which in this case will be either a positively or negatively associated emotional tone incorporated in the atmosphere.

2. **Unity in the emotional experience**

This means that relative to the aim of the experience and its associated dominant emotional tone, this tone should be supported throughout the whole experience. Not only that, but every aspect of the game should support it by not deviating from that emotional tone.

3. **Creating a sense of consistency and being part of a whole world**

Consistency is very significant in that it helps sustaining the player's suspension of disbelief and by extension not breaking their immersion. This means the prototype should have all of its aspect come together as a whole and as such be consistent.

4. **What breaks immersion, weakens atmosphere**

Anything that may distract or disengage the player from their experience both in the game-world and during the experiment should be controlled. To be more specific, the general approach should be non-intrusive for experimenting, and the prototype should engross the player into the experience to avoid breaking player immersion and thus maintain the atmosphere established.

5. **Supporting and giving context to the player's actions or the lack thereof**

This is very much linked with the previous three requirements as this helps in extending and sustaining the suspension of disbelief. By providing context and reasoning as to why certain aspects of the prototype might function in a certain way or do not, missing or even out of place, the player may justify and accept this relative to the context provided to them.

6. **Details in the environment heavily impact the mood**

Details in video games generally intrigue players and create moments where they may take interest. More so, details such as lighting, weather, and props which support the emotional tone of the environment heavily contribute towards establishing a strong atmosphere. As such details in the environment add towards the atmosphere and by extension also support both environmental storytelling and even encourage emergent narrative.

Since incorporating atmosphere or rather creating an experience that is atmospheric can be a grand task that requires unity in many aspects of a game, in addition to numerous iterations, a simpler approach for this project should be considered by including the above mentioned in a smaller scale.

4.2.4 Color Grading

As briefly mentioned in the Investigation chapter, color grading is a method of altering or enhancing the color of video or still images to increase or decrease the overall tone and emotion (Tulleken & Bailey, 2015). However, it is in order to get a better understanding of the concept of color grading by clarifying the term relative to the problem statement.

What is it?

Initially it is important to realize that the term color grading is often used interchangeably with color correction. While both terms relate to altering colors, their differences lie in the approach and the goal. Based on (Van Hurkman, 2011), color correction can be understood as;

> *"…a process that is more technical in nature, of making adjustments to correct clear qualitative problems in an image, bringing it to a fairly neutral state."*

This essentially means that color correction is used to tweak, adjust and clean each frame in terms of exposure, contrast, light and color balance, or only to adjust specific colors of to fit the preferred conditions (Figure 20).

Figure 20 Original frame (left) and color corrected frame (right).

Color grading on the other hand, Van Hurkman describes color grading as;

> *"…a more intensive process of developing an appropriate overall style for the image, relative to the narrative and artistic needs of a program."*

This essentially means that color grading is atmospheric in that a color overlay that suits a specific tone or theme is applied to the frame(s). This is mostly prominent in fictional movies that may aim at a specific tone that is tied to the narrative and overall emotional tone and atmosphere (Figure 21). This technique has progressively been adopted in video games as well to alter, amplify and enhance the overall look, or in other words to set a theme and rework the visual atmosphere.

Figure 21 Original frame (left) color graded frame (right) from the movie Domino (2005).

Why it matters

In the context of the problem statement, color grading matters as it is a viable tool to modify and achieve a specific tone. Although the atmosphere of a game was argued to be significant in establishing the perception of an intended emotional tone and set the mood, color grading can be argued as a feasible method of visually supporting and even altering that notion. Moreover, since the implementation of atmosphere may be a grand task to achieve and master, the concept of color grading may be useful in this framework to easily adjust and stimulate the overall feelings or emotional tone experienced.

How to Color grade

The general method of color grading is typically through manually tweaking and adjusting an array of various values in a video editing software to achieve a desired look and tone for intended footage. However, as an alternative of individually adjusting various values, the same result can be achieved through utilizing Lookup Tables (LUT).

As such, in order to color grade, the LUT 2D texture is utilized (Figure 22), where for instance a still image of the game scene is used. The texture is then applied as an overlay on the still image and imported in a image editing software where the still image can be tweaked to have the desired look. Finally, after the desired changes are applied, the 2D texture is saved as a costum LUT (Figure 23), which can then be used as a reference point to dynamically alter the whole visual tone and look of the game (Unity Technologies, 2013). Furthermore, this process can also be further simplified by using premade LUT's that are designed to implement a specific tone and feel.

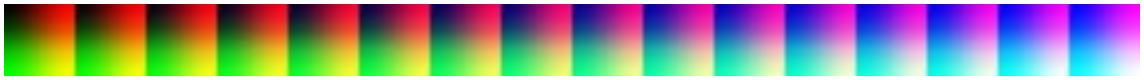


Figure 22 unaltered LUT texture.

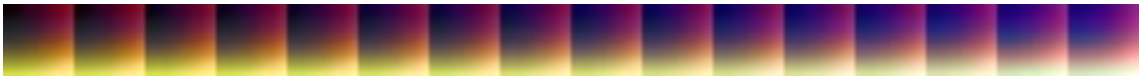


Figure 23 altered LUT texture.

Considerations

To conclude with, based on the previously mentioned the following should be considered relative to the implementation of the prototype:

1. **Color grading as a means of adjusting the atmosphere**

For the purpose of testing, this method should be highly considered as implementing atmosphere in of itself can be problematic and out of scope due to lack of resources. As such color grading should be used to visually alter the look and tone of the original implementation to appear atmospheric.

2. **Color grading through lookup tables and game engines**

Relative to the use of color grading in the video game industry, many game engines do in fact support and utilize a color grading component that utilizes LUTs, that allows for fast and easy implementation. As such the choice of game engine for the purpose of implementation is not limited and should be based on accessibility and experience.

4.3 ENVIRONMENTAL STORYTELLING, EMOTIONS, AND EMERGENT NARRATIVE

Video games commonly utilize the game's space to convey a wide range of information to players. This includes setting up emotional associations specific to a narrative or environment which can be open for player interpretation amongst other things. By extension, it also serves as a means for players to construct an emergent narrative. Thus the following will provide an overview of methods and techniques that should be considered for implementation.

4.3.1 Environmental storytelling: Creating Immersive 3D Worlds

Don Carson is a central figure within the discipline of environmental storytelling due to his previous experience as a theme park designer. As a part of his craft, he sets up a form of guideline and framework for how an environment should be designed to tell a story, whilst keeping them immersed and entertained.

Environmental storytelling

As the term suggests, this notion relates to telling a story through the environment. Carson emphasizes this by stating that;

> "One of the trade secrets behind the design of entertaining themed environments is that the story elements is infused into the physical space a guest walks or rides through"(Carson, 2000).

Meaning that while the individual is experiencing the world or physical space, that space is essentially conveying the story, especially in how the details of the environment such as color, lighting and textures can impact them emotionally. Additionally, Carson states that much of this notion revolves around influencing and taking advantage of the expectations and previous experiences of the audience.

Importance of Story in environmental storytelling

The significance of a "story" in environmental storytelling, as stated by Carson, should not be understood as a linear narrative being conveyed, but rather as the details in the environment that form a bigger picture. In a sense, what Carson describes here is very reminiscent of atmosphere in games, as it is essentially a means to make the game-world

be seamless and coherent. Consistency is the point of emphasis here, as the core notion is to essentially through the "story" create an immersive experience where a set of rules are defined and players can thus suspend their disbelief, and that this notion is not broken throughout the experience.

Conveyance of information

Another interesting concept which Carson touches on is essentially the conveyance of information to players. As such he states that regardless of how elaborate or exquisite the game may be, the utmost important task is to provide the answer to the players first question, which will always be "Where am I?", followed by "What is my relationship to this place?". Basically providing context to the player in which they can immerse themselves in the game. This can be done through clues left throughout the environment, assisted by the player's self-identity and self-discovery. The latter two being centered on player incentive to learn through their experience. Specifically, this notion is commonly utilized through having story elements scattered throughout in which further inspection by the player can lead to revelation or interpretation of the narrative.

Methods of Environmental Storytelling

In context to storytelling through a game environment, Carson also introduces a few methods for which this can be achieved. Cause and effect is an example of this, where specific areas in the game can give the player suggestions and clues that are open for interpretation as to what has taken place. An example of this could very well be a trail of blood or shattered glass that do not explicitly tell the player what has happened but what may have. This is particularly relatable to emergent narrative as this method does not spell out the narrative, but allows for player centric interpretation and thus emergent narrative.

Another method is in designing the familiar, which essentially revolves around designing the environment and its components to be comprehendible and relate to familiar

counterparts. Carson describes this method as giving players reference points in which they can relate to or get a perspective on the situation.

Simplicity is another point of emphasis as a method, where he states that visual complexity should be used lightly and placement of items and props should be done with intention and afterthought. In the same context, he mentions that lighting should also be taken into consideration as a means of drawing attention and used with care relative to the intended mood. Also, players should not be confused by having too many choices at a given moment.

Lastly contrasting elements is another method which is stated to help in guiding and in a sense encouraging exploration in the environment. Meaning that for instance having small confined spaces before grand spacious areas or vice versa help in creating a more exciting and dramatic environment.

The Ideal Features

To conclude, based on Carson's guidelines, the following features for implementing environmental storytelling should be considered;

1. **Infusing narrative elements in the environment**

This is very self-explanatory as a requirement to have narrative elements and cues imbedded into the environment in order to "tell" a story, in addition to leave space for interpretation. As such for the purpose of prototyping the environment should have narrative elements and cues that can be interpreted.

2. **Consistent and coherent game-world**

Very reminiscent of the requirement made in the previous section [4.2.3] on atmosphere, consistency is a significant constant that helps fostering immersion and overall avoid breaking it.

3. **Proper conveyance of context through environment**

Similar to the requirement for atmosphere, the player needs to be informed about the world they find themselves in and its governing rules. Therefore, it is vital to properly introduce and inform them in order to avoid causing confusion and otherwise that may negatively impact their experience.

4. **"Cause and effect" events to evoke an emergent narrative**

Through this notion, players may be able to interpret and construct an emergent narrative. Also, this can support the implementation of "emotionally intense experience" requirement set in previous section [4.2.3] on atmosphere.

5. **Simple and familiar environment to avoid confusion**

To avoid overwhelming players visually it is important to cater towards a simpler design of the environment. More so what the players perceive and experience should be familiar and by extension function as a point of reference so that they are not alienated and confused in the process.

6. **Exciting and entertaining environment that encourages exploration**

This is a very significant point as the experiment requires players to play, thus the prototype should be encouraging them to "stay". Meaning that the prototype should be appealing and have content that motivates players to explore and experience the game-world. This is especially so that players can in fact experience, interpret, and be influenced, in addition to indicating the affect.

4.3.2 Environmental Storytelling

In Jethro Jongeneel's article on Environmental Storytelling (ES), he provides an extensive assortment of various ES methods and general guidelines for practical uses and their effect for various purposes in video games. As such these methods will be investigated further in relation to the problem statement.

ES as a narrative approach

One of the main points of emphasis in Jongeneel's article is that ES relies much on the player's interpretation. Meaning that pieces of information in the form of environmental elements or clues scattered throughout the game-world can be registered and consequently interpreted by them to form a whole, which is directly relatable to the concept of Emergent Narrative (EN). However, he also states that the application of ES is numerous depending on the approach, and as such states that;

> *"ES is built around explaining anything from 'character relations' to 'history of a specific area' by presenting environmental clues which the player can string together to create their own image of the situation. This means that ES is completely subjective and depends largely on what the player already knows in this or comparable (game) worlds."* (Jongeneel, 2013)

However, in relation to this, there are two concern stressed by Jongeneel that may arise relative to ES. One being that players may be oblivious to their surroundings and essentially oversee potential environmental elements and clues. And the other being comparative to EN as the interpretation of said environmental clues may be wholly unique to each individual player.

Subtle yet noticeable

Relative to the issue of important environmental clues that may be overseen, Jongeneel states that;

> *"As ES is part of the game-world itself and the player is able to traverse the world at his or her own pace, the issue of the player walking past a*

> *clue without giving it another glance will always be present. Some players actively scour the area for clues, but others have the opinion that if something does not move it is of no importance."*

As such, he also highlights that there may be many ways of solving this issue, one of which being repetition of clues as to give the player more than one opportunity to encounter it. More so the repetitions in themselves don not have to be identical, as long as they support an overarching narrative.

Interpretation of Environmental clues

Interpretation and meaning is a consequence of partaking in a given medium as highlighted by Jongeneel. Whatever may be intended in terms of meaning can and will be interpreted differently based on an individual's experience. More so he states that;

> *"Something we run into as soon as we start thinking of ES is that it has different meanings for different people. This is inevitable because, as a form of indexical storytelling, a large part of ES happens in the mind of the player."*

This is basically directly linked to the study of (Fernández-vara, 2011), where the culmination of indices (various audiovisual clues in the environment) tell a story based on their interpretation. However, similar to the issues that may arise with EN due to each experience becoming unique as a consequence of individuals, this can be countered.

Through ES it is possible to influence the mindset of the players and by extension their interpretation of environmental clues. This is essentially done through conditioning players, presumably in advance, as to stimulate the proper mindset for interpretation.

Preparing and creating a state of mind

By utilizing ES players can be taught about the game-world and the governing rules and reality in which it exists. As Jongeneel describes it, through concept of conditioning the players can be set in the appropriate state of mind to understand something as

intended. This notion relies and draws on the individual's real world connections and experiences. For instance, as an example he states that;

> *"Player conditioning is a tool that makes sure players are no longer blank slates by preparing the player before they encounter certain environments."*

This means that when implementing ES, by conditioning the player, they will take on a certain mindset. As an example, Jongeneel describes how for instance every human being knows the connection, meaning and interpretation of a pool of blood, simply because we have been conditioned to know the connection and meaning and interpret it accordingly. In relation to video games this is evident where players know the meaning and interpretation of for instance, spikes, lasers and other deadly hazards without explanation. Additionally, he states that conditioning should be utilized similar to how tutorial levels teach players about mechanics. In that they should witness and shown the possibilities and connection(s) in order to be conditioned, and then confronted with the actual set-up where they interpret and find meaning.

Influencing emotions and affecting mood

As stated by Jongeneel, a game's setting can greatly influence the player's mood, which is evident in a number of video games. However to create an atmosphere and consequently influence the mood, many aspects of the game need to work in unison, which is very reminiscent and relatable to (Kasavin, 2012). He goes on to state that;

> *"Subconsciously the emotions and feelings of the player are greatly influenced by the atmosphere of a game and by carefully manipulating the atmosphere a designer can incite a state of mind in the player."*

Although atmosphere in of itself is the culmination of many aspects (lighting, color, sound, and etc.) of the game functioning together to achieve an overarching emotional tone, the environment can greatly influence on how the player feels if carefully designed, is it may also break the sensation.

Additionally, Jongeneel states that when designing an atmosphere, it is vital to choose and implement the right elements for the intended mood. Similar to conditioning a player, many elements have a universal meaning and can be interpreted generally in the same way. However, he also mentioned that there can be elements that can drastically different in terms of interpretation based on personal experiences among other things. For instance, he gives the example of having a cradle, which is universally connected with a child, however there may be different associations as an individual to trigger a sad emotion due to having lost a child, instead of an intended happy emotion that might have been the aim. Although subjectivity plays a role in interpretation and how elements and clues may trigger and influence certain emotions, Jongeneel describes that this may be countered through conditioning. Meaning that by conditioning the player to take a certain mindset and given context to, the subjective aspect may subside and as such give emphasis to the intended meaning and interpretation.

The Ideal Approaches

To summarize, there are many applications of ES in video games and as such many methods to achieve them. Relative to the problem statement however, the following requirements and methods that should be highly considered for implementation;

1. **Environmental clues to encourage EN**

Relatable to the problem statement, environmental clues are needed to hint at a possible narrative which can be subject to interpretation. Although interpretation can take place with the absence of clues, it is essentially to control the outline for interpretation as to be contained within the game's world. Meaning that to avoid abstract and outlandish interpretations, environmental clues can limit the interpretation locally.

2. **Repeated and Noticeable clues**

As highlighted, depending on the player type and play style, environmental clues and the potential storytelling can be overseen. As such, elements that are vital for this purpose should be easily noticeable as to not be overseen, and if possible repeated. This

is to avoid a linear approach in addition to not only emphasize but also to give additional chances to encounter the element/clue that might have otherwise been overseen.

3. **Conditioning the player's mindsets**

To counter the issue of having widely unique and individual interpretation of meaning of the content, the players should be conditioned to take on a certain mindset. This means that the environment and its elements should be designed in a manner that psychologically prepares players for what they are about to see and experience.

4. **Building an atmosphere**

Although not a simple task and heavily reliant on unity of various assets in every aspect of the prototype for the aim of a singular intended tone, this notion should be considered through a simpler approach. More so, for the purpose of building an atmosphere the visual design of the world and the details seen (e.g. color palette, assets and props etc.) within should be paid close attention to. More so this should be considered in relation to having an immersive experience.

4.3.3 Adaptive Storyworlds

Previously it was debated that influencing emergent narrative (EN) could be problematic due to its subjective nature, as the experience would always be unique to each individual based on their interactions and journey within the game-world. In this context (Schoenau-Fog, 2015) provides a potential solution for the problem through a linear approach that utilizes the space-time continuum.

The aim

Schoenau-Fog describes that supporting a free roaming open story-world while maintaining some form of order for events being presented to mediate a narrative can be a challenge. In this context he states that;

> *"…stories conventionally are authored and experienced as linear chronological structures while interactivity gives users the agency and possibilities to perform various actions in a non-linear and unpredictable fashion."*

In particular, he touches on the concept of the Narrative Paradox which consist of contradicting conditions of user freedom and author controlled content. He also states that there has been attempts at solving this problem through various means of which EN and ES can be mentioned. As such he proposes a framework for a potential solution which utilizes the concept of space-time in order to avoid this issue.

Potential approach and framework

The main concern in question can be boiled down to two main problems; one being content that is overseen (lost event or bad timing) by players leading to a disconnect in narrative and thus confusion, and the second being the (wrong) order of which content is experienced in a free roaming experience as player navigation and interaction is unpredictable, which may result in players having unique experiences.

In relation to this, Schoenau-Fog introduces the Space-Time Interactive Narrative framework (SPATIN), which revolves around organizing event in an open story-world. The framework consists of;

1. **Event capsules**

These function as placeholders for event types and their associated assets required to create a certain event in the story-world. The events can in this context be created based on four categories. (a) Locked in time but not space, (b) locked in space but not time, (c) locked in time and space, (d) neither locked in space or time. This essentially allows for flexibly generating events based on player position in space, time or both.

2. **Temporal order of events**

Although events do not necessarily have to be ordered in space or time, as described by Schoenau-Fog, they have the possibility to. The order of events however may be authored and be experienced by users in a number of ways. Some of these event orders include; (a) Casual ordered events, where the cause-effect of an event is evident and/or experienced before an actual involvement with the event, (b) Random ordered events, no logical order or pattern where players can experience events randomly and subsequently construct an EN, (c) Synchronous ordered events, linked to player's actions

and involvement that trigger events, (d) A-synchronous ordered events, manifest based on player action on a long term action-consequence basis.

3. **Space-Time Drama Manager (STDM)**

The STDM is responsible for organizing events based on several variables such as; Number of events, Encountered/triggered events, and potential events to be encountered based on order type, which is used to manage and trigger event in the story-world. Essentially the STDM runs a checklist on these parameters given by the author in order to manage and implement events.

4. **Interaction Manager**

As there is may be means of interaction, the Interaction Manager is in charge of the possible interactions in time and space. Since the player can have the means to interact within the world, they do therefore alter their position both in time and space and as such this should be managed in relation to events. However, these interactions can be simply limited to encountering aforementioned events.

Applications

Previously it was argued that influencing EN could potentially be very subjective and arbitrary due to the personal and unique experiences of players as a direct consequence of having a free roaming game-world. However, based on Schoenau-Fog's framework, some form of control may be attained as to limit the unique experiences and constraint the player constructed EN to the authored events. Thus the following features should be considered for implementation;

1. **Environmental Storytelling and Emergent Narrative**

Core to the problem statement, this is essentially what should be utilized in the implementation where players may construct EN based on their experience in the environment and consequently the EN.

2. **Management and Order of events**

Similar to the points made in the previous section [4.3.2], narrative and environmental clues and elements should not be missed or overseen. Thus the SPATIN framework

should at least be utilized in some of its components to ensure the intended events are experience while maintaining a consistent experience for all players.

3. Engagement within story-world

As a major concern, player incitement is necessary for an EN to be constructed. Thus players should feel encouraged to engage the world and immerse themselves in the experience. This is however not a simple task, but this could be utilized through interaction in the world, exploration, and narrative elements that engage the players in the story-world.

4.3.4 Emotions, Feelings, and Mood

While often used interchangeably, emotion(s), feeling(s) and mood are different in their own sense. More so since emotion, mood, and feeling are interrelated, the distinction may be unclear. As such these terms will be clarified relative to the context of the problem statement.

Definition and context

Emotion is commonly defined as a biological and conscious mental reaction and/or interpretation towards specific triggers that is experienced internally which cause physiological and behavioral changes as a consequence (Matsumoto, 2009; Schachter & Singer, 1962). Meaning that emotions are associated with an individual's mind-set, which can be expressed and measured (e.g. facial expression, body language, galvanic skin response, brain EEG patterns etc.).

Feelings however are related to both physical and emotional experiences that are often the result of external as well as internal stimulants triggered by the senses (Matsumoto, 2009). This means that a feeling can for example be triggered by physical sensations such as hunger and thirst or through the integration of an emotion such as feeling sad or happy etc.

Mood on the other hand can be defined as conscious state of mind or predominant emotion that is not necessarily expressed or as intense as emotions. Mood is more generalized in that it is influenced by multiple inputs (Bronner & Velthoven, 2008). To

further clarify, mood is the result of many physiological and psychological inputs such as environment, comfort levels, state of mind, and emotions can all contribute to set a specific mood.

To set this in perspective, emotions is triggered by specific stimulants that internally influence behavior, feelings are external as well as internal stimulants that are triggered by senses, and mood is the combination of multiple inputs external and internal inputs based on the circumstance in which an individual is currently present.

In the context of the problem statement however, this means that emotion may be triggered by a player internally based on what they experience. Furthermore, based on their senses (e.g. perception) triggered by the stimulant(s) in the video game in addition to whatever emotion that they experience, they may develop a specific feeling. Lastly, this may also influence the participating individual in altering their mood based on the previously mentioned.

4.4 IMPACT OF COLOR GRADING EXPERIMENT

During the demo-day at Aalborg University Copenhagen (AAU CPH) on 27th of April 2016, a simple experiment was conducted involving 14 participants (10 males and 4 females) to determine whether the use of color grading incorporating a cold-contrast or warm-contrast would have a positive or negative effect as discussed in section [4.2.2].

The experiment consisted of a questionnaire and two in-engine demo scenes, each applied a different color grading LUT (Figure 24 and Figure 25). The participants were given a brief verbal introduction about the nature of the test. The experiment was setup on the basis of a within-group design (Lazar, Feng, & Hochheiser, 2010), where participants would be exposed to both conditions. Thus, the order in which the conditions were experienced was randomly assigned. Furthermore, the experiment aimed to measure the participants state of valence, arousal, current feeling and emotion felt relative to what they were exposed to. Also, they were requested to indicate how they perceived the visuals to impact them.

Figure 24 Demonstrational scene 1 incorporating a cool contrast LUT.

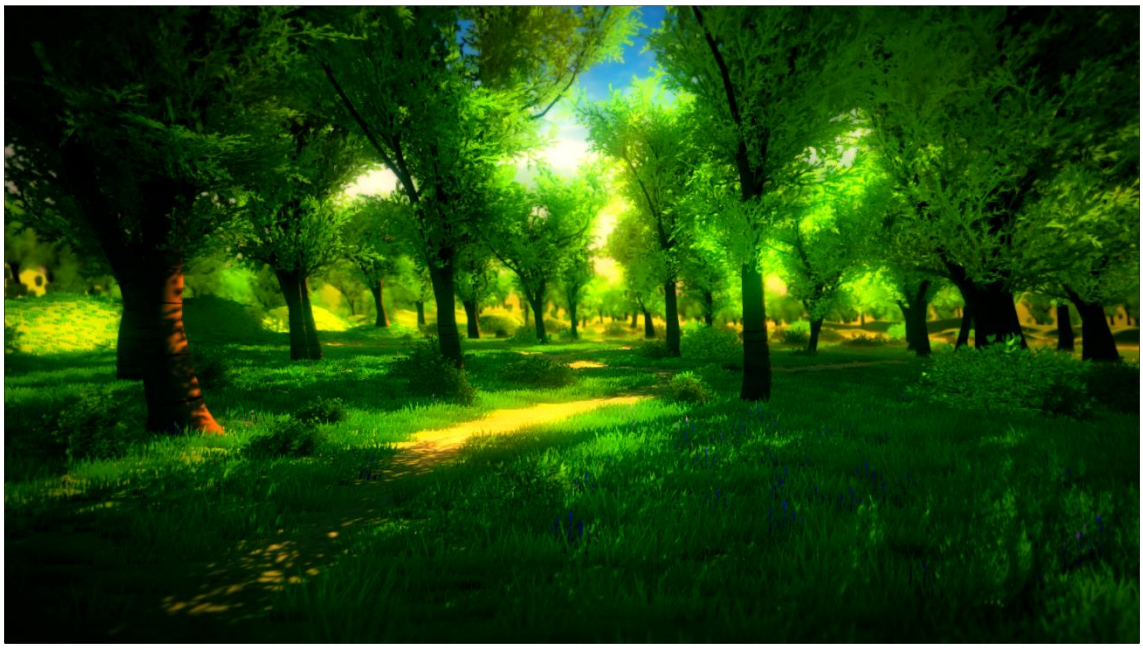


Figure 25 Demonstrational scene 2 incorporating a warm contrast LUT.

Past the initial introduction, the participants were informed to answer the first two sections of the questionnaire, where they had to indicate their demographics, in addition to indicate their current at present time state of valence and arousal.

Furthermore, they also had to fill in the Positive and Negative Schedule (PANAS) indicating their current at present time feeling and emotion felt (i.e. mood).

The participants were then prompted to experience an in-engine demo scene – either applied a cold or warm contrast LUT – followed by indicating their current at present time state of valence, arousal, in addition to answering the PANAS relative to what they had just experienced. As an additional item, they also had to indicate the extend of which what they had experienced had impacted them negatively or positively on a linear scale (ranging from 1-7). Likewise, this step was repeated a second time, exposing them to the other condition. Finally, the participants were able to compare still images from both demo scenes and indicate their state of valence and arousal relative to the still images as to how they felt about them.

4.4.1 Results and observations

Despite the population size, simple descriptive data analysis was used on the acquired data from the experiment, which did not indicate any interesting tendencies or significances in relation to the used conditions, refer to Appendix [13.1]. However, in relation to basic visualization of the data, it is apparent that there was an overall decrease in the participant's Positive score (PANAS) after exposure to the first and the second condition respectively. Likewise, the there was also decrease in the state of valence and arousal, but mostly during the first experience.

Without jumping to conclusions, a possible explanation for this might simply be the tedious and tiresome nature of the experiment that has influenced the participants state of valence, arousal, as well as their feelings and emotions felt at that time. This is mainly due to the shear amount of data points collected at each step of the process that may have influenced the participants. Relatively, the questionnaire's setup should be revised to be less tiresome and tedious, as some participants were concerned about the length of the questionnaire, repetition of the questions and the amount of data points which they had to fill in. As such it would be possible to link the overall decrease in valence, arousal and the PANAS's positive and negative scores to the design of the questionnaire.

Moreover, the lack of significance, despite the population size, could be possible be linked to the fact that the conditions (e.g. cold-contrast and warm-contrast LUT) were very subtle in relation to one another. This was also brought up on a few occasion verbally and through the feedback section by some of the participants. However, a reasonable approach for avoiding this issue could be to incorporate diverse color grading LUTs that have more noticeable differences. Another possible approach could also revolve around comparing the use of a color grading LUT to the lack of one as opposed to comparing two or more LUTs. Furthermore, the experiment could also be designed differently as to incorporate a between group design as opposed to within group.

Furthermore, the environment in which the experiment was conducted may have affected the participants. The consultation area on the demo day was quite noisy and distracting. Additionally, some of the participants were at times briefly interrupted or distracted during the experiment session by their peers, which could have influenced the general outcome.

As for observations however, participants had a very diverse set of time allocated to experiencing the demo scenes. Although they were informed that the demo scene footage was running in a loop, some spent up to five minutes or more watching each scene, whereas others simply found a few seconds to be sufficient. Additionally, there seemed to be a general need for more descriptions for each question, as the participants either did not understand what was required from them, or that they simply were in doubt.

In summary, based on the outcome of this experiment, the questionnaire should be redesigned. This is especially in terms of overall length, required data point input, and design of the individual questions, which should be short and to the point. Additionally, the design of the experiment should be looked into as to incorporate a between group design, with a control group and an experimental group. This is mainly in relation to indicating a possible correlation between the use of color grading LUT and user centered interpretation and emergent narrative relative to environmental storytelling. Lastly, the experiment should incorporate more individual so that statistical analysis may be

applicable to the acquired data, which may reveal tendencies and possible significant differences.

4.5 CHAPTER SUMMARY

Based on the suggested requirements in the literature review chapter, the following points have been established.

In section [4.2], It was emphasized that consistency in the use of assets and emotional tone is of utmost important. Also context and details should always be given in order to avoid breaking immersion and to support creating stronger atmosphere. More so, it was stated that the implementation of an environment should be restricted to a neutral tone as to avoid interference with the stimulant. Additionally, the gameplay should not be distracting or overwhelming where it may reduce the impact of the stimulant. Furthermore, the duration of the experiment should allocate a sufficient amount of time for the stimulant to cause an affect, which consequently should be evaluated through the Self-Assessment Manikin methodology in addition to the International Positive and Negative Affect Schedule Short Form.

Within section [4.3], several key features were established for the purpose of implementation. The concept of “cause and effect” was reasoned to be an important means of introducing narrative elements, encourage emergent narrative and exploration. In the same sense, these elements should be noticeable and through proper event management be reoccurring, making them hard to miss. Additionally, proper conveyance and context was argued to be significant in relation to the overall environmental storytelling, atmosphere and immersion. In the same context, it was established that the game environment should be simple and familiar in order to ease the player into the experience and reinforce a desired state of mind through the concept of conditioning.

Finally, through the simple experiment described in section [4.4], it was concluded that the stimulant (e.g. color grading) should be intensified as it was deemed to be too subtle. More so the environment in which the experiment is to be conducted should be devoid

of interference that may influence the experiment. Lastly the questionnaire and evaluation methods used, as well as the design of the experiment should be revised and further refined.

4.6 CONCLUSION

Based on the reviewed literature and the established points in this chapter, the following has been concluded.

First and foremost, the prototype should implement a simple and familiar environment that utilizes environmental storytelling through “cause and effect” events and similar narrative elements. These elements and events should also be reoccurring and managed so that they are not avoided while supporting the freedom of exploration.

However, in relation to the concept of building an atmosphere, a simpler approach must be considered where the emotional tone can be quickly altered and conveyed. This is on part due to the comprehensive task of building an atmosphere in addition to the sheer amount of customized assets and resources, as such a simpler and more condensed component should be considered. This could potentially be approached through the color grading tool in order to simply adjust, increase or decrease the emotional tone and mood visually as a factor of the overall atmosphere. More so, simplicity, consistency and context should be precondition for implementation.

Lastly, based on the demo day test results and observation, adjustments should be made towards the experimental design as setup. The evaluation methods should also be looked into and possibly modified, refined and tailored to suit the circumstances.

Chapter 5

FINAL PROBLEM STATEMENT

Grounded on the Introduction chapter [2], the initial problem statement was formulated relative to the interest to investigate the extent of which emotions and mood-states would be evoked by color:

> ***" How does the overall use of color as a way of establishing mood impact an emergent narrative that is integrated through environmental storytelling?"***

However, on the basis of the Investigation [3] and Literature Review [4] chapter conclusions, constraints, issues and limitations were defined. As such, rather than establishing a dominant emotional tone and mood through overall use of color, the notion of altering atmospheric environments – that already incorporate an emotional tone – through color grading was looked in to, as a means to alter the feeling and emotions felt. Thus the following final problem statement has been formulated:

> ***" How does the use of color grading for the purpose of altering the mood and emotional tone of an environment's atmosphere, affect the interpretation and associated emergent narrative of narrative cues and elements of an environmental storytelling?"***

Chapter 6

METHOD THEORY

6.1 INTRODUCTION

In this chapter, methods and approaches best suited for conducting the experiment and the subsequent evaluation will be presented. As such, emotional assessment evaluation methods will be explored further, and the design of the questionnaire will be refined relative to the feedback from the previous experiment. Additionally, a small pilot experiment will be conducted in order to further improve the experiment and evaluation process.

6.2 EMOTIONAL ASSESSMENT AND EVALUATION

Relative to the problem statement, the measurement of the individual participant's present mood and emotion is of significance. As such the following methods have been preferred for this purpose.

6.2.1 Self-Assessment Manikin

The Self-Assessment Manikin (SAM) is an personal assessment method to directly measure an individual's reaction and associated emotional response to various stimuli through representative pictograms (Bradley & Lang, 1994). Through this method, participants are able to indicate the extend of which these pictograms best represent their current emotional state of valence, arousal, and dominance (Figure 26).

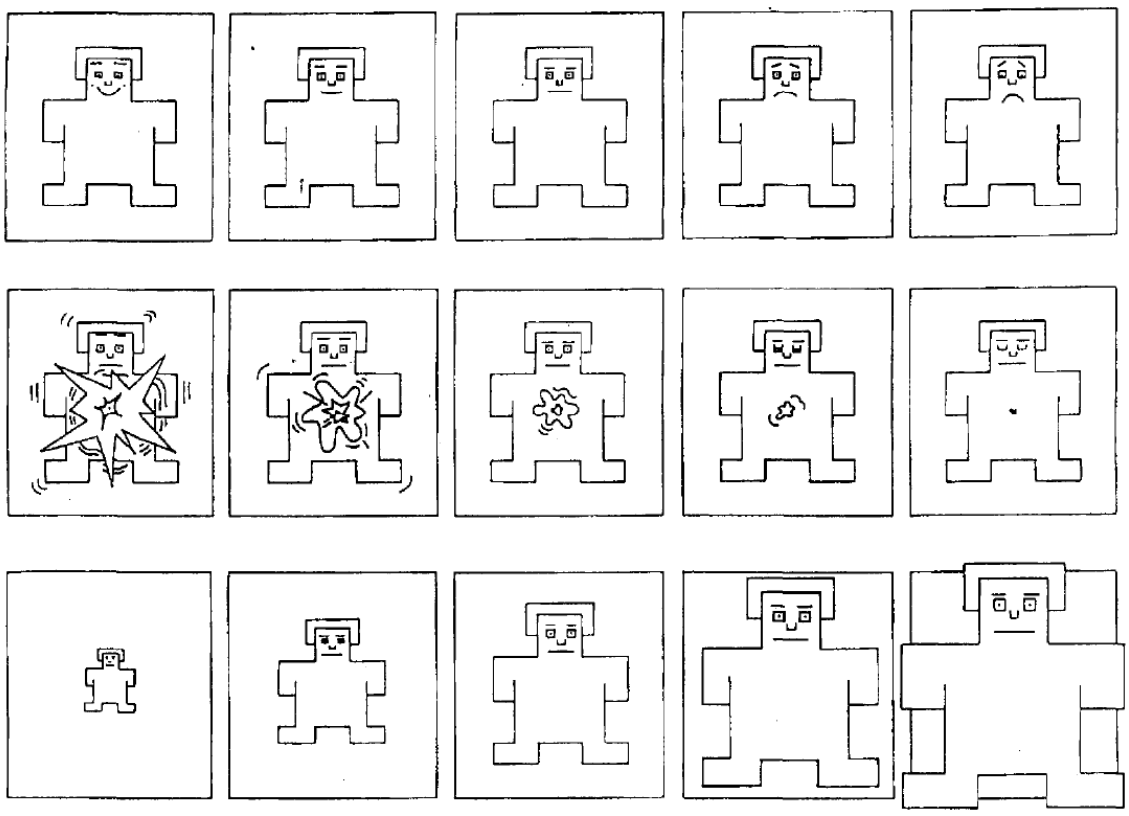


Figure 26 The original Self-Assessment Manikin with the affective dimensions of Valence (top row), Arousal (middle row), and Dominance (bottom row).

As earlier discussed in the Literature Review [4] chapter, valence is in this context the intrinsic positivity or negativity felt towards an event, object or situation, and arousal is the state of being proactive or reactive (i.e. calm or excited) both physiologically and psychologically towards stimuli. Dominance however, is not an emotional response but rather the extend of which an individual's perception of being in control of what they perceive or experience.

As shown in (Figure 26) the SAM ranges on a scale of 1 to 5 where each end represents the extremes (e.g. very sad or very happy) and the middle value indicates a neutral standing. However, there are many variants of the SAM which range on a 5, 7, and 9-point scale. However, since the individual's emotional state can be considered as a continuous variable as opposed to categorical, it would be appropriate to allow for more sensitivity of measurement by utilizing a 9-point scale. This means that individuals have the ability to provide a more subjectively accurate indication on how they feel emotionally on the 9-point scale.

More so, since the SAM is a non-verbal measurement technique and as such language independent, the illustrations should be more emphasized. For instance, the pictograms for the state of valence should be visualized in portrait mode as to properly demonstrate their emotional state since the body does not undergo any change (Suk & Irtel, 2006). Furthermore, as the measure of dominance is irrelevant in relation to the problem statement, it will not be included in the experiment. Therefore, the following SAM modifications will be utilized (Figure 27 & Figure 28).

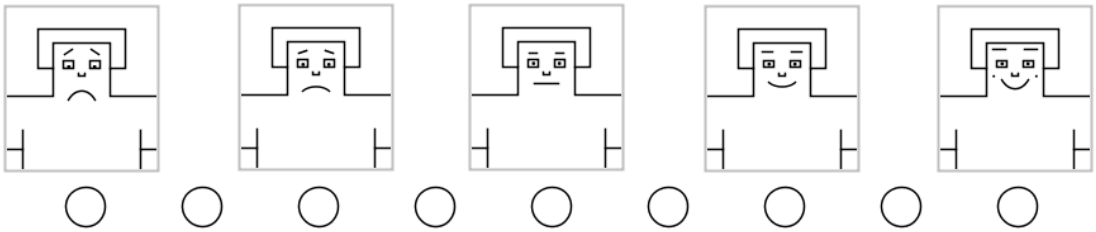


Figure 27 The 9-point portrait mode SAM for the measure of valence.

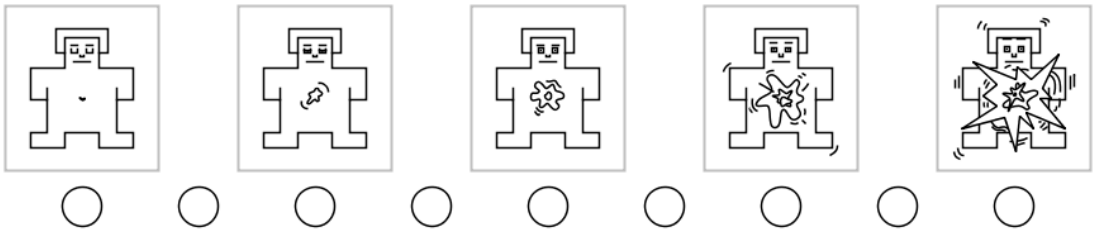


Figure 28 The 9-point full body mode SAM for the measure of arousal.

Lastly, based on the observations made and the feedback from the preliminary test, it would be practical to use simple explanations and common language for describing what is meant with valence and arousal. This is to ensure that participants are not familiar with full meaning of the terms can understand what they are being required to indicate.

6.2.2 Positive and Negative Affect Schedule

The Positive and Negative Affect Schedule (PANAS) is a questionnaire originally developed by (Watson, Clark, & Tellegen, 1988) for experiments in cognitive psychology, that consists of 20 adjectives associated with either positive or negative emotions, for the measure of affect obtained through self-report (Crawford & Henry, 2004). Each adjective ranges on a 5-point Likert scale, where 1 indicates "very slightly or not at all" and 5 indicates "very much". Furthermore, this method can be used both for short term and long term evaluation of an individual's mood and feelings either at the current time or over a longer period, relative to the descriptions in section [4.3.4].

	Not at all	**A little**	**Moderately**	**Quite a bit**	**Extremely**
1. Interested	1	2	3	4	5
2. Distressed	1	2	3	4	5
3. Excited	1	2	3	4	5
4. Upset	1	2	3	4	5
5. Strong	1	2	3	4	5
6. Guilty	1	2	3	4	5
7. Scared	1	2	3	4	5
8. Hostile	1	2	3	4	5
9. Enthusiastic	1	2	3	4	5
10. Proud	1	2	3	4	5
11. Irritable	1	2	3	4	5
12. Alert	1	2	3	4	5
13. Ashamed	1	2	3	4	5
14. Inspired	1	2	3	4	5
15. Nervous	1	2	3	4	5
16. Determined	1	2	3	4	5
17. Attentive	1	2	3	4	5
18. Jittery	1	2	3	4	5
19. Active	1	2	3	4	5
20. Afraid	1	2	3	4	5

Figure 29 The 20 item Positive and Negative Affect Schedule with 10 positive and 10 negative adjectives, which measure the feelings and emotions felt relative to scores calculated.

However, based on the verbal consultation and feedback received from the participants after the preliminary test, it was expressed that the PANAS felt a bit drawn out and that they at times had a hard time understanding the full meaning of the adjectives. For example, some of the participants struggled to comprehend what was meant with "Strong" or "Jittery" and how they should relate. Additionally, due to the nature of questionnaires becoming tedious over time, and for the sake of taking precautions for language barriers and short comings in understanding the full meaning of the adjectives, the short form of the International Positive and Negative Affect Schedule Short Form (I-PANAS-SF) should be utilized.

The I-PANAS-SF is a refined and shortened version of the PANAS questionnaire by (Thompson et al., 2007) which consists of merely 10 adjectives. The short form is in essence as reliable, efficient and valid as the PANAS for measuring affect. Additionally, the I-PANAS-SF was tested and found to be suitable for cross cultural usage, where English is not the native language (Karim, Weisz, & Rehman, 2011). Additionally, the adjectives more common and understandable (Figure 30). Lastly, the adjectives could be either briefly described or even translated incase participants may be in doubt.

	Not at all	**A little**	**Moderately**	**Quite a bit**	**Extremely**
1. Upset	1	2	3	4	5
2. Hostile	1	2	3	4	5
3. Alert	1	2	3	4	5
4. Ashamed	1	2	3	4	5
5. Inspired	1	2	3	4	5
6. Nervous	1	2	3	4	5
7. Determined	1	2	3	4	5
8. Attentive	1	2	3	4	5
9. Active	1	2	3	4	5
10. Afraid	1	2	3	4	5

Figure 30 The 10 item International Positive and Negative Affect Schedule Short Form, with 5 positive and 5 negative adjectives which measure the feelings and emotions felt relative to scores calculated.

6.3 PROPOSED INTERPRETATION EVALUATION MODEL

Relative to the problem statement there is a need for an evaluation method for the subjective user provided interpretation and emergent narrative of their experience. Although content analysis could be applied to the textual data, it is deemed insufficient in this context and framework. As such, this section proposes a method of evaluation for user interpretation and emergent narrative.

6.3.1 Russel's Circumplex Model of Affect

The Circumplex Model of Affect is a model for representing the structure of emotional experience as well as cognitive structures through self-report (Russell, 1980). This model characterizes emotions on two emotional dimensions, pleasure-displeasure (valence) and activation-deactivation (degree-of-arousal). Additionally, affect describing adjectives distributed on the model relative to the two emotional dimensions, help in indicating user's state of valence and arousal (Figure 31).

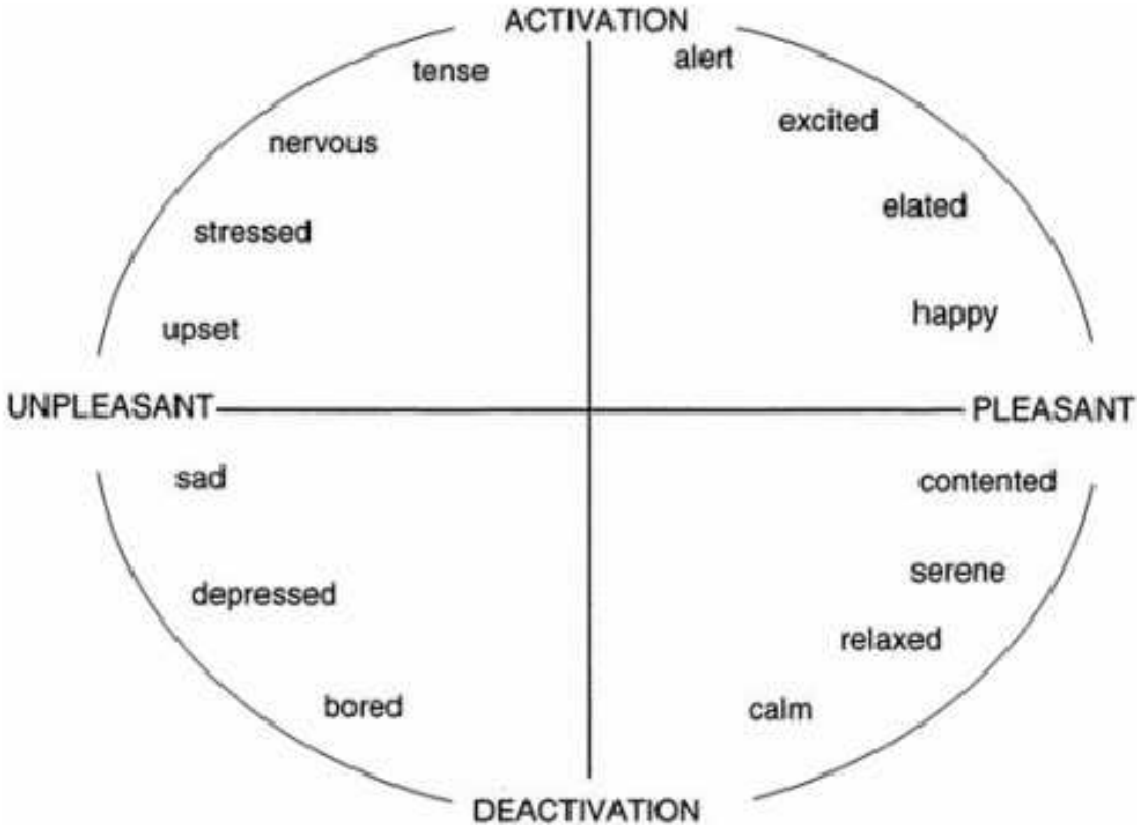


Figure 31 Russell's Circumplex Model of Affect with Valence on the X-axis and Arousal on the Y-axis

More so, as described by Russell in relation to conceptualization of affect;

> *"it would be used for interpreting verbal descriptions of emotion, including anything from a subtle hint to an explicit declaration."*

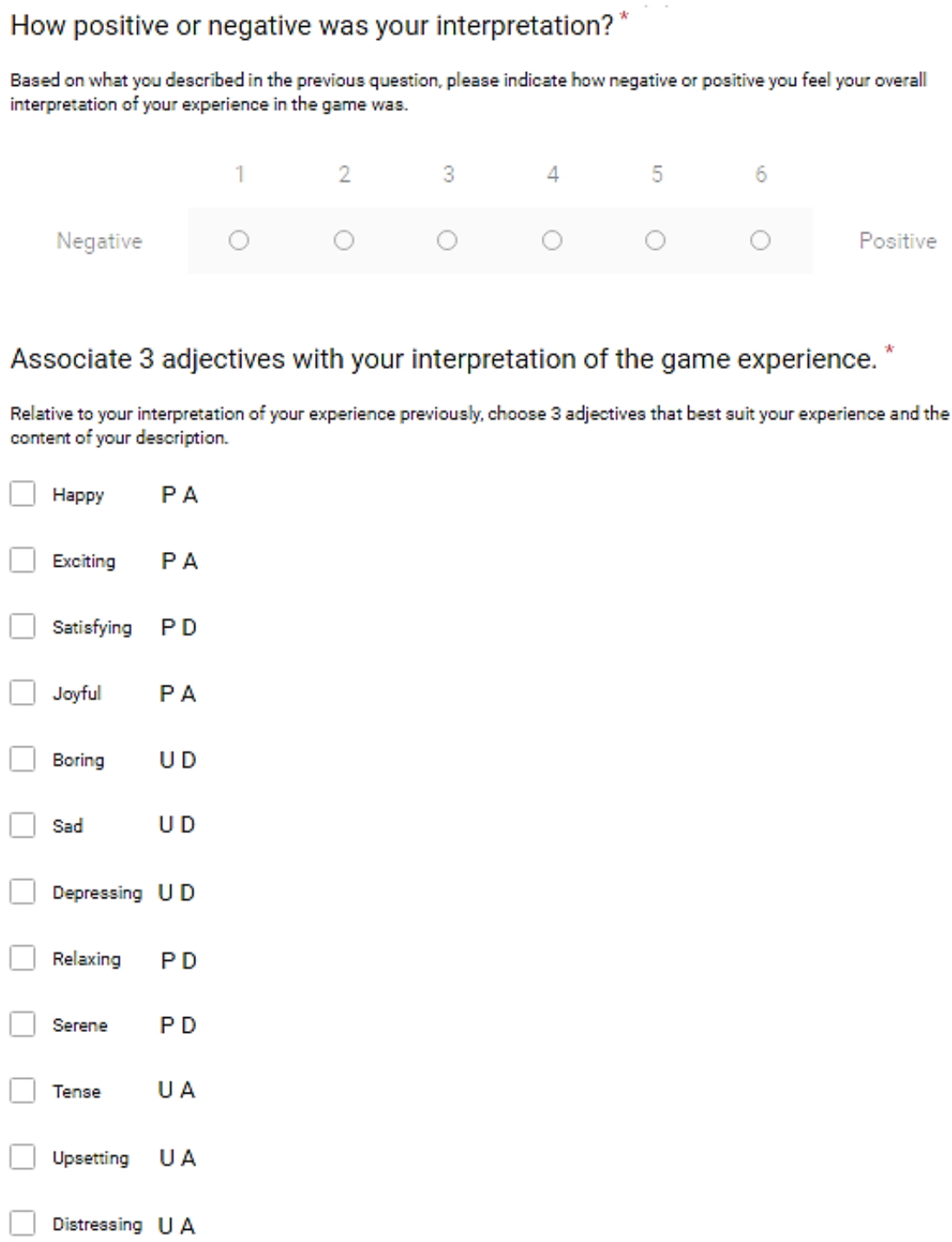
Therefore, as a proposition for the purpose of evaluation in the experiment, users should be requested to associate descriptive adjectives that best describe their interpretation of an emergent narrative relative to their experience. This is so that it may be possible to categorize the interpretations in relation to emotionally descriptive adjectives (Figure 32).

	PLEASANT	**UNPLEASANT**
ACTIVATION	PA	UA
DEACTIVATION	PD	UD

Figure 32 Categorizing emotionally descriptive adjectives.

Moreover, although each category contains a large number of emotionally descriptive adjectives, for the purpose of limiting the total number of choices while preserving variety, only a few core adjectives will be made available to users (e.g. 12). Additionally, the choice of selection will be limited to three, as to avoid situations where an equal number of descriptive adjectives from each category are selected.

Lastly, a Likert scale ranging from 1-6 (no middle value) could supplement the adapted evaluation method in order to compare and cross validate the choice of adjectives. As a result, the proposed method of evaluation could be composed as such (Figure 33).



How positive or negative was your interpretation? *

Based on what you described in the previous question, please indicate how negative or positive you feel your overall interpretation of your experience in the game was.

	1	2	3	4	5	6	
Negative	○	○	○	○	○	○	Positive

Associate 3 adjectives with your interpretation of the game experience. *

Relative to your interpretation of your experience previously, choose 3 adjectives that best suit your experience and the content of your description.

- ☐ Happy P A
- ☐ Exciting P A
- ☐ Satisfying P D
- ☐ Joyful P A
- ☐ Boring U D
- ☐ Sad U D
- ☐ Depressing U D
- ☐ Relaxing P D
- ☐ Serene P D
- ☐ Tense U A
- ☐ Upsetting U A
- ☐ Distressing U A

Figure 33 Proposed method of evaluation for the purpose of categorizing user interpretation of an emergent narrative relative to experience, through choice of adjectives and Likert scale. (Categorization is only visible for demonstration)

6.4 QUESTIONNAIRE PILOT EXPERIMENT

Grounded on the conducted experiment described in section [4.4] and the evaluation methods discussed above, a pilot experiment was conducted to further improve the overall experiment design and procedure. The purpose of this experiment was as such to refine the improvements made relative to the observations and feedback from the preliminary experiment during the demo-day. The pilot experiment was conducted on the 7th of May 2016, incorporating 14 participants (10 males and 4 females).

The questionnaire pilot has a similar design to the previous experiment where participants would undergo a verbal introduction. However, the difference here was that the verbal introduction urged them to read the descriptions and that they should consult the conductor if they were in doubt. More so the introduction section was kept brief and informed the participants about the nature of the experiment.

Moreover, demographic information such as age and gender was a prerequisite as before, however as an additional item the participants were asked to indicate their gaming experience in terms of dedication and skills. The purpose of this was mostly in relation to the finding in [4.2.2] for the purpose of statistical analysis if needed.

Like the previous experiment, participants were required to indicate their current at present state of valence, arousal, and feelings and emotions felt, through the 9-scale SAM and the I-PANAS-SF respectively. The I-PANAS-SF in specific was received positively due to being short and utilizing common words.

As the next step, the participants were presented with a (color graded) still image of an in-game demo scene (Figure 34) incorporating environmental storytelling through a cause and effect event, described in section [4.3.1]. As such, through open ended questions the participants were required to provide an explanation as to what they think might have happened in the scene and how it may have happened. Moreover, it was also indicated that there were no right or wrong answers, emphasizing that they simply had to interpret the content. This was mostly to avoid being assertive in terms of

questioning, but also to let the participants freely use the image as a point of reference for an emergent narrative.

Figure 34 Image used in the questionnaire pilot experiment for the purpose of interpretation.

Proceeding the interpretation, the proposed interpretation evaluation method was used. Here the participants were asked to rate their individual interpretation by indicating the extend of which they felt their interpretation was positive or negative. Additionally, they were required to choose three adjectives that best suited their interpretation.

To finish, the participants had to indicate their state of valence, arousal, as well as feeling and emotions felt through self-report with the SAM and I-PANAS-SF methods.

6.4.1 Data analysis and Observations

Despite the nature of the pilot test and the small sample size, the acquired data was analyzed, see Appendix [13.9]. Through basic data visualization, it was apparent that there was a very slight (insignificant) increase in the participants' state of valence and arousal, however the opposite was true for the positive and negative scores (P and N score) which was acquired through the I-PANAS-SF. More so, through the Spearman correlation test it was suggested that there might be a correlation between the before and after values of valence, arousal, P score and N score respectively. Consequently, a Friedman k sample test was applied and no significance was found.

Moreover, based on the data it was observed that participants who rated a negative interpretation scores had a tendency of choosing adjectives that were categorized as descriptive of deactivation and unpleasant emotions. However, the opposite was true for participants who rated a positive score. Although it should be noted that outliers were present in each case. Additionally, as an interesting point of observation, the descriptions provided by participants that rated a negative score was in all cases very short, describing only the central theme of the still image. On the other hand, the participants who rated a positive score had a lengthy and more detailed descriptions in comparison to the negative. However, in all cases the interpretation was true to the central theme (affect), although the details of the descriptions varied (cause), with a couple of outliers being quite imaginative.

In summary, the pilot experiment was successful in improving the overall questionnaire design and as such should be utilized with further improvements based on the feedback. Despite the lack of a significant or clear trend, the proposed approach and evaluation methods is speculated to aid in indicating significance and tendencies relative to a larger sample size. Furthermore, observation as a method has been very beneficial in both the preliminary and pilot experiment, and as such should be incorporated in the final experiment as well. Lastly, the final experiment should incorporate a playable prototype where participants can actually experience the in-game environment fully, instead of still images and looping footage.

6.5 CONCLUSION

In conclusion, the following methods have been established for the final experiment.

In section [6.2.1], the Self-Assessment Method was described as method capable of directly measuring an individual's reaction and associated emotional response to stimuli. Additionally, adjustments were made in relation to the preliminary experiment.

More so, in section [6.2.2] the Positive and Negative Affect Schedule questionnaire was described as a useful method for the measure of affect through of an individual's positive or negative feelings and emotions felt regardless of stimulus. However, based

on the feedback the International Positive and Negative Affect Schedule Short Form questionnaire will be substituted as it is less tiresome and has the same outcome.

Furthermore, an interpretation evaluation method was proposed in section [6.3] based on Russell's Circumplex Model of Affect. This adapted method was described as a viable tool for categorizing user centric interpretation, addition to avoiding bias analysis.

Finally, the pilot experiment in section [6.4] was successful in further improving and refining the overall design of the questionnaire and experiment. Despite the lack of significance in the data, some slight patterns and tendencies were existent and described. Also, observation as a method was deemed to be a valuable approach to gain additional data during the experiment.

Chapter 7

EXPERIMENTAL DESIGN

7.1 INTRODUCTION

In this chapter, the overall design of the experiment in relation to the problem statement, literature review considerations as well as the preliminary and pilot experiment will be described. As such, requirements and design of the prototype and the experiment as a whole will be established, in addition to the experiment setup.

7.2 PROTOTYPE REQUIREMENTS

Based on the literature reviewed in chapter [4], an extensive amount of requirements was considered for the purpose of implementation. However, these considerations should be limited into a defined set of requirements for the actual implementation of the prototype. As such, the following requirements have been set.

7.2.1 Content, setting, and experience

As the aim of the experiment is in essence to measure changes in feelings and emotions felt relative to the stimulus (color grading) and consequently change in the interpretation, the experience in the prototype's environment should not be emotionally overwhelming or distracting in any substantial way. This is mainly to reduce unintended influences caused the previously mentioned. As such, for the purpose of the experiment the experience could be devoid of a general goal or objective, other than exploring and making sense of the environmental storytelling and narrative clues. Moreover, although any environment or setting implemented may not be completely emotionally neutral, a natural setting such as a forest could be considered. This is also so that it may function as a "blank slate" or emotionally ambiguous starting point in which the applied color grading may influence how the setting is interpreted.

7.2.2 Consistency in implementation

As a very central notion concerning emotional experiences and atmosphere in video games, consistency in the prototype should be valued significantly. This essentially means that for instance all the subsequent asset uses should be consistent in style and support the same central theme or intended tone and the overall emotional experience. In the same context there should be made an effort for not breaking the user's immersion that may occur through inconsistencies, and as such avoid weakening the emotional tone and atmosphere.

7.2.3 Conditioning and context

Relative to the previous considerations for section [4.3.2] in relation to ES, conditioning or creating a certain mindset for the users to a desired state should be valued. However, this can simply be incorporated through the design of the familiar, where narrative elements, setting and other elements have the necessary conditioning tied to them. Meaning that, for instance all individuals who see a tombstone will perceive it as the resting place of an individual and as such do not require to be conditioned. To further clarify, this essentially means that by incorporating a familiar setting – for instance a forest – the users are already accustomed with it and conditioned to some degree.

More so, narrative elements and events should as such be utilized through the "cause and affect" concept of environmental storytelling described in section [4.3]. This is also to avoid having widely unique interpretations, since being conditioned similarly towards an event means that a similar mindset is present relative to the perceived event.

Furthermore, providing context to users in relation to their experience is important. This is partially doable through having a familiar setting and clues as to why and how, which can function as a point of reference so that they are not alienated and confused in the process.

7.2.4 Details in the environment

Relative to environmental storytelling and emergent narrative, the environment in which the users can be involved with an experience should contain details. This can be

understood as assets and elements that support the bigger picture and add a little flavor to the overall experience and bring it to life. For instance, tree branches in a forest setting could gently sway as to indicate a gentle breeze, or simply have diversity in the foliage to be more relatable to the real counterpart. More so, implementing assets to enhance the look of the environment could in this context also be considered as details.

As an additional property, details often intrigue and as such also encourages exploration in the environment. More so, details which support the emotional tone of the environment heavily contribute towards establishing a strong atmosphere and impact the mood. However, in the context of the prototype a simpler design of the environment should be implemented as to not visually overwhelm users.

7.2.5 Narrative cues, elements and Emergent Narrative

As a primary approach in evoking emergent narrative, the prototype should contain environmental storytelling cues and elements that may functions as such. Therefore, such cues and elements may be incorporated both in the environment and through "cause and effect" events, so that they may be interpreted by users to form an emergent narrative. As such, an author structured narrative will be irrelevant, as long these basic components for interpretation and subsequent emergent narrative are present.

7.2.6 Event management and repetition

As it was highlighted in section [4.3], depending on the user's player type and play style, environmental cues, clues and the potential storytelling element can be overseen. As such, relative to the considerations in section [4.3.3] a management tool should be implemented that make it possible to repeat elements so that there might be a bigger chance for user's to encounter them. Additionally, the cues, elements and alike should be sufficiently noticeable as to not be overseen or deemed insignificant by users. Lastly, this would be an ideal method to incorporate an environmental storytelling in a nonlinear level design.

7.2.7 Color grading LUT

As an integral part of the problem statement, the game engine used for implementing the prototype should have the option to apply color grading through a LUT. More so, the use of color grading to visually alter the scene should not be too subtle. This is to visually alter the atmospheric look and emotional tone of the prototype so that it may cause an effect.

7.3 DESIGN OF THE EXPERIMENT

The design of the experiment, especially the questionnaire, has been an iterative process which has undergone improvements and refined through both the preliminary experiment [4.4] and the pilot experiment [6.4]. However, this section will focus on the type of experiment, hypothesis, as well as the sampling method and statistical analysis procedure.

7.3.1 Type of experiment

Relative to the considerations made in the previous experiments, a true experiment (Lazar et al., 2010) will be conducted incorporating a control and an experimental group to measure any changes that may occur, and determine whether the hypothesis caused this change.

Evidently the purpose of the experiment is to validate the hypothesis;

> ***"There is a significant difference between the use of color grading and the interpretation of environmental storytelling."***

Therefore, the hypothesis will be tested between two groups of participants, one with no application of color grading (group A) and one with applied color grading (group B) as the two conditions of the experiment.

Furthermore, in this context, the dependent variables are the general feelings and emotions felt relative to the stimulus by the player as well as their emergent narrative interpretation. The independent variable however will be the color grading LUT. Since the dependent variables are expected to be influenced by the independent variable,

they will have to be measured through the emotional assessment and evaluation methods (SAM and I-PANAS-SF), and the proposed interpretation evaluation method described in the Chapter [5].

In summary, the experiment will have a basic design as opposed to a factorial design as the number of independent variables is one. Furthermore, between-group approach has been selected to incorporate a control and experimental group. More so the dependent variables which are expected to be influenced by the independent variable will be measured through a quantitative data gathering approach, in this case a questionnaire, including evaluation methods that allow for comparing changes that may occur.

7.3.2 Questionnaire improvements

As a necessary part of the experiment, the questionnaire has undergone several iterations both in design and overall use of evaluation methods. As such, the length of the questionnaire has been significantly shortened in comparison to its previous iterations. Additionally, much of the descriptions has been clarified relative to the feedback received. Technical terms and expressions that may cause confusion has been replaced with a more common language to not only emphasize the meaning of the questions, but to also be more user friendly towards participants that may not be as knowledgeable in the English language. For instance, the term “Valence” and “Arousal” have been replaced with “Happiness” and “Excitement” respectively.

Furthermore, the verbal instructions have been integrated into the questionnaire so that it may be consistent for all participants, this is mostly to avoid the conductor accidently paraphrasing the instructions for each participant.

Lastly, the number scales for each instance and use of a Likert scale question has been simplified and described to avoid confusion and to provide a better understanding. More so, closes-ended questions were used to acquire specific data (e.g. valence, arousal) and open-ended question were used to get an insight into player interpretation and how it may have changed relative to stimulus. The full questionnaire design and question descriptions can be referred to in the Appendix [13.3].

7.3.3 Sampling method

Since the experiment has no specific target audience, the sampling method could be quite flexible. As such, for the purpose of acquiring participants, simply approaching random individuals sufficed. This method could basically be categorized as a convenience sampling method, where individuals are approach relative accessibility and the location(s) selected. However, this sampling method can be subject to sampling bias due to not being representative of an entire population. Therefore, for the purpose including more diversity in the population, random individuals were approach at three different campuses; Aalborg University Copenhagen, IT University of Copenhagen, and the Technical University of Denmark (DTU).

7.3.4 Statistical analysis

Evidently, the purpose of statistical analysis methods is to test the acquired data from the experiment and to either validate or reject the hypothesis relatively. As such, two hypotheses are presented, a null hypothesis and an alternative hypothesis. The aim of the statistical analysis will thus be to test, indicate and show a difference between the control (A) and experimental (B) group and preferably reject the null hypothesis. Based hypothesis made in section [7.3.1], a null hypothesis can be stated;

Null hypothesis (H_0):

> ***"There is no significant difference between the use of color grading and the interpretation of environmental storytelling."***

Alternative hypothesis (H_a):

> ***"There is a significant difference between the use of color grading and the interpretation of environmental storytelling."***

Consequently, if the analysis of the data indicates a difference between the two groups, it would be possible to reject the null hypothesis and possibly prove the alternative hypothesis to be true.

Evidently, as a preliminary step in the process of statistical analysis, the data has to be prepared. This means that the data has to be cleaned for possible typos and errors made by the participants. For instance, a participant may have by accident indicated their age as “277”, where the correct answer would have been 27 or alike (Lazar et al., 2010).

Furthermore, some descriptive statistics may be applied to the data, such as calculating the mean, median and visualizing it through boxplots for instance. Additionally, it should be noted that even though that questionnaire are usually qualitative means of measurement, the use of Likert scale will make it a quantitative method. More so, relative to the use of Likert scale the acquired data will be non-parametric (Jamieson, 2004). The data will also be checked for normal distribution through the Kolmogorov-Smirnov test.

A Spearman correlation test will also be performed on the data to indicate whether or not there is a correlation between two sample of the dependent variables, essentially testing if there is a linear relationship between the two.

Moreover, due to the experiment incorporating between-group design with 1 independent variable and more than 2 dependent variables (Figure 35), the Kruskal-Wallis test (one-way ANOVA) will be applied to indicate whether there is a significant difference between two samples (e.g. before and after). It should be noted that the both the interpretation summary (text) and choice of adjectives (text) will not be include in the statistical analysis calculations, but rather analyzed and used comparison.

Independent variable	*Dependent variable*
Color grading	Arousal
	Valence
	Positive/Negative score
	Interpretation (text)
	Interpretation score
	Choice of adjectives

Figure 35 List of independent and depend variables of the experiment.

Finally, if there are any significant differences in the analyzed data, a post hoc Mann-Whitney U-test will be applied measure where exactly the indicated difference between the groups is. The analyzed results from the experiment can be seen in section [9.2], for further details refer to Appendix [13.9].

7.4 DESIGN OF THE PROTOTYPE

The design of the prototype is primarily based on the requirements described in section [7.2]. As such, this section will define and illustrate the design choices that were implemented in the prototype.

7.4.1 Level design and setup

Designing the prototype level was relatively straightforward, relative to the requirements of having a non-linear design. This essentially meant that the level had to allow players to freely roam the zone as they pleased. However, limitations apply as levels can be comprised of finite space and players should as such be in a manner of speaking “fenced in”. Although, it is important that relative to the [7.2.3] context should be given as to why they may be unable to go beyond the boundaries. As such, a medium sized level was built as can be seen in (Figure 36), where the player was fenced and

Figure 36 Allocated space for exploration and boundaries of the prototype level.

prevented from going out of bounds by using boulders. Since players are already familiar with this concept (e.g. large boulders blocking their path), they will as such also be given a rational reason as to why they cannot go further than the allocated area. Another example of this method used was essentially through the caves. After the initial spawn in the world, players explore the surrounding area and will be attracted towards the exits which in this case would be the caves. However, an event trigger was place at each cave entry that would enable an event where a boulder would fall down, preventing them from exiting the zone (Figure 37 Cave exit before (left) and after (right) boulder blocking the way out.Figure 37). This notion in of itself potentially lead to encouraging

Figure 37 Cave exit before (left) and after (right) boulder blocking the way out.

players to explore the zone in search of other ways of exiting the area.

7.4.2 Environmental storytelling elements, cues and events

For the purpose of evoking an emergent narrative; narrative cues, elements and events were implemented through environmental storytelling. As an initial approach, it was

Figure 38 Providing context to players so they may interpret as to why they happen to be where they are.

important to give sufficient clues and context as to why and how players had ended up in the setting (Figure 38). However, on the basis of the set requirements, the context and clues did not have structured and as long as enough clues and elements were present for the player to piece an explanation together while being open for interpretation. Moreover, this was designed and implemented relative to the availability of the assets that fit the theme.

Apart from the initial conveyance of context, several elements and cues were added that would potentially be relatable. To further clarify, the implemented assets which functioned as narrative cues and elements in the overall environmental storytelling, were not designed to tell an authored story, but rather to serve as a potential source for a story to be told by the players. This means that in all instances of event and element implementation, there we no clear link to an overarching narrative. However, there were vague and potential links present for players to correlate and create a link between one or more of these events and elements, subsequently leading to an emergent narrative. For instance, three tombstones were implemented with varying sizes, which might be interpreted as a family's gravesite, where the smallest belongs to a child and the one with the sword belongs to the father, and the mother in the middle (Figure 39).

Figure 39 Three tombstones of varying sizes as narrative elements to evoke an emergent narrative.

On the other hand, three idols/statues where implemented with varying sizes as well, that could potentially be linked to the graves but also function as a standalone (Figure 40).

Figure 40 Three statues/Idols of varying sizes as narrative elements to evoke an emergent narrative.

There was however no clear relation between the two other than the quantity and proportions, but that was simply designed to function as a vague link that could be interpreted as such. More so, the skull of an animal was placed at the cave exit points with a sword stuck in it (Figure 41). This simply signaled that it had been slain (affect) but not clear indication as to by whom (cause). However, the sword is identical to that

Figure 41 An animal skull with pierced with a sword as narrative elements to evoke emergent narrative.

on the gravesite, which would in a sense create a very ambiguous link between the two element. As such, the player is to some extend made to fill in the gaps by interpreting and creating an emergent narrative. Furthermore, due to the placement of the skull at the cave and the event trigger for the boulder to fall and prevent players from exiting, a possible link could also potentially be made between the two.

To end with, on the basis of the requirement relating to event management and repetition, some of the events and elements were repeated throughout the zone. That is every element except the idols/statues and the initial campsite. This was mostly due to the campsite being the first thing that the players would experience and thus not overseen in any case. The idols/statues however were not repeated since they were located in the center of the zone and quite large and as such hard to miss. However, to avoid players experiencing the same elements (e.g. animal skull, tombstones etc.) twice at different locations, event triggers were scripted to hide the second implementation once the player had experienced one instance of them first. To clarify, some elements were repeated in different parts of the map so that players would experience them regardless of which direction they traversed. As such, event managers (triggers) were scripted to hide the repeat implementation of an element relative to the players first encounter with them.

In summary, environmental storytelling was incorporated through narrative elements and cues in the environment, and implemented several times to avoid oversight. More so these elements and events were design, based on the availability of assets, to be incorporate a vague relationship while leaving the player to fill in the gap and create an emergent narrative.

7.5 EXPERIMENTAL SETUP

For the purpose of the experiment, a consistent setup for conducting the experiment was desired. However, due to the convenience sampling method, especially in relation to the various campuses, and the desire to include a larger sample size the approach was slightly modified to suit this notion. As such, the experiment was not setup up at a

fixed location, but was rather flexible as it could be setup wherever the participants would be willing to participate.

Additionally, based on the feedback gained from the previous experiments a few requirements where established. Firstly, the participants were required to use a pair of headphone, as to cancel out external noises and distractions, thus focusing more on the experience. If they did not have a pair of headphones, one would be provided. Secondly, the necessary files for the experiment was provided on an external hard drive that contained versions compatible with both windows and mac devices (Figure 42).

Figure 42 A typical experiment setup at the individuals own devices.

The main concern in relation to this approach was that the area in which the experiment would be conducted would remarkably vary in terms of distractions etc. However, this turned out to be a non-issue as the period in which the experiment was conducted was aligned with the end of the semester at the various campuses, which resulted in rather calm and quite environments throughout.

Furthermore, it was hoped that by setting up the experiment on the participants' devices, they would be participating in the comfort of a familiar setting. This was rationalized with the idea that individuals would be comfortable playing or simply using

their own devices, which would be ideal. Essentially the setup for all the participants was very similar with no extreme outliers.

7.6 CHAPTER SUMMARY

In summary, this chapter has relative to the Literature Review [4] and Method Theory [6] chapters defined the guidelines for the design of the prototype as well as the experiment.

In section [7.2], the prototype requirements were established relative to the extensive list of considerations in the literature review. These included requirements such as; consistency and context, details in the environment, narrative cues and elements, event management and color grading.

Moreover, in section [7.3] the design of the experiment was described as being a true experiment, incorporating a between-group design. The questionnaire design was also improved relative to the feedback acquired and observations made during the preliminary and pilot experiment. More so, the sampling method was described in addition to approach to statistical analysis for the acquired data.

Furthermore, the design of the prototype was described in section [7.4] relative to level design and the implementation of narrative elements through environmental storytelling. These were thus described in terms of choices made and general aim.

Lastly, section [7.5] described the experimental setup of the final experiment across the different locations, approach, equipment used and general concerns and considerations.

Chapter 8

IMPLEMENTATION

8.1 INTRODUCTION

For the purpose of the experiment, a prototype was implemented. As such this chapter will describe the technical aspects of the implementation process in terms of choice of game engine and assets used in addition to the creation of a simple Space Time Drama Manager (STDM) script.

8.2 CHOICE OF GAME ENGINE

For the implementation of the prototype the Unity game engine (Unity Technologies, 2016b) was utilized. Although any current available game engine would have been sufficient for the task, the deciding factor was essentially narrowed down to asset availability on the game engine's marketplace.

This was primarily due to the lack of resources for creating custom assets necessary for implementation, which was circumvented by utilizing already existing asset packs that were similar in style and theme.

8.3 CHOICE OF ASSETS

As it was argued in the Literature Review [4] relative to the considerations for implementation, in addition to the design requirements in section [7.2], a certain level of consistency was necessary in the overall use of assets. Additionally, the design of the environment, as described in section [7.4], was required to have a neutral tone as to not deliberately influence the player. As such, relative to both the asset availability and the design requirements, the setting was chosen be a forest. This essentially led to the incorporation of the following assets.

8.3.1 Nature Starter Kit 2 by Shapes

This nature pack by (Shapes, 2016) contained a variety of bushes, trees and textures for ground, foliage and skybox (Figure 43). Additionally, the pack also included a premade scene for the purpose of demonstration of its assets, which was used in its original form for the preliminary test. However, the layout and asset placement in the scene was altered to fit the environment design and environmental storytelling needs.

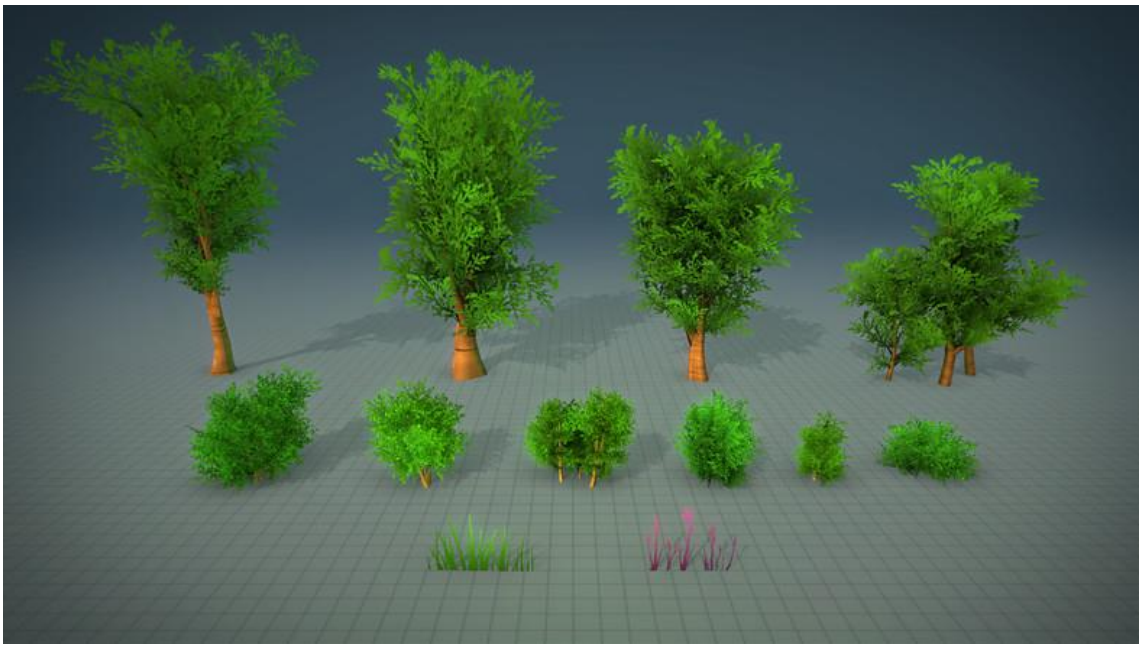


Figure 43 Nature Starter Kit 2 containing various assets for implementation of a natural environment.

8.3.2 Cartoon Halloween Pack

The Cartoon Halloween pack by (Lescuyer, 2015) contained a large assortment of assets (Figure 44), of which only the tombstones were used to serve as narrative elements in the environment.

Figure 44 Cartoon Halloween Pack containing various Halloween themed assets of which the tombstones were used.

8.3.3 First Person Character Controller

The First Person Character Controller in the Standard Assets pack by (Unity Technologies, 2015) was used. By default, the FPS Controller is set to fulfill the basic needs for games that utilize a first person view. It is highly modifiable and as such was adjusted to fit the needs for the prototype in terms of walking/running speed, camera movement (head bob) (Figure 45).

Figure 45 First Person Character Controller asset of the Standard Assets pack, modified and used for character control.

8.3.4 Campfire Pack

The Campfire Pack by (Dreamdev Studios, 2013), contained a diverse assortment of assets (Figure 46) that closely matched the style of the Nature Starter Kit 2. Primarily the

Figure 46 Campfire Pack containing various themed assets used for boundaries and narrative clues.

rocks were used for the purpose of creating a natural boundary, whereas other assets were utilized for the purpose of narrative elements in environmental storytelling

8.3.5 Standalone Assets and Props

Additionally, for the purpose of incorporating environmental storytelling, the following assets were utilized as supplementary narrative elements. These included standalone assets such as;

- Idol by (Bugrimov, 2014)

Figure 47 Idol asset used as narrative element that might be interpreted and linked with other elements and cues.

- Axe by (Fairy Shop, 2015)

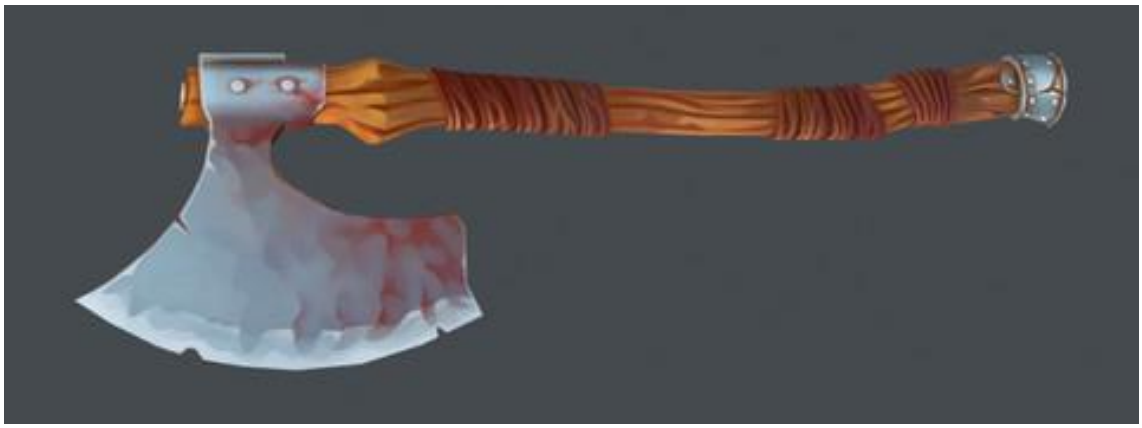


Figure 48 Axe asset used as narrative element that might be interpreted and linked with other elements and cues.

- Bull Skull by (Jansson, 2012)

Figure 49 Skull asset used as narrative element that might be interpreted and linked with other elements and cues.

- RPG Swords by (Lusth, 2013)

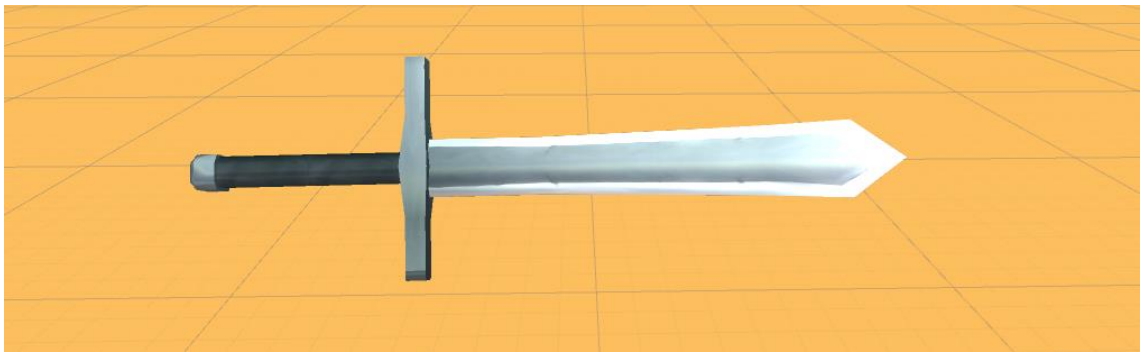


Figure 50 Sword asset used as narrative element that might be interpreted and linked with other elements and cues.

Furthermore sound files by (Reinsamba, 2007) and (Kwandalist, 2008) were used for ambience in the environment and boulders falling respectively. Finally, the LUT texture used in the prototype was part of a compilation of built-in color grading tables in Photoshop, which was shared on the Unreal Engine forums by a community member (Shannon, 2014).

8.4 COLOR GRADING LUT

For the purpose of applying color grading to the prototype, the approach was fairly straightforward in the Unity editor. Since the Camera Component (Unity Technologies, 2016a) was already incorporated into the First Person Character Controller [8.3.3], the necessary step to apply the color grading was to simply apply the necessary component script (Figure 51). As such, this was done through the (Component -> Image Effects -> Color Adjustments-> Color Correction (3D lookup texture)). Furthermore, the intended PNG file had to simply be selected for this automated process to complete (Figure 52).

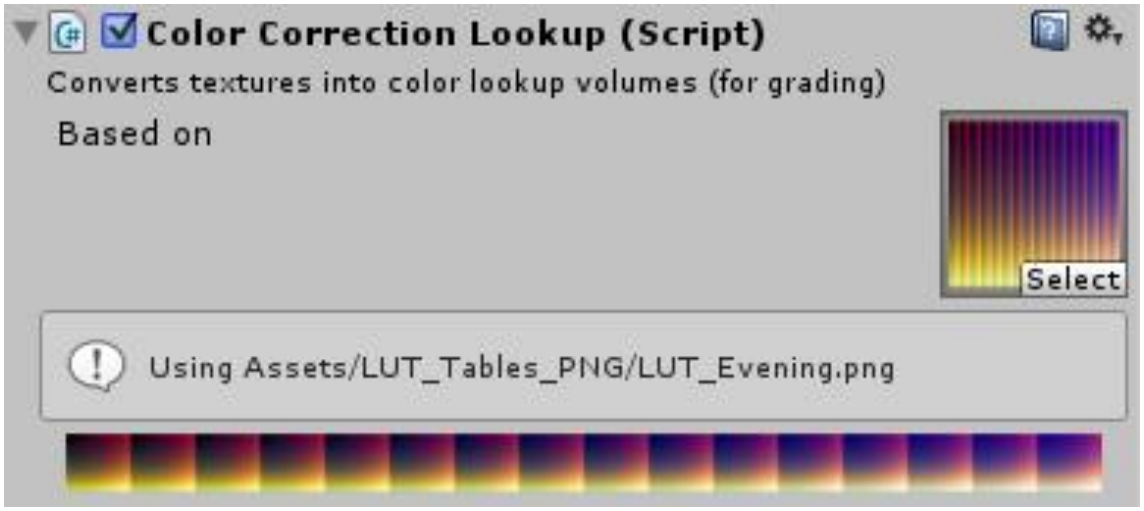


Figure 51 Color grading LUT component and application method of the LUT texture in the Unity game engine.

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Figure 52 In engine scene with no color grading (left) and applied color grading (right).

8.5 SPACE TIME DRAMA MANAGER

Relative to the considered SPATIN framework introduced in the literature review under section [4.3.3], a Space Time Drama Manager (STDM) was scripted. This was mostly relatable to the synchronous ordered events or narrative elements, which would be linked to the player's actions and involvement and the repetition of narrative and environmental clues and elements in order to ensure that they would not be missed or overseen in the non-linear environment design.

The STDM was as such responsible for organizing the previously mentioned based on; location of the player and encountered narrative elements/events in the environment.

Essentially the STDM functioned based on the assigned parameters given, in order to manage and enable or disable matching events (Figure 53). Since the aim was to ensure that the player would not oversee narrative elements implemented in the environment, there were duplicates to increase the chance of experiencing them. As such a simple script was made which would relative to the first experienced narrative element, enable an asset (e.g. rock) that which hid the other identical element, in addition to disabling the trigger for that specific zone, that would otherwise hide the current one element. In other words, one trigger zone near a narrative element would hide and disable the other identical element to avoid duplicates being experienced, in addition to circumventing the issue where players would oversee or miss said elements due to the non-linear design.

```
1  using UnityEngine;
2  using System.Collections;
3
4  public class BlockEnabler : MonoBehaviour {
5
6      public GameObject trigger;
7      public GameObject rock;
8
9      void OnTriggerEnter (Collider other){
10         trigger.SetActive(false);
11         rock.SetActive(true);
12     }
13 }
14
```

Figure 53 A simple script to hide an assigned trigger and enable an intended model to hide a specific narrative element. This was also modified to function in reverse when it was needed.

8.6 ITERATIONS AND IMPROVEMENT

The prototype was pilot tested by peers prior to the final experiment and as such did undergo minor tweaks and adjustments. One of the major concerns were the boundaries or colliders utilized to restrain players to the designated area. More so, in a small number of areas players would be wedged between boundaries and as such unable to continue with the experience. Additionally, the lack of colliders in some of the assets due to oversight were also the cause of issues as they would allow players to walk through various assets and have a negative impact on their experience.

8.7 CHAPTER SUMMARY

In this chapter, the technical implementation of the prototype was described. As such, section [8.2], described the reason behind the choice of game engine for the purpose of implementing a playable prototype.

Furthermore, in section [8.3] the choice and purpose of assets was explained in relation to the prototype requirement section [7.2].

Additionally, the technical implementation involved in applying a color grading LUT was described in section [8.4]

Moreover, the “Space Time Drama Manager” event management script was explained in terms of function and purpose in section [8.5].

Finally, section [8.6] provided an insight on the general iterations and improvements involved in the construction of the playable prototype.

Chapter 9

RESULTS

9.1 INTRODUCTION

The final experiment relative to the hypothesis stated in section [7.3.1] was conducted on 44 participants (22 males and 22 females) from three different locations during week 19, 2016. In this section, the most relevant data will be illustrated and later described in findings and observations. The mean values relative to the control (A) and experimental (B) group for the questionnaire will be presented, as opposed to each individual.

9.2 EXPERIMENT RESULTS

Data normality test indicated no normal distribution [Appendix 13.9]	*Grp A*	*Grp B*
Indicate your state of happiness.	6,7	6,3
Indicate your state of excitement.	4,7	4,5
Indicate to what extend you feel this way right now.		
Active / Engaged	3,0	3,2
Alert / Aware	2,4	2,2
Attentive	3,2	3,2
Inspired	3,0	2,2
Determined	3,0	3,0
Calculated Positive score	14,5	13,8
Afraid	1,2	1,4
Ashamed	1,1	1,3
Nervous	1,5	1,9
Hostile	1,3	1,1
Upset	1,3	1,5
Calculated Negative Score	6,4	7,1

How positive or negative was your interpretation?	4,4	3,7
Associate 3 adjectives with your interpretation of the game experience.		
Happy	8	4
Exciting	7	5
Satisfying	4	3
Joyful	9	3
Boring	5	11
Sad	0	5
Depressing	4	6
Relaxing	13	12
Serene	6	6
Tense	4	4
Upsetting	3	6
Distressing	3	1
Indicate your state of happiness.	6,2	5,9
Indicate your state of excitement.	4,7	4,2
Indicate to what extend you feel this way right now.		
Active / Engaged	2,9	2,5
Alert / Aware	2,2	2,2
Attentive	3,1	2,6
Inspired	3,0	2,5
Determined	2,7	2,4
Calculated Positive score	13,9	12,2
Afraid	1,4	1,4
Ashamed	1,2	1,1
Nervous	1,3	1,5
Hostile	1,3	1,5
Upset	1,6	1,7
Calculated Negative Score	6,7	7,2

Figure 54 Calculated mean values of the submitted answer for the control (A) and experimental (B) group.

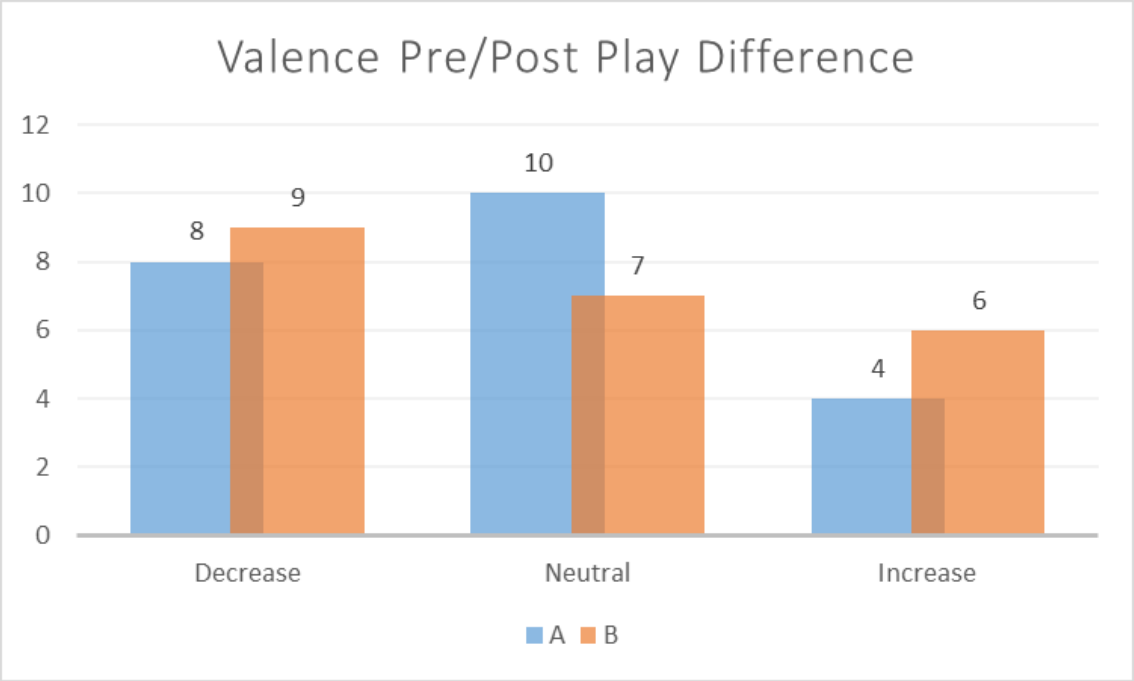

Figure 55 The difference between pre and post play values for individuals' state of valence. There is primarily a decrease for group B, whereas group A mostly stay neutral.

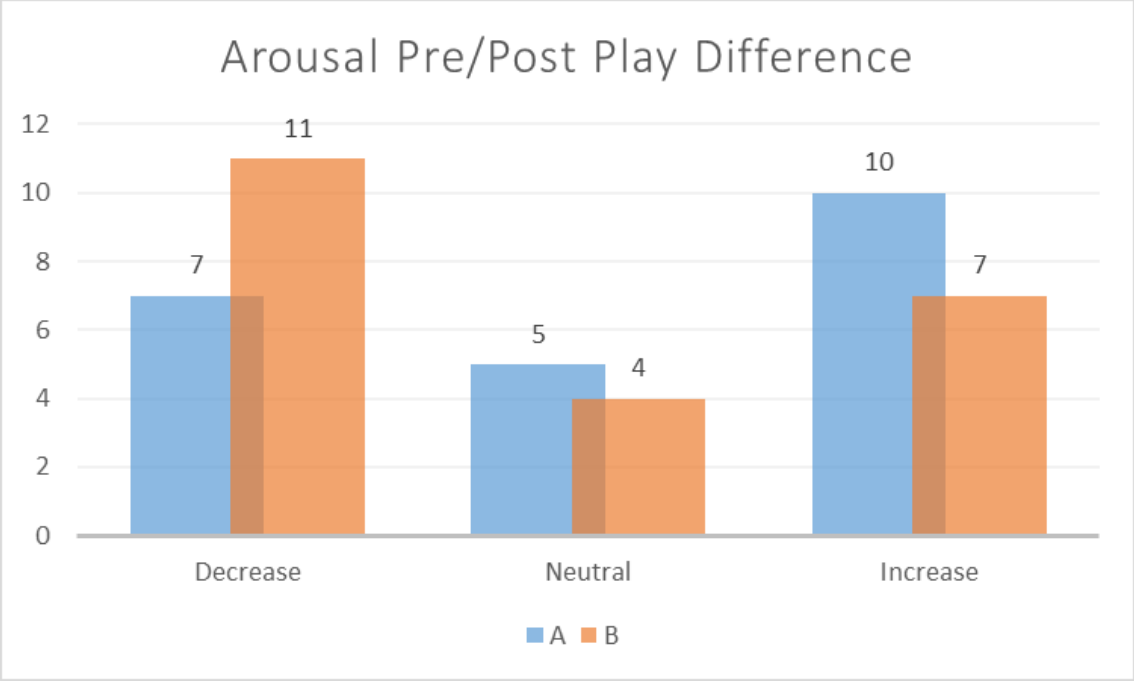

Figure 56 The difference between pre and post play values for individuals' state of arousal. There is primarily a decrease for group B, whereas group A experiences an increase.

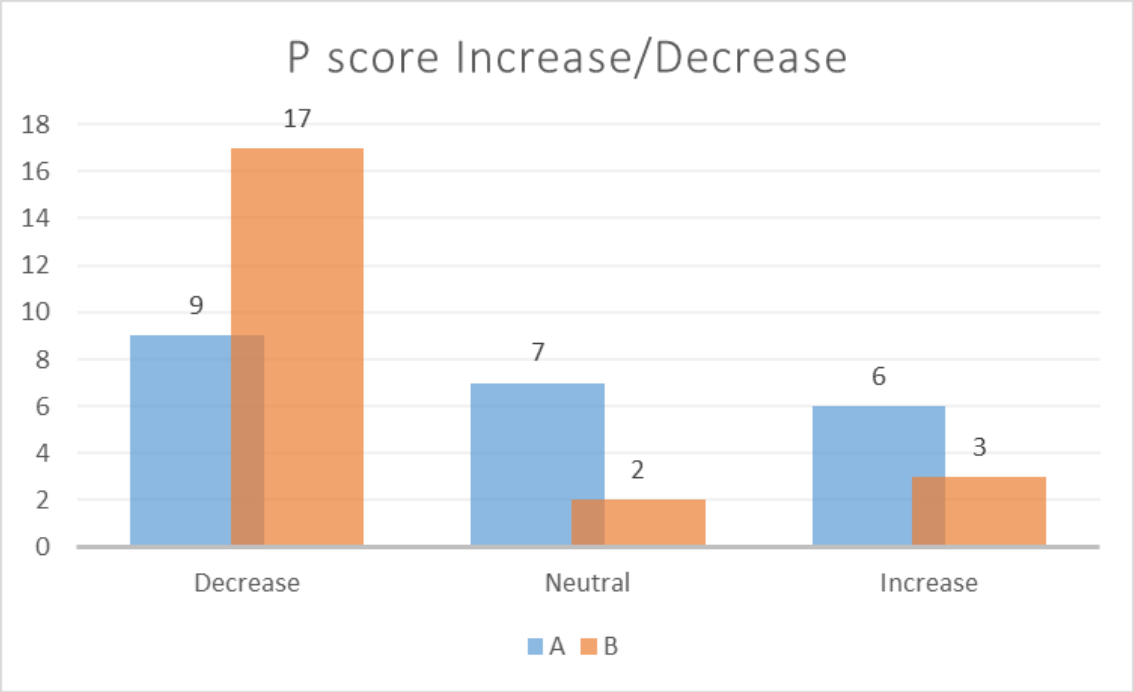

Figure 57 The difference between pre and post play values for individuals' positive score relative to the I-PANAS-SF questionnaire. There is a significant decrease experiences in group B, whereas group A is mostly streamlined.

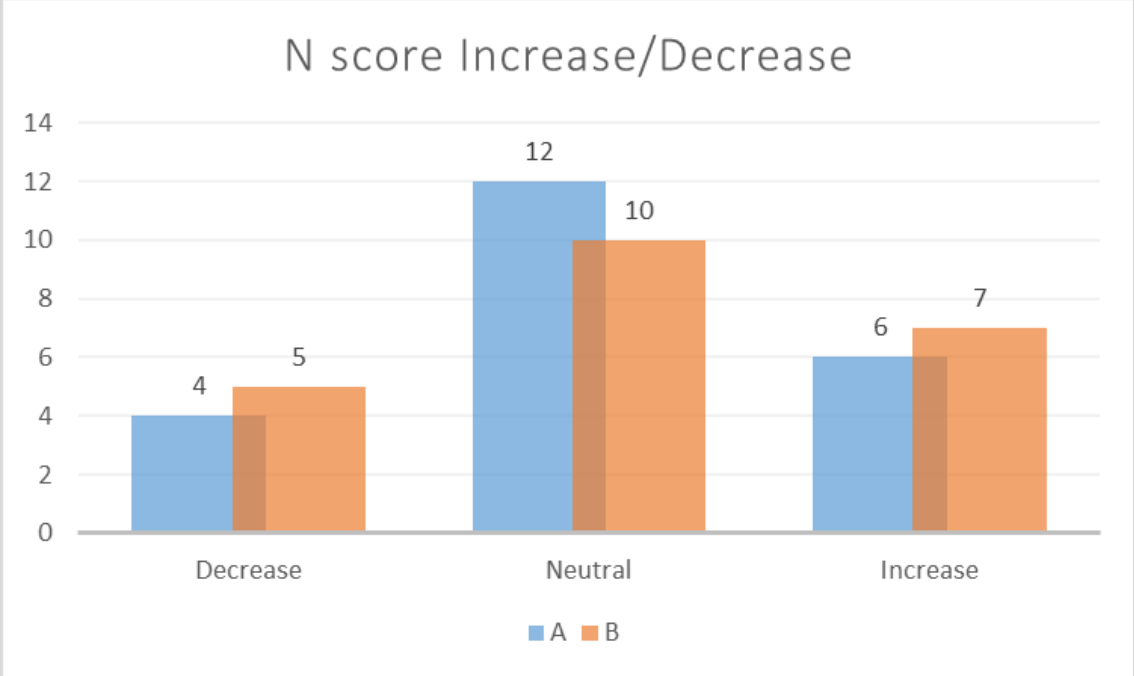

Figure 58 The difference between pre and post play values for individuals' negative score relative to the I-PANAS-SF questionnaire. The changes are fairly streamlined across the two groups.

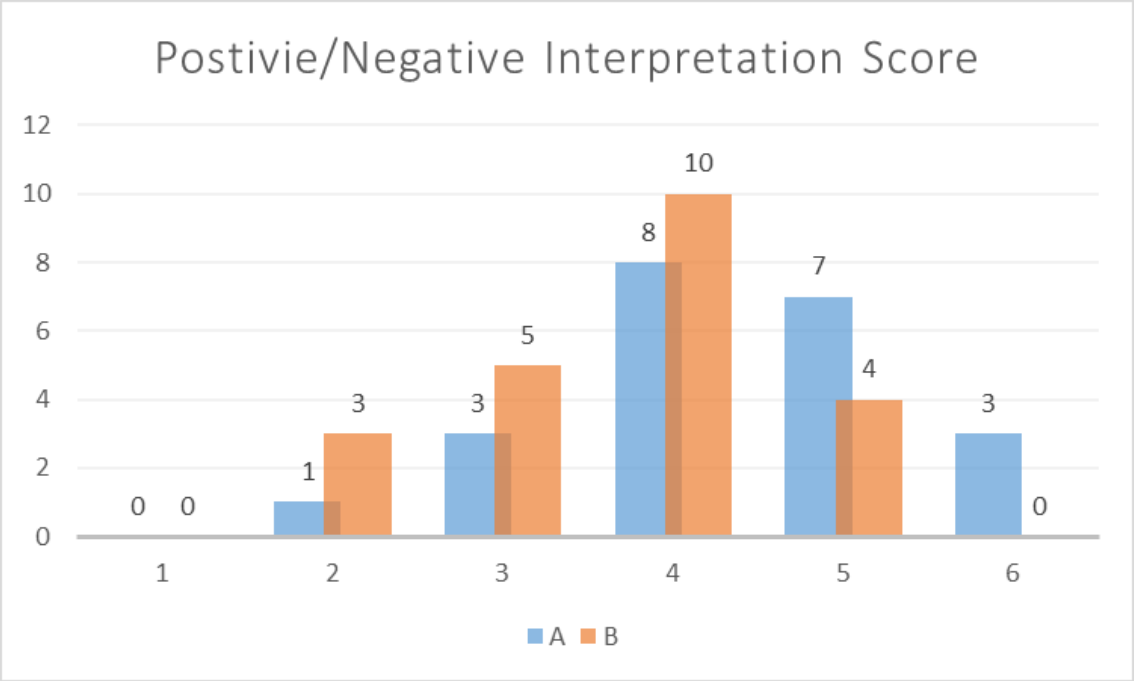

Figure 59 The positive/negative interpretation score relative to individuals' own rating of interpretation, where 1-3 is a negative score and 4-6 is a positive score indication. Generally, there is more negative scores for interpretations in group B in comparison to group A.

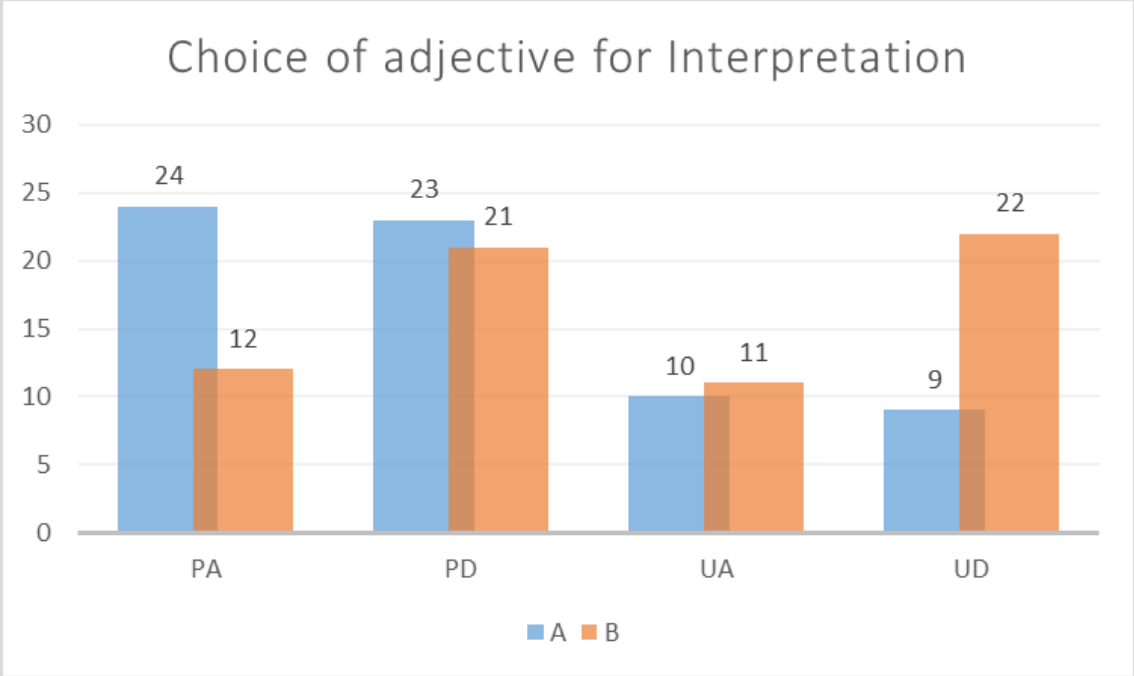

Figure 60 Choice of emotionally descriptive adjectives as categorized on the Pleasant/Unpleasant and Activation-Deactivation dimensions. There is a tendency for the use of adjectives in the Pleasant-Deactivation and Unpleasant-Deactivation category in group B, whereas group A primarily uses adjectives categorized as Pleasant-Activation and Pleasant-Deactivation.

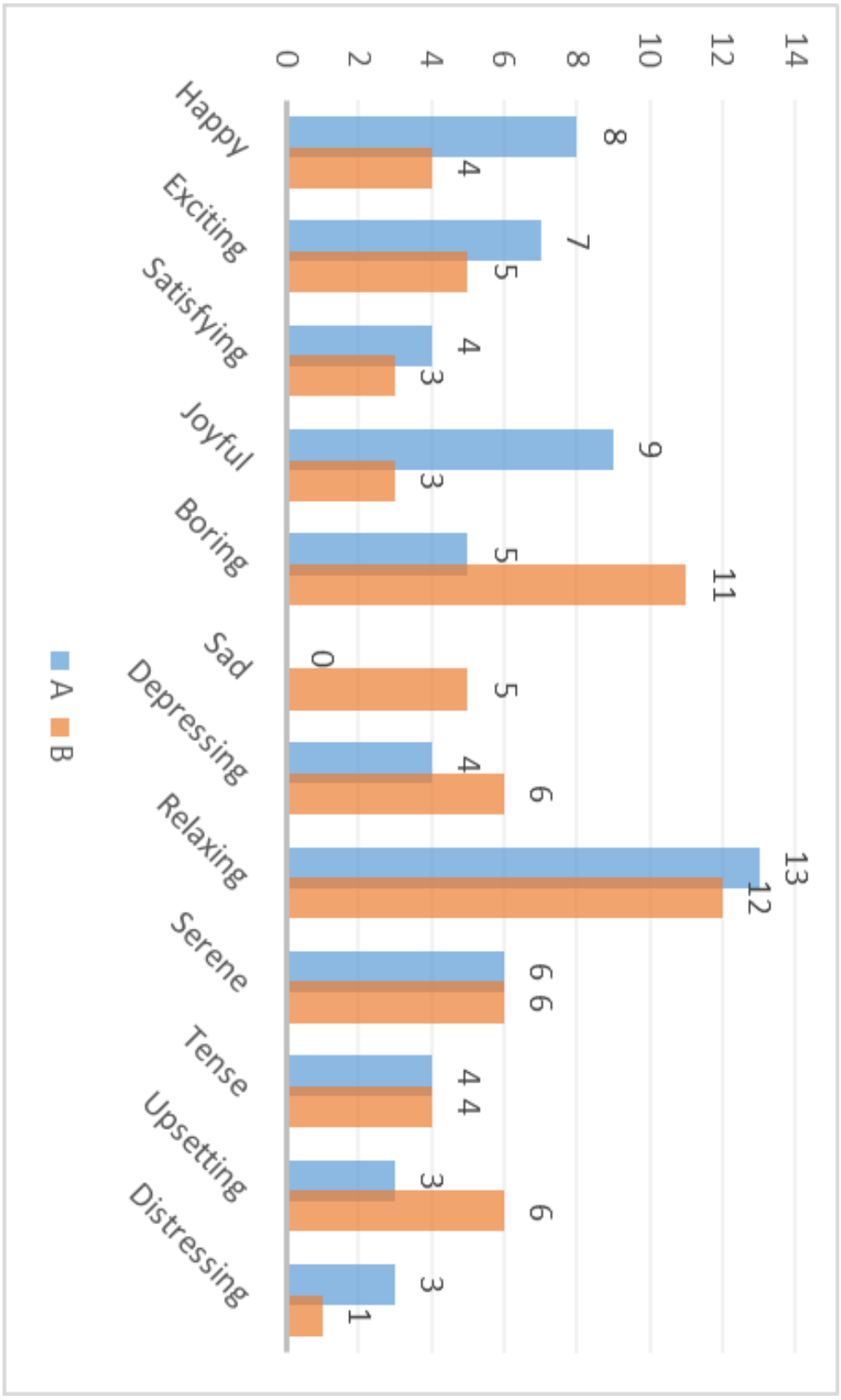

Figure 61 Use of emotionally descriptive adjectives outside the categorization. The choice of adjectives between group A and B are fairly close, however there is remarkable differences in the use of Boring, Joyful, Sad and Happy between the two groups.

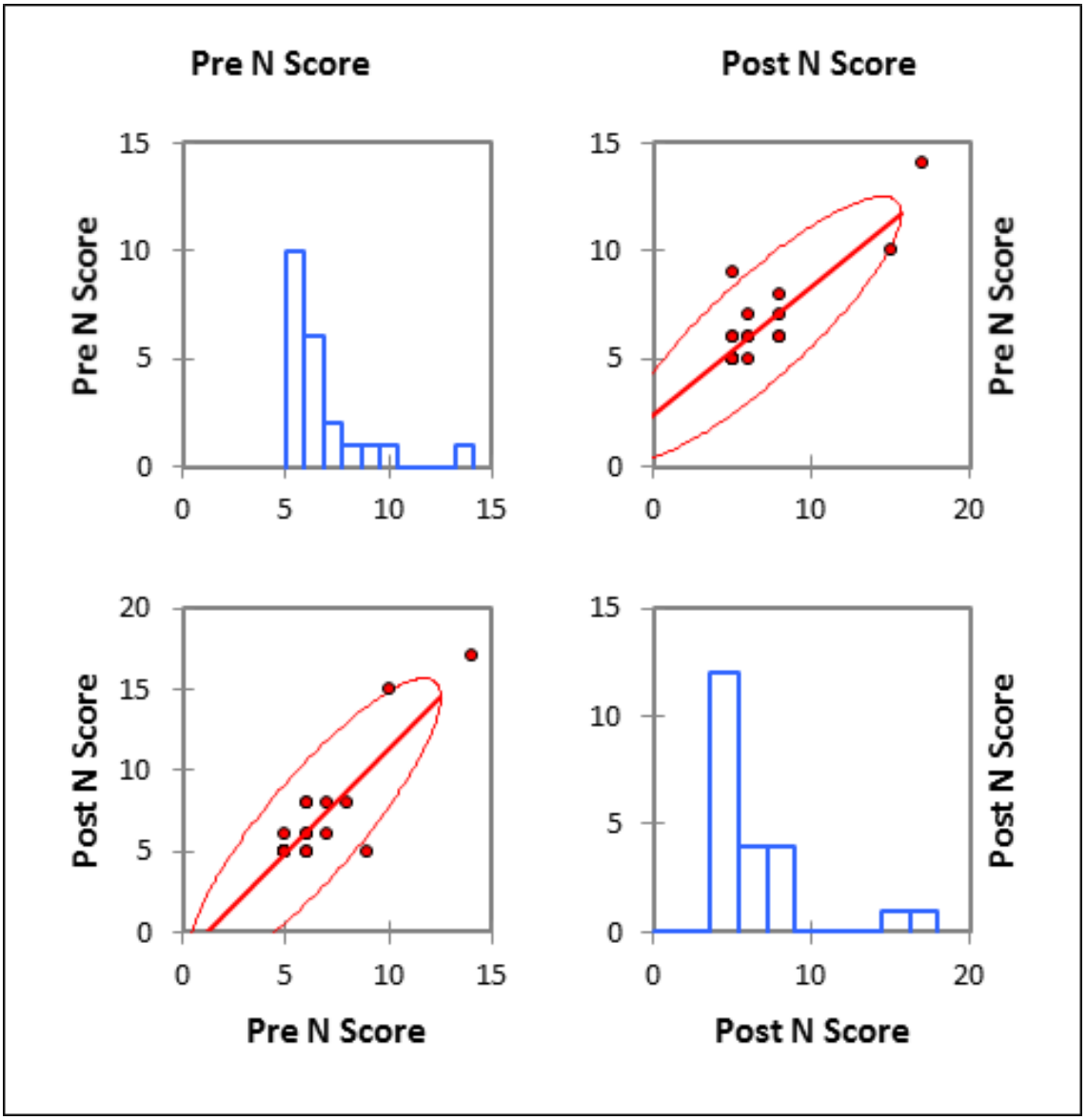

Figure 62 Spearman correlation test performed on the pre and post play negative scores relative to the I-PANAS-SF questionnaire for group A. There seems to be a correlation between the pre and post negative score with a 0,512 coefficients of determination indicating a strong correlation with a p values less than 0.05. There might be a good chance that the participants of group A have been affected primarily on their negative score through their experience.

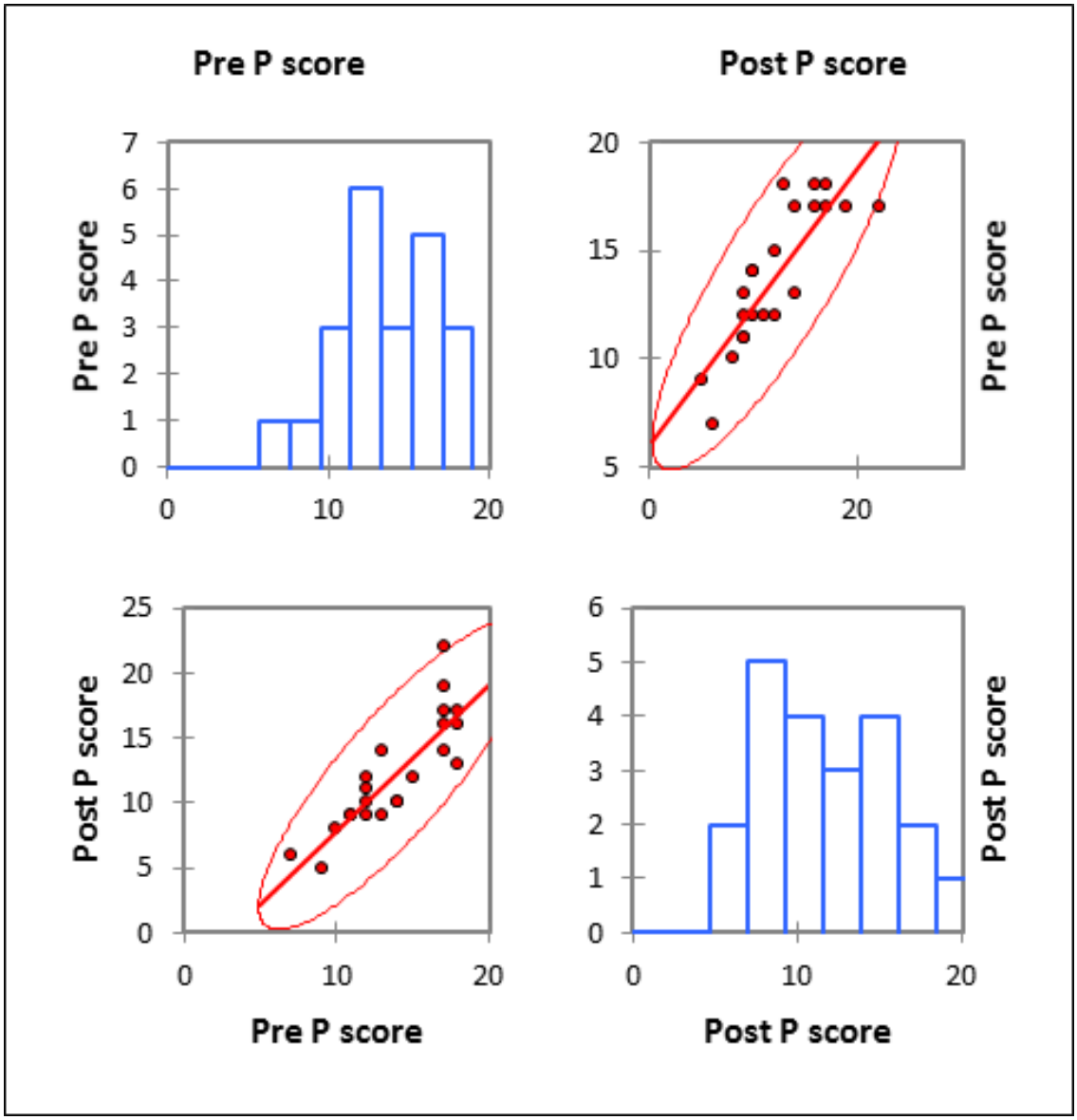

Figure 63 Spearman correlation test performed on the pre and post play positive scores relative to the I-PANAS-SF questionnaire for group B. There seems to be a correlation between the pre and post positive score with a 0,746 coefficients of determination indicating a very strong correlation with a p values less than 0.05. There might be a very good chance that the participants of group B have been affected on their positive score through their experience.

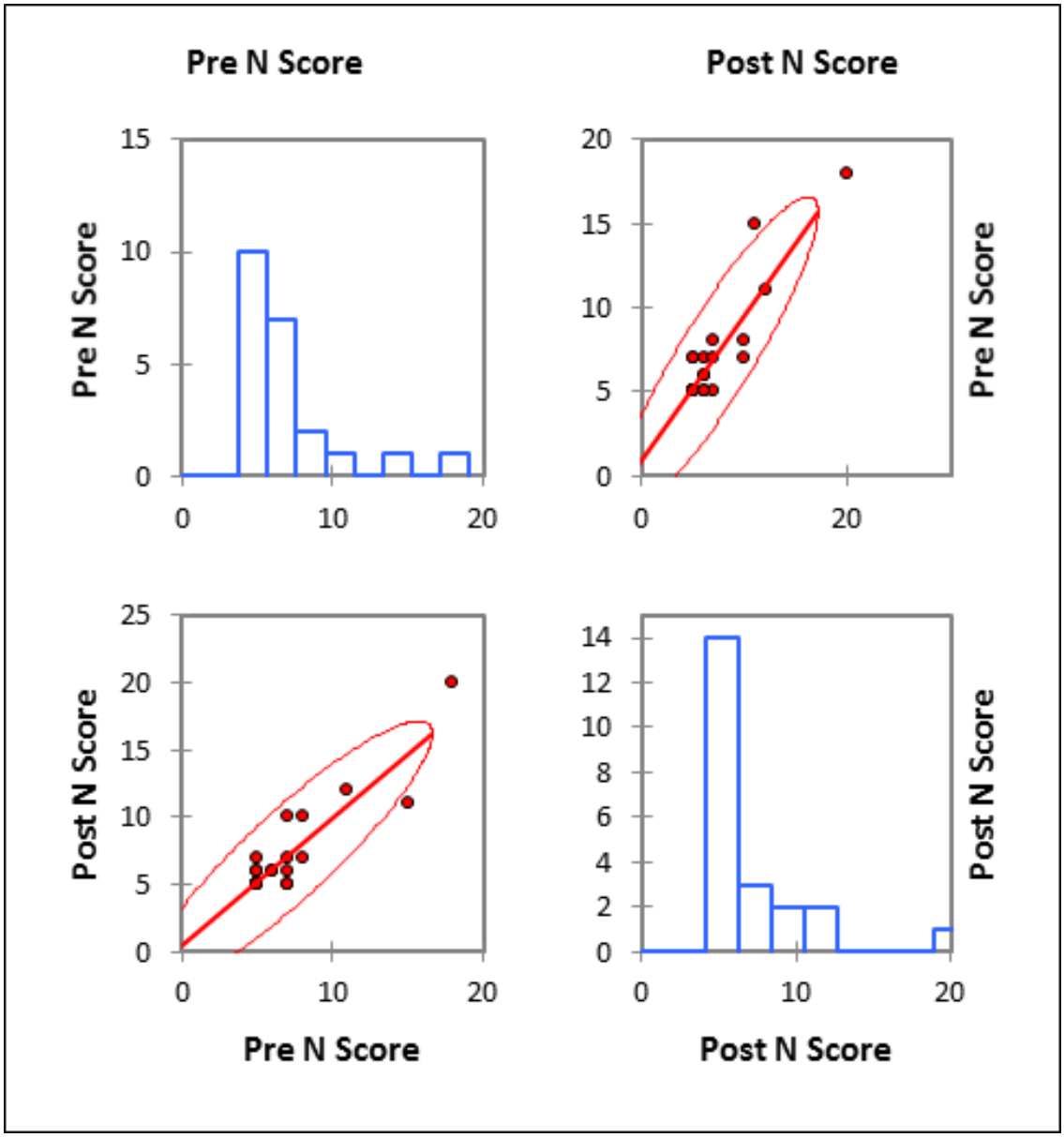

Figure 64 Spearman correlation test performed on the pre and post play negative scores relative to the I-PANAS-SF questionnaire for group B. There seems to be a correlation between the pre and post negative score with a 0,538 coefficients of determination indicating a strong correlation with a p values less than 0.05. There might be a very good chance that the participants of group B have been affected on their negative score through their experience

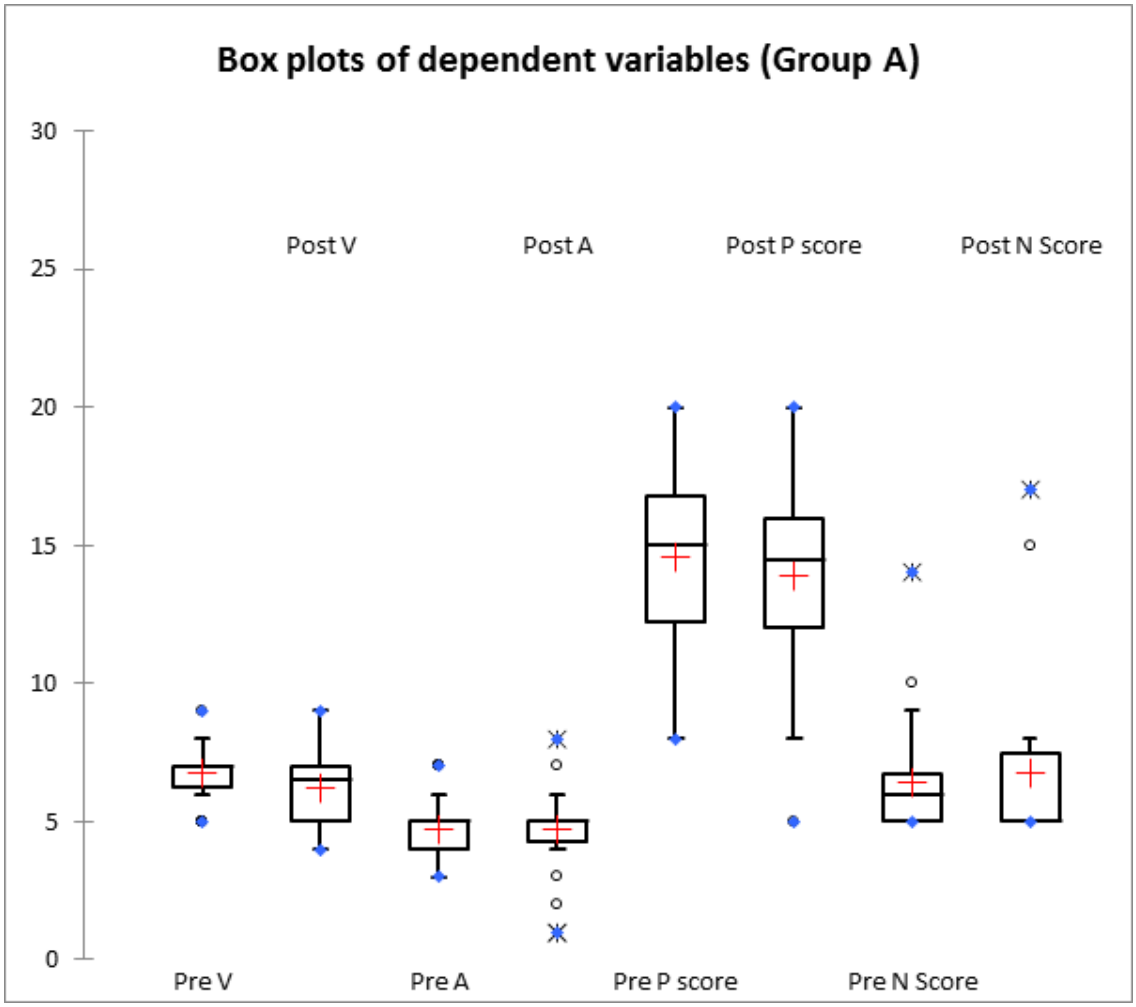

Figure 65 Box plot of all the dependent variables measured pre and post play for group A which shows differences in data distribution, means and medians.

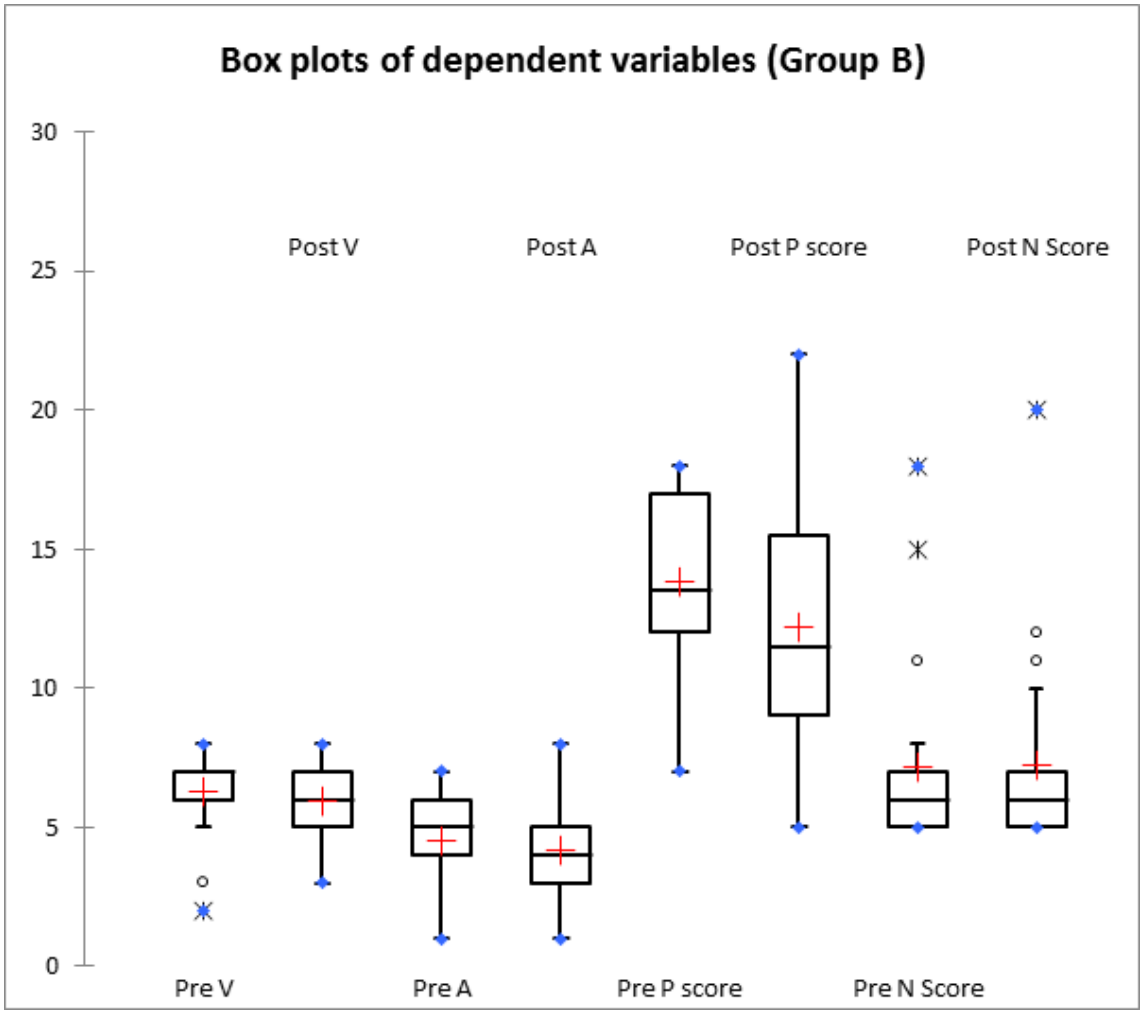

Figure 66 Box plot of all the dependent variables measured pre and post play for group B which shows differences in data distribution, means and medians.

Variable	Observations	Minimum	Maximum	Mean	Std. deviation
P/N interp (A)	22	2,000	6,000	4,364	1,049
P/N interp (B)	22	2,000	5,000	3,682	0,945

Kruskal-Wallis test:

K (Observed value)	4,481
K (Critical value)	3,841
DF	1
p-value (Two-tailed)	0,034
alpha	0,05

Figure 67 Kruskal-Wallis test applied to the Positive/Negative interpretation scores of group A and B, testing for a significant difference between the two. With a p value less than 0.05, the test indicates that there indeed is a significant difference between the Positive/Negative interpretation scores of group A in comparison to group B.

Variable	Observations	Minimum	Maximum	Mean	Std. deviation
P diff B	22	-5,000	5,000	-1,636	2,300
N diff B	22	-4,000	3,000	0,091	1,540

Kruskal-Wallis test:

K (Observed value)	10,044
K (Critical value)	3,841
DF	1
p-value (Two-tailed)	0,002
alpha	0,05

Figure 68 Kruskal-Wallis test applied to the difference between pre and post play values for individuals' positive and negative score relative to the I-PANAS-SF questionnaire, testing for a significant difference between the two. With a p value less than 0.05, the test indicates that there indeed is a significant difference between the difference of pre and post play values of the positive and negative scores of group B.

Variable	Observations	Minimum	Maximum	Mean	Std. deviation
P diff B	22	-5,000	5,000	-1,636	2,300
N diff B	22	-4,000	3,000	0,091	1,540

Mann-Whitney test:

U	109,000
Expected value	242,000
Variance (U)	1761,151
p-value (Two-tailed)	0,002
alpha	0,05

Figure 70 Post hoc Mann-Whitney test applied to the difference between pre and post play values for individuals' positive and negative score relative to the I-PANAS-SF questionnaire, to test for further significant differences. With a p value less than 0.05, it is confirmed that there indeed is a significant difference between the two values for group B.

Variable	Observations	Minimum	Maximum	Mean	Std. deviation
P/N interp (A)	22	2,000	6,000	4,364	1,049
P/N interp (B)	22	2,000	5,000	3,682	0,945

Mann-Whitney test:

U	328,000
Expected value	242,000
Variance (U)	1650,384
p-value (Two-tailed)	0,035
alpha	0,05

Figure 69 Post hoc Mann-Whitney test applied to the positive/negative interpretation score of group A and B, to test for further significant differences. With a p value less than 0.05, it is confirmed that there indeed is a significant difference between the positive/negative interpretation scores of group A and B.

9.3 FINDINGS

Based on the applied statistical analysis in section [9.2] on the acquired data from the experiment conducted, some interesting tendencies were evident. As such, they will be described in relation to what they may suggest and indicate, especially in relation to the hypothesis stated in section [7.3]. Thus, a potential explanation will be given that may lead to a conclusive answer for the final problem statement based on the rejected null hypothesis.

At the first glance of the data, it was clear that both the experimental and control group had a parallel standing during the initial process of the experiment in terms of overall feeling and emotions felt (Figure 54). This is a good sign as it indicates that the start condition for both groups have been similar, and as such will have little to no significance for the overall measurement. Meaning that any change in the data may be apparent when comparing them.

Furthermore, by calculating the differences between pre and post play of the various dependent variables such as, valence, arousal and the positive and negative scores, changes that had occurred during the experiment was visible (Figure 55, Figure 56, Figure 57, Figure 58, Figure 59 & Figure 60). Although most of the compared data between the two groups were fairly close, three interesting trends were visible through data visualization.

Firstly, there was a visible tendency for a decrease in the positive score (P score) for the experimental group (B), whereas the control group (A) had a more streamlined development (Figure 57 & Figure 58). This might suggest that the experimental group was affected negatively on the positive feelings and emotions felt, which may have led to this decrease. In contrast, the control group may not have had a significant impact.

Secondly, the comparison of the differences for the pre and post play sessions for the arousal value for the experimental and control group indicated that the experimental group experienced a significant decrease, whereas the control group experienced an increase (Figure 56). In correlation with the setting of the prototype, this might suggest

that the visual differences relative to the applied color grading might have led the experimental group to experience calm feelings.

Finally, the choice of emotionally descriptive adjectives in relation to their categorization (e.g. PA, PD, UA, UD) showed an interesting pattern where the experimental group would primarily utilize low arousal adjectives (PD and UD) with varying valence, whilst the control group would mainly use pleasant adjectives (PA and PD) of varying arousal (Figure 60 & Figure 61). Generally speaking, this might be speculated to signify an interesting tendency relative to the groups which could be related to the previous point on arousal. This means that due to the decrease in arousal for the experimental group (i.e. feeling calmer) their adjective choices were affected by it. Additionally, it is also interesting to see the explicit use of unpleasant descriptive adjectives in the experimental group in comparison to the control group. On the other hand, the control group primarily fixated on pleasant descriptive adjective usage with varying levels of arousal, which makes sense relative to the streamlined values. Relative to the prototype, this might mean that the control group had a more pleasant experience, whereas the experimental group did not.

Further, a correlation test was applied to the pre and post play samples of each variable to test if any significant correlations were present. Although most of the data showed a very low, though insignificant correlation in terms of the pre and post conditions of the variables, three of the samples stood out. Nonetheless, the correlations were indicated in the pre and post conditions of the positive and negative scores of the experimental group, in addition to the pre and post conditions of the negative scores of the control group (Figure 62, Figure 63 & Figure 64). This might essentially mean that a change between the pre and post measurement had occurred which might have had an influence. Specifically, the correlation suggests that the participants in the experimental group had a meaningful decrease in the feelings and emotions felt, whilst the control group only experienced this decrease on their negative score. For further clarity, this showed that the control group maintained mostly the same scores in the positive and negative score for the before and after condition, whereas the experimental group

experienced a significant decrease relative to the start condition. Furthermore, this change was also evident in the choices of the emotionally descriptive adjectives, and the participants' individual interpretation scores, which might confirm this assumption.

Moreover, through the applied Kruskal-Wallis test (Figure 67 & Figure 68) and post hoc Mann-Whitney test (Figure 69 & Figure 70), it was evident that there was in fact a significant difference between the before and after conditions of the participants' individual interpretation score relative to their group. Where the experimental group had a tendency for scoring on the lower end of the scale towards the negative, whilst the control group was mostly positive in comparison. More so, there was also a significant difference found between the positive and negative scores of the experimental group. This might mean that the experimental group had been influenced negatively by color grading. In relation to the control group however, the decrease that had occurred could be linked to the overall design and setting of the prototype. Essentially this might mean that since the setting is a passive and serene, in addition to the lack of any objective or game mechanic, the participants were simply affected by it. Meaning that the decrease, in for instance arousal was due to the setting, making the participants feel more calm. Since this condition has been exactly the same for the experimental group, except that it was applied a color grading LUT, it might lead to speculations that the noteworthy decrease could be caused or amplified by this notion.

For further discussion, it is possible to assume that based on the indicated significance and comparison with the other measurements (e.g. adjectives), that the experimental group were affected emotionally to a higher degree than the control group. As such, it would also be possible confirm this assumption based on the choice of descriptive adjectives and interpretation scores provided by the participants that this had an impact on how they perceived their interpretation.

However, relative to the textual data in terms of the actual interpretation of the experience an interesting tendency is visible. Although there seems to be an almost equal distribution of the varying degree of player experience between the control and the experimental group. The participants of the latter provided interpretations that

were at best descriptive of their frustration, in addition to mainly being a rational view of the world, see Appendix [13.5] and [13.6]. The control group has by far more expressive and imaginative descriptions and interpretation of the environmental storytelling elements and cues. Relative to the statistical data, this could potentially mean that the participants in the experimental group where affected in such a way that influence their ability to construct emergent narrative. In contrast, it might be assumed that the control group possibly had more suitable and ideal means for an emergent narrative to be constructed. Although both versions of prototype used in the control and experimental group were identical, it could be assumed that the visual alteration relative to the color grading might have had an effect. This might mean that the use of color grading in this specific context has had a negative effect on the experimental group and as such lead to a negative perception of the content of the prototype and caused participants to view the environmental storytelling as obsolete or insignificant. As such, it might also be assumed that the control group simply had better visual condition to encourage an emergent narrative.

Since the null hypothesis has been rejected under the condition of significant difference of $p < 0.05$ and also taking into consideration the analyzed textual interpretation, it might be possible to answer the final problem statement. The final problem statement is the following:

> ***" How does the use of color grading for the purpose of altering the mood and emotional tone of an environment's atmosphere, affect the interpretation and associated emergent narrative of narrative cues and elements of an environmental storytelling?"***

As such, in the confines of this specific context and use of color grading, it might be possible to state that there the specific use of color grading has had a negative impact on the player's ability to construct an emergent narrative.

9.4 OBSERVATIONS

As a qualitative means of measurement, participants were observed throughout the duration of the experiment. This was mostly to see any interesting trends and tendencies while participants were involved with the experiment. Additionally, participants were also consulted afterwards in regards to some of their observed actions. As such, the following observations were made.

9.4.1 Exploration

Exploration was the primary means of interaction within the prototype, as such participants explored their surroundings relative to their initial level of curiosity. An interesting observation was that relative to the limited space allocated for exploration, the external space beyond the boundaries seemed to be more interesting to many players. As such, many attempted to find the means to escape and see what may lie on other side on the basis of their curiosity. This desire was amplified through the events where boulders would fall and block the exit.

Another interesting observation was that the majority of the players experienced what is known as “illusion of grandeur” or simply put, they speculated that there might be more to the prototype that visually present. As such the desire to explore and make meaning where there was none was observed in and implied by a number of participants.

The extent and method of exploration in the prototype was observed to vary across all participants and groups, where some would take their time to explore the zone and clues carefully, whilst some would examine the details of the environment and others simply attempt to find some means of interaction or objective to fulfill. An interesting trend was that in most cases, participants who by their own definition were experienced gamers, would mostly attempt to find a gameplay objective or mechanic. As such, lack of success would greatly reduce interest and subsequent conclusion to their experience.

As for method of exploration, participants who identified as non-players with low experience tended to move very slowly in the environment, whereas participants who

identified as more seasoned tended to move faster and utilize the spring function more often. Furthermore, the zone was explored by some by strictly keeping close to the edge of the map and going in a circular motion around the whole area to find an exit, others however would keep more towards the middle of the map and move in unpredictable directions relative to what they may be curious about at that time.

9.4.2 Goals and objectives

As to exclude as many potential means of influence on players, the prototype was designed as a simplified walking simulator. As such, the prototype did not have any explicit objectives and means of progression. There also no right or wrong ways of playing, which essentially meant that there were no reward or punishment systems implemented. What was interesting to observe in this context was that this notion led to players creating objectives of their own, in this case finding an exit to progress further or finding an intractable or potential "hidden" game mechanic, which was the goal for most. This also related to the illusion of grandeur where many thought that there was more to the experience than it was conveyed to them, which encouraged many to find this "hidden" mechanic or objective which did not exist.

On the other hand, lack of game mechanics and intractable led to some participants trying to exploits through unconventional means, such as using colliders to their advantage and going out of bounds in search for what may be on the other side. Those who did not however, were anxious to know whether or not they might have missed something meaningful, as the prototype did not provide any form of feedback as to whether they did something right or wrong. As such, the lack of punishment and reward in a sense confirmed their suspicion.

More so, participants who identified as experienced players, were demotivated by the lack of purpose and objectives and as such lost interest. In this context, due to the participants' desire for objectives, goals and game mechanics, some of the narrative elements in the prototype were not deemed significant or relevant and as such were not inspected in further details.

Chapter 10

DISCUSSION

10.1 INTRODUCTION

In this section the various aspects of the thesis will be evaluated and discussed. Possible issues, concerns and solutions may as such be highlighted relative to the prototype, the experiment and the results.

10.2 THE PROTOTYPE

The created prototype for the experiment was very limited as it was very dependent on available assets for implementation. In addition to that the assets were also required to be consistent, which meant that the prototype could only be implemented with what was available and consistent in style. Consequently, this significantly narrowed the possibility and diversity for what may actually be possible to implement. On the other hand, the assets required for implementation (e.g. sound, models, textures etc.) could have been custom made in terms of what was desired to be created. However, this was an unrealistic objective relative to the human resources available at the time of implementation.

Another point of concern was the lack of objectives and mechanics incorporated. Albeit the prototype was intentionally designed to be very basic and only support the most essential mechanics such as movement, to avoid any potential distraction or influence that may take away from the applied stimulant. It is speculated that perhaps some form of objectives should have been implemented regardless. This could be assumed to support the intended goal of the experiment, where players were given the objective to investigate the area for potential clues, instead of leaving it up to the individual player to come to that conclusion, essentially giving purpose to the experience. Additionally, there could have been some intractable props and assets present for the players,

regardless of how simple or meaningless to simply incorporate some basic drive or sense of progression into the experience. This was primarily evident in the overall feedback and the fact that most players felt that they were actively searching for them.

10.3 THE EXPERIMENT

The overall approach to the experiment is considered to have been successful, however some slight concerns were involved. Primarily, the method of sampling should have been more random in nature as to be more representative of a broader population. More so in the same context, the participants should have through the demographic section of the questionnaire been categorized in a better way. Although the categorization was hoped to be achieved through, age, gender and player experience as identified by the participants, player type could have also been taken into considerations. This is mostly relative to behavior and tendencies that is tied to player types and as such would be interesting to investigate. It was also apparent through observation and consultation with participants that their player type, not to be confused with player experience, had somewhat of correlation with how they interacted, behaved and more importantly interpreted the content.

Another point of concern would relate to the experimental setup, even though it was fairly similar and streamlined across the different locations and individual participants, a different approach could perhaps have been utilized. This is mainly a concern, as it is impossible to estimate whether subtle changes in the lighting of the actual environment in which the experiment was conducted, or even the participants' display settings could have had an effect on the outcome and as such could have been taken into considerations and controlled initially.

Finally, the evaluation methods could have been further improved for the purpose of cross validation, in addition to allocate less time in the experiment. This was so that the main bulk of the participants' time would be spent in the experience as opposed to answering the questionnaire. In the same context, perhaps supplementary and

nonintrusive objective means of measurement should have been incorporated for the purpose of cross validation.

10.4 THE RESULTS

The findings suggested that the null hypothesis was rejected and as such accepting the alternative hypothesis could be possible. However, in the confines of the problem statement, the final experiment was only inclusive of one color grading LUT, which is not definitive of how color grading may effect emergent narrative in general terms. For further clarity, it is possible to assume that the suggested effect is mainly in this specific context, represented in the prototype with that specific use of color grading LUT. This is simply to say that it is possible to assume based on the results that color grading has had an impact on individual's ability to construct an emergent narrative relative to environmental storytelling, but that this could primarily be stated in this specific context and use of color grading for now.

More so, the results were analyzed with different categorization method such as gender and player experience. The analyzed data based on gender as opposed to groups, see Appendix [13.8], showed a very streamlined and almost equal developments across the board and as such deemed insignificant and excluded from further analysis.

Chapter 11

CONCLUSION

Through the final problem statement, the following was asked:

> ***" How does the use of color grading for the purpose of altering the mood and emotional tone of an environment's atmosphere, affect the interpretation and associated emergent narrative of narrative cues and elements of an environmental storytelling?"***

Through the entire process of this thesis, the possibility of influencing the interpretation and construction of an emergent narrative relative to environmental storytelling has been investigated. While the results did in fact suggest a significant difference in how participants were influenced and subsequently affected in relation to their ability to construct an emergent narrative, it was only achieved in the specific context and confines of the experiment. As such, for a more conclusive answer to the final problem statement, further investigation into varies archetypes and styles of color grading should be examined.

Color theory and the effects of color can be at times very contradicting in available literature based on context and purpose. As such, this should be taken into consideration for further investigation and experimentation when applied to color grading in video games in relation to emergent narratives and environmental storytelling.

Chapter 12

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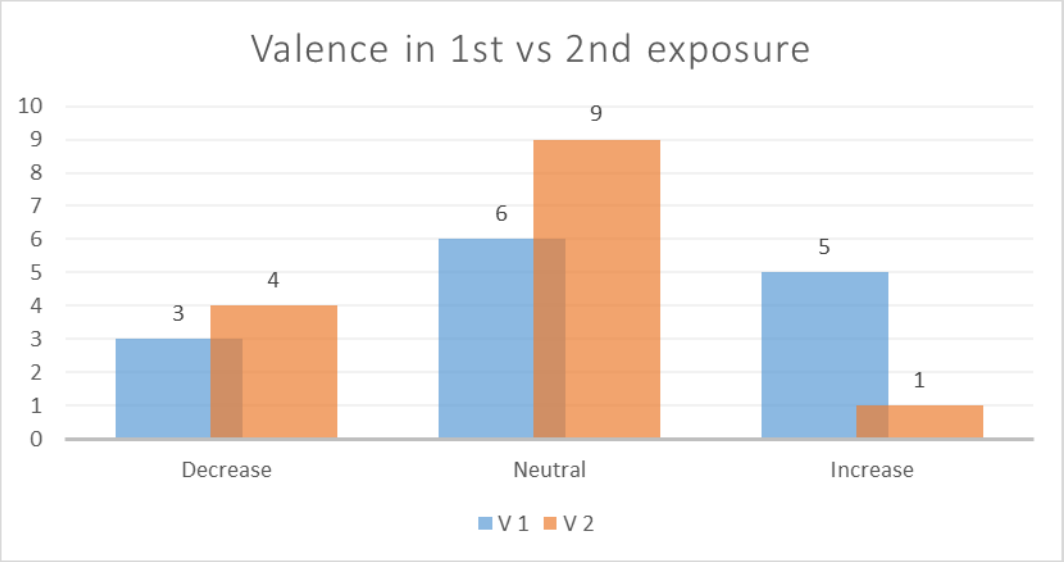
Figure 5	http://www.macgamerhq.com/wp-content/uploads/2013/04/Portal-2-gameplay-9.jpg
Figure 8	https://www.youtube.com/watch?v=dnK-EGbEQHk [Abridged]
Figure 9	http://ayay.co.uk/backgrounds/action_games/team_fortress_2/pyro-vs-soldier.jpg
Figure 10	http://3.bp.blogspot.com/-bzi_cqmz6Fc/VpQqX-Ag-5I/AAAAAAAAM6g/f4U5PS_lyr8/s1600/5.jpg
Figure 12	http://www.jethrojongeneel.com/articles/T4.php
Figure 13	http://i.imgur.com/l7J5k0V.jpg
Figure 14	http://vignette2.wikia.nocookie.net/bioshock/images/3/31/Thsthsrt.jpg/revision/latest/scale-to-width-down/1024?cb=20130416113349
Figure 15	http://vignette1.wikia.nocookie.net/bioshock/images/0/01/Memorial_Gardens_(1).jpg/revision/latest?cb=20130725135122&path-prefix=de
Figure 16	http://beyondnaturalselections.weebly.com/uploads/1/6/8/0/16809370/234933667_orig.png
Figure 17	http://vignette1.wikia.nocookie.net/wowwiki/images/0/05/Cataclysm_Gilneas_-_City_Streets.jpg/revision/latest?cb=20090821235218
Figure 18	http://us.media5.battle.net/cms/gallery/IVJL65TBCYMS1347378692922.jpg?v=0
Figure 19	http://i.gbc.tw/gb_img/0/002/825/2825240.jpg [Abridged] http://img12.deviantart.net/3b6c/i/2012/166/2/0/vale_of_eternal_blossoms_by_secretsalute-d53m6zm.jpg [Abridged]
Figure 20	https://youtu.be/vc4lBVKWmxA?t=14s [Abridged]
Figure 21	https://vimeo.com/12036783 [Abridged]
Figure 22 Figure 23	https://forums.unrealengine.com/archive/index.php/t-48641.html
Figure 26	http://www.sciencedirect.com/science/article/pii/0005791694900639 (Bradley & Lang, 1994)

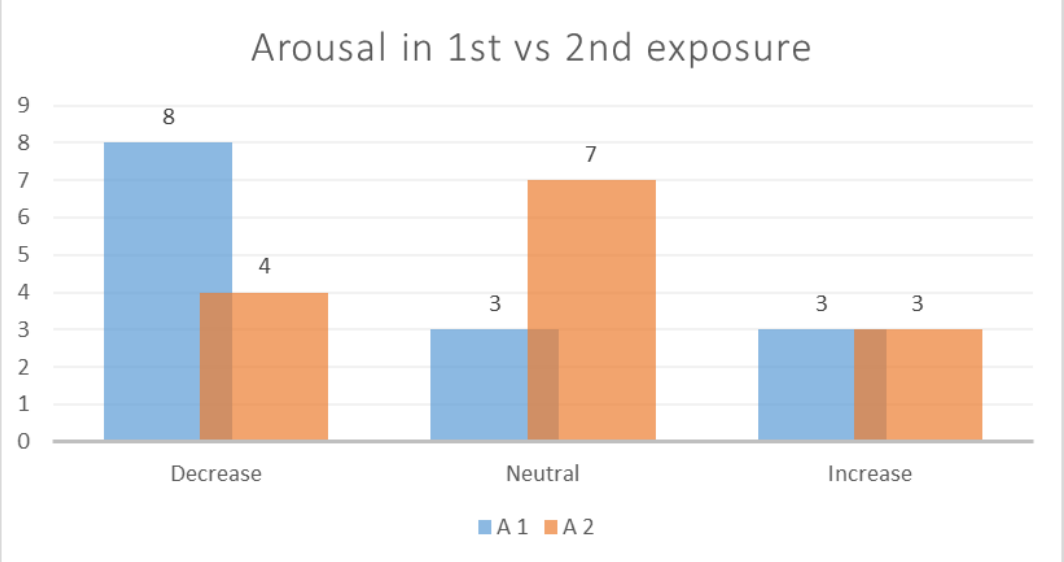
Figure 27, Figure 28	http://irtel.uni-mannheim.de/pxlab/demos/index_SAM.html [Abridged]
Figure 31	https://www.researchgate.net/figure/239842533_fig1_Figure-1-The-circumplex-model-of-affect-Russell-1980-with-valence-on-the-horizontal
Figure 43	https://www.assetstore.unity3d.com/en/#!/content/52977
Figure 44	https://www.assetstore.unity3d.com/en/#!/content/45896
Figure 46	https://www.assetstore.unity3d.com/en/#!/content/11256
Figure 47	https://www.assetstore.unity3d.com/en/#!/content/24534 [Abridged]
Figure 48	https://www.assetstore.unity3d.com/en/#!/content/45935 [Abridged]

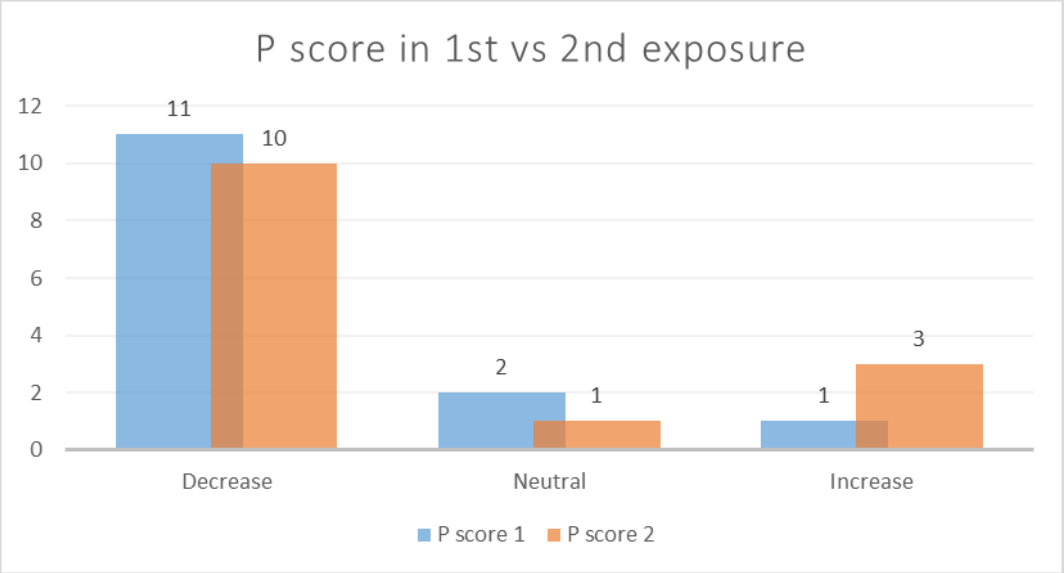
Chapter 13

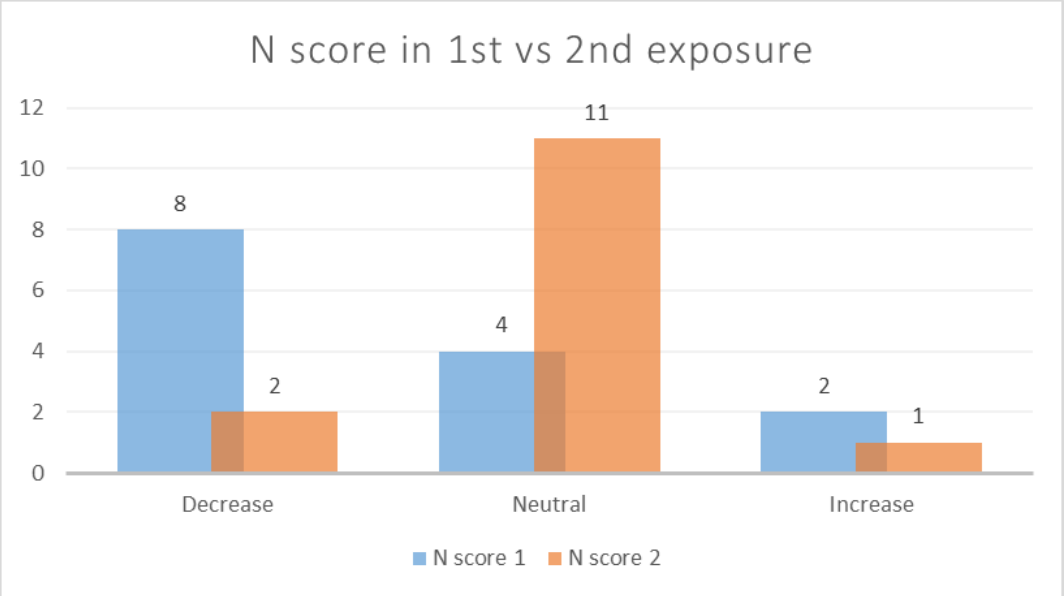
APPENDIX

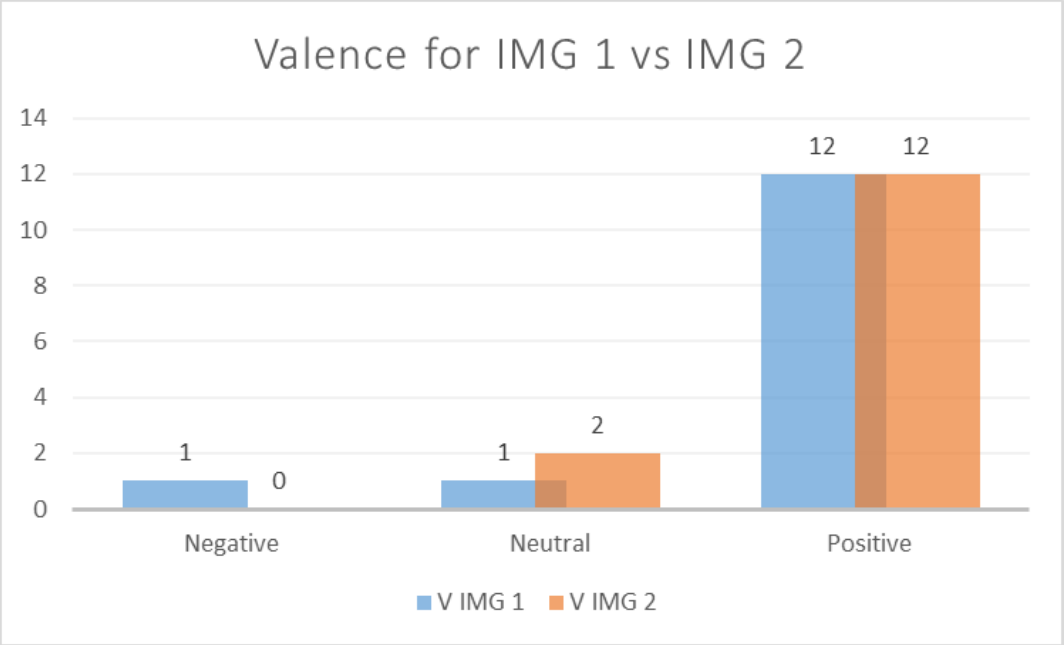
13.1 DESCRIPTIVE DATA – PRELIMINARY TEST (LUT)

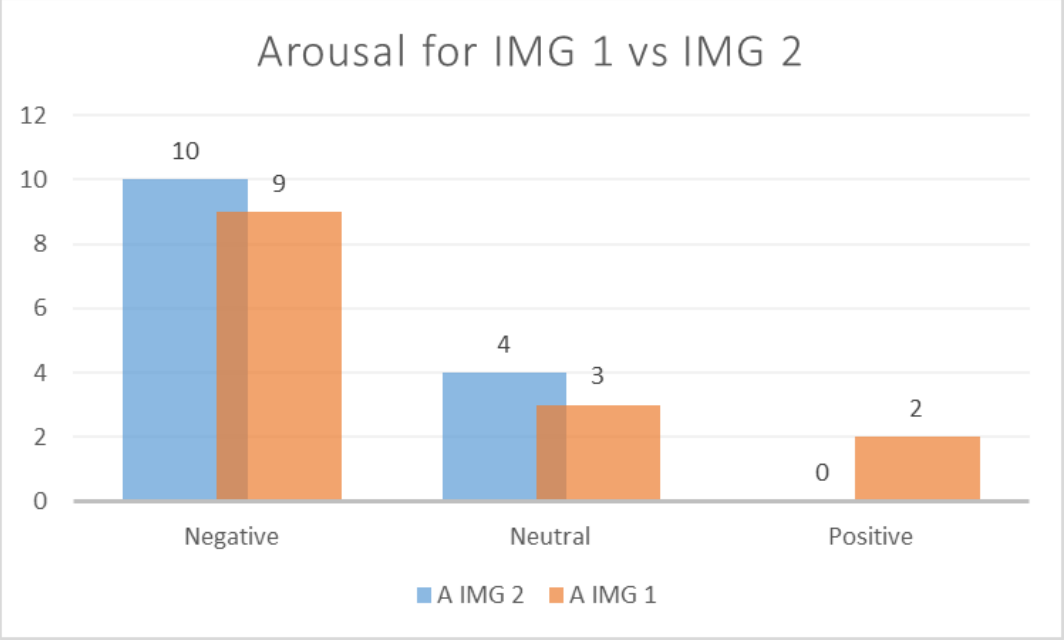


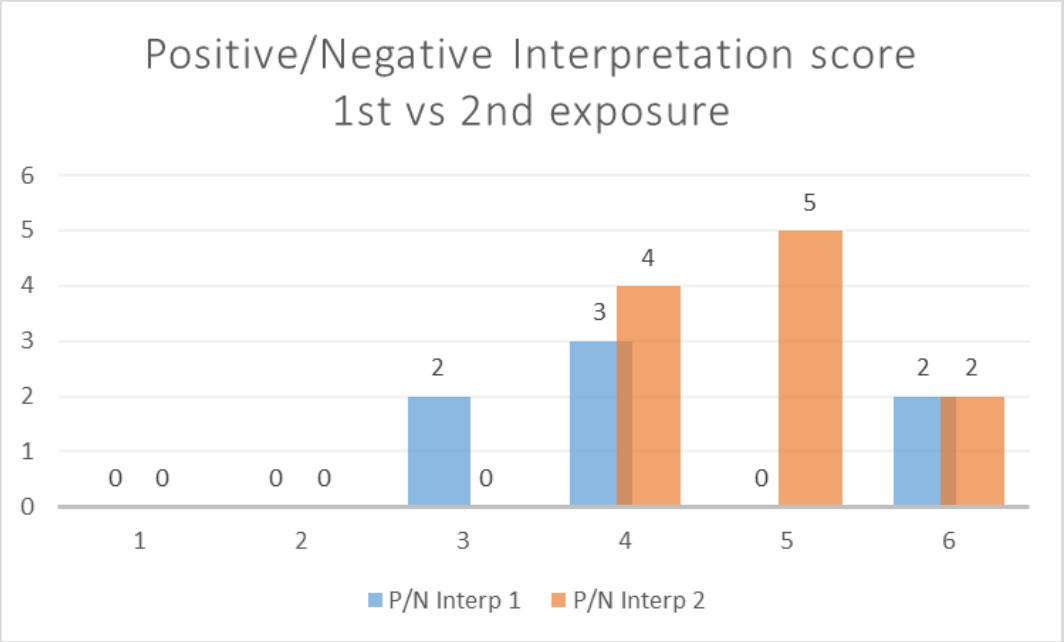


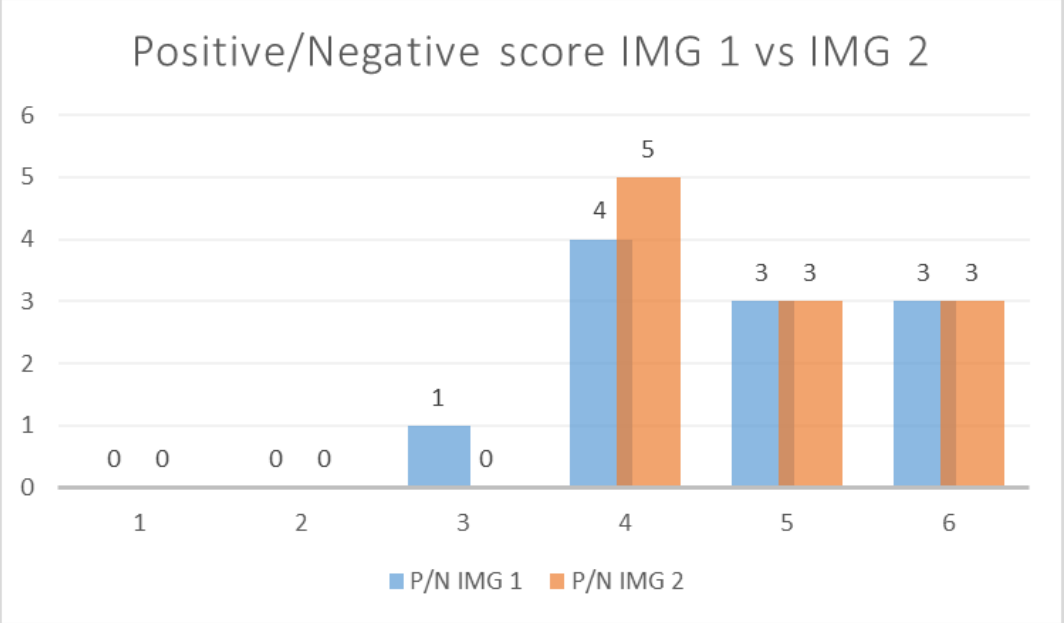

P score in 1st vs 2nd exposure
12
10
8
6
4
2
0
11
10
2
1
1
3
Decrease
Neutral
Increase
P score 1
P score 2


N score in 1st vs 2nd exposure
12
10
8
6
4
2
0
8
2
4
11
2
1
Decrease
Neutral
Increase
N score 1
N score 2

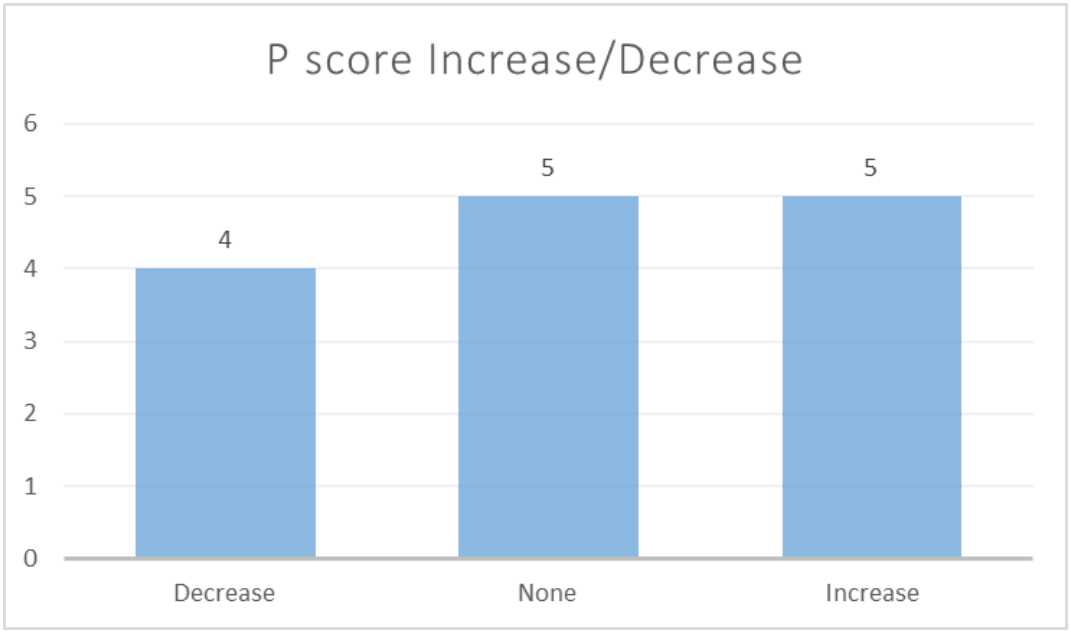

Valence for IMG 1 vs IMG 2
14
12
10
8
6
4
2
0
1
0
1
2
12
12
Negative
Neutral
Positive
V IMG 1
V IMG 2

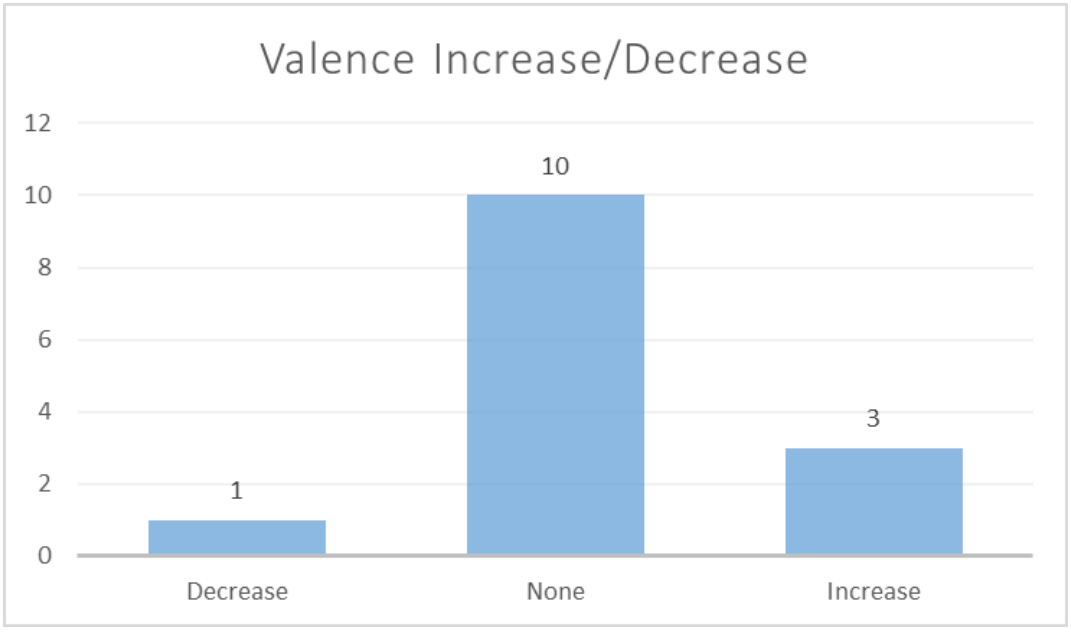

Arousal for IMG 1 vs IMG 2
12
10
8
6
4
2
0
10
9
4
3
0
2
Negative
Neutral
Positive
A IMG 2
A IMG 1

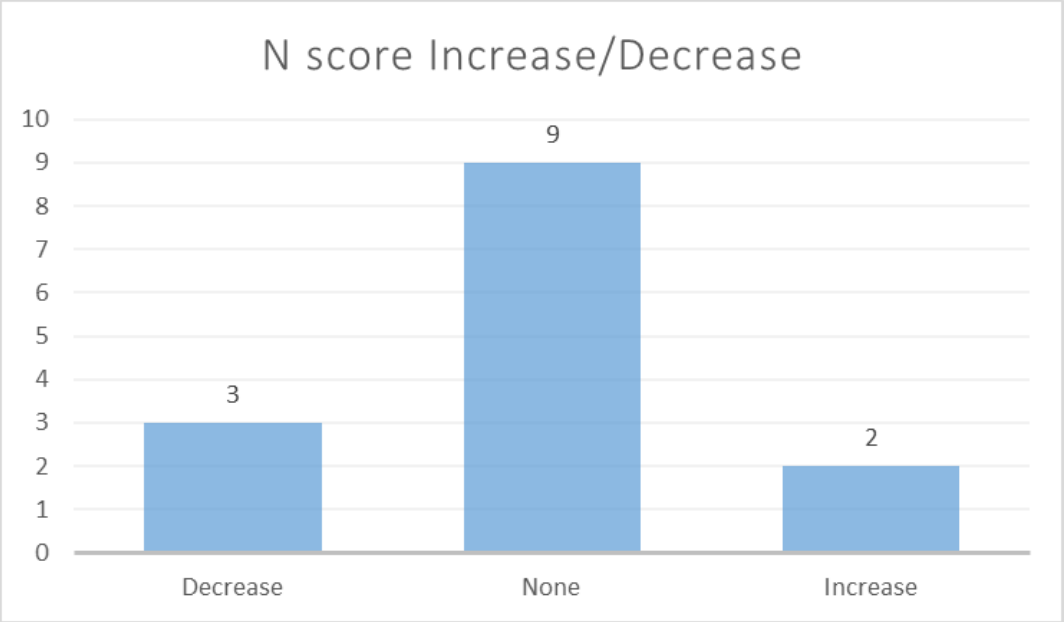

Positive/Negative Interpretation score
1st vs 2nd exposure
6
5
4
3
2
1
0
0 0 0 0 2 0 3 4 0 5 2 2
1 2 3 4 5 6
P/N Interp 1
P/N Interp 2

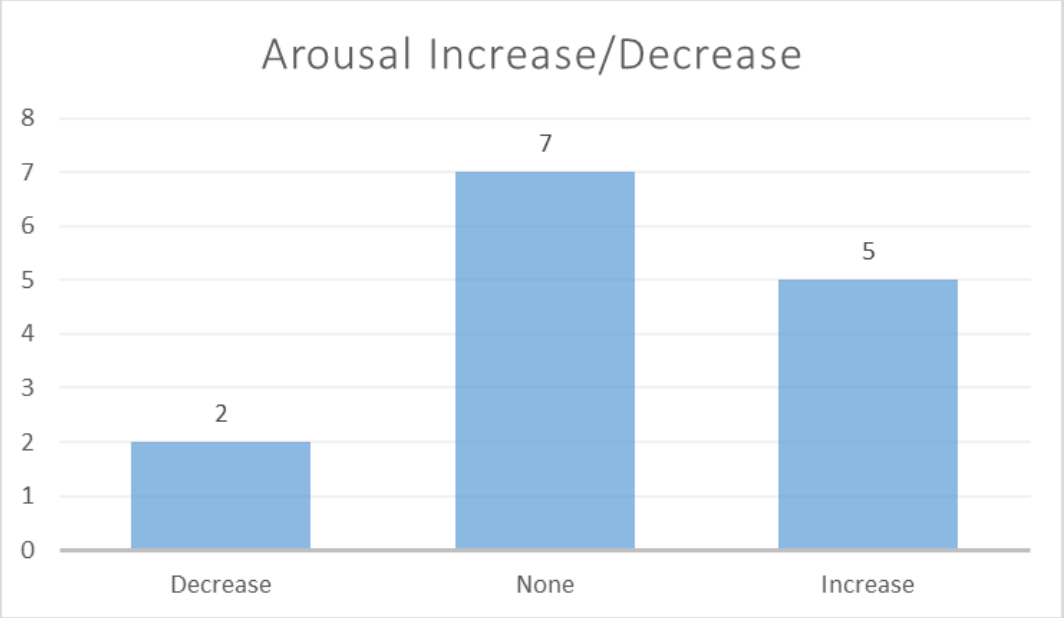

Positive/Negative score IMG 1 vs IMG 2
6
5
4
3
2
1
0
0 0 0 0 1 0 4 5 3 3 3 3
1 2 3 4 5 6
P/N IMG 1
P/N IMG 2

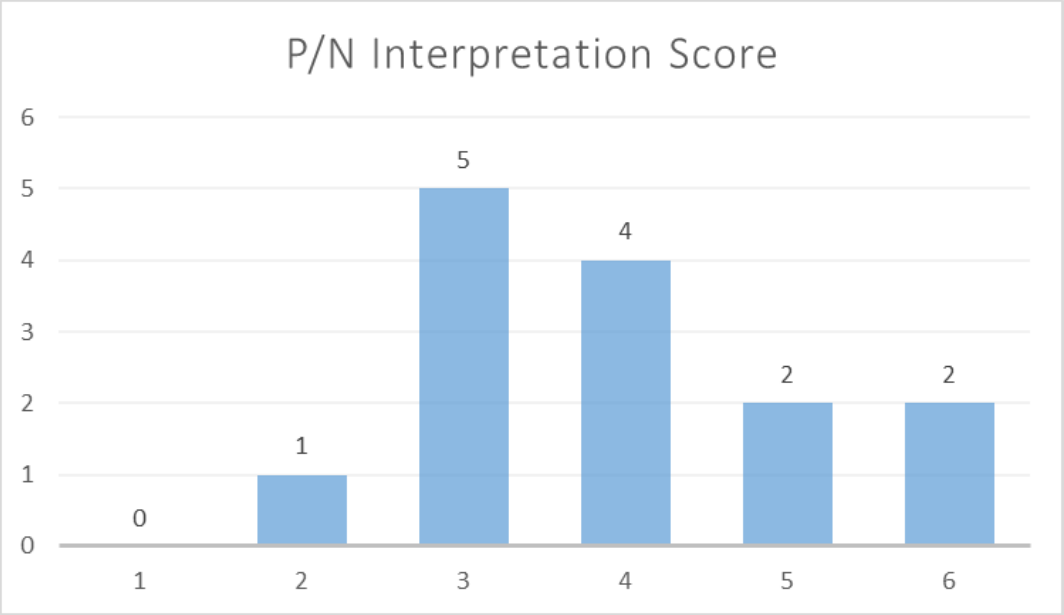
13.2 DESCRIPTIVE DATA – PILOT EXPERIMENT (QUESTIONNAIRE TEST)

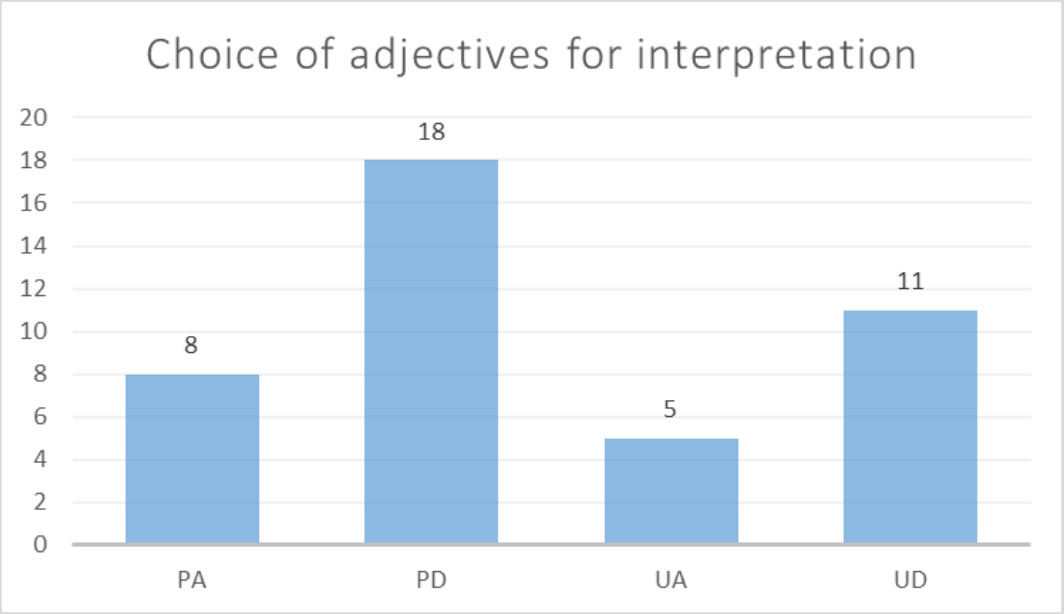





N score Increase/Decrease
10
9
8
7
6
5
4
3
2
1
0
3
9
2
Decrease
None
Increase


Arousal Increase/Decrease
8
7
6
5
4
3
2
1
0
2
7
5
Decrease
None
Increase


P/N Interpretation Score
6
5
4
3
2
1
0
0
1
5
4
2
2
1
2
3
4
5
6


Choice of adjectives for interpretation
20
18
16
14
12
10
8
6
4
2
0
8
18
5
11
PA
PD
UA
UD

	Pre V	Post V	V Diff	Pre A	Post A	A Diff	P/N Interp
Mean	6,36	6,57	0,21	3,50	3,57	0,07	3,93
Median	7,00	7,00	0,00	2,00	3,00	0,00	4,00
Min	2,00	3,00	-1,00	1,00	1,00	-3,00	2,00
Max	9,00	9,00	2,00	9,00	7,00	1,00	6,00
StD	2,02	1,72	0,67	2,53	2,09	1,03	1,16
StD	**Pre P score**	**Post P score**	**P score Diff**	**Pre N score**	**Post N score**	**N score Diff**	
Mean	11,79	11,07	-0,71	7,21	6,36	-0,86	
Median	10,50	10,00	0,00	5,50	5,00	0,00	
Min	6,00	6,00	-9,00	1,00	5,00	-9,00	
Max	23,00	19,00	2,00	18,00	13,00	3,00	
StD	5,12	3,90	2,79	3,47	2,32	2,80	

13.3 QUESTIONNAIRE DESIGN – FINAL EXPERIMENT

Questionnaire instructions

Please READ the following instructions carefully before proceeding!

The questionnaire you are about to partake in incorporates questions that relate to your current feelings and emotions while involved with the experiment. Therefore it is very important that you answers are relative to how you feel emotionally at the current time, that is, now at the present.

As a precaution every question provides a small description to clarify and emphasize as to what is being asked of you. As such, please be kind to carefully read the descriptions first before indicating your answer. Feel free to consult the conductor if you are in doubt about anything.

The test will be conducted in 3 steps;

1. Read and fill in the first part of the questionnaire until you are prompted to "Play the game!"
2. Play the assigned game version relative to your Participant ID (Participant A = Game A and Participant B = Game B)
3. Read and fill in the last part of the questionnaire

Lastly, by agreeing to participate, you indicate that you understand what you will be doing and that your answers will be collected anonymously and used for research purposes.

Click "NEXT" when you are ready to participate.

*Required

*

You may not participate unless you have understood and agreed to the terms.

☐ I understand what I will be doing and agree to participate.

NEXT

12% complete

Demographics

Participant ID *

This is relative to the Game version provided (e.g. A or B). Consult the conductor for your participant ID if you are unsure.

Your answer

Age *

Please indicate your age with numeric values.

Your answer

Gender *

This is your biological sex as differentiated with reference to the reproductive functions.

- ○ Male
- ○ Female
- ○ Other:

Gaming Experience *

This is your personal approach to gaming and the level of dedication towards video games in general. That is how much you are involved with playing video games and how dedicated and experienced you are with playing them in terms of skill.

- ○ Not a gamer (no experience and no dedication)
- ○ Newbie or Newcomer to games (very little experience, very low dedication)
- ○ Casual or Mid-core gamer (moderate experience, average dedication)
- ○ Hard-core gamer (very experienced, very dedicated)

BACK NEXT 25% complete

How are you feeling right now?

Indicate your current state of happiness. *

This is the measure of happy and pleasant or unhappy and unpleasant feeling felt by what is seen or experienced, where 1 is "very sad" and 9 is "very happy" as also indicated by the image below.

1	2	3	4	5	6	7	8	9
○	○	○	○	○	○	○	○	○

Indicate your current state of excitement. *

This is the physiological and psychological measure of inactivity or activity relative to what is experienced, where 1 is "calm" and 9 is "excited" as also indicated by the image below.

1	2	3	4	5	6	7	8	9
○	○	○	○	○	○	○	○	○

Indicate to what extend you feel this way right now. *

Indicate on a scale of 1-5, where 1 is "not at all" and 5 is "extremely", the degree of which you associate with the following feelings right now, that is, at the present moment.

	Not at all	A little	Moderately	Quite a bit	Extremely
Active / Engaged	○	○	○	○	○
Afraid	○	○	○	○	○
Alert / Aware	○	○	○	○	○
Attentive	○	○	○	○	○
Ashamed	○	○	○	○	○
Determined	○	○	○	○	○
Nervous	○	○	○	○	○
Hostile	○	○	○	○	○
Inspired	○	○	○	○	○
Upset	○	○	○	○	○

BACK NEXT 37% complete

Play the game!

If you are unsure, consult the conductor so that you may play the correct version of the game.

Before starting, be sure to use headphones during the entire play session as it is a requirement for the experience.
Additionally, when launching the game, set the graphics quality to "beautiful". In case your Mac or PC is not able to run the game/visual experience properly, you may reduce the quality to "good" or "simple" as a minimum.

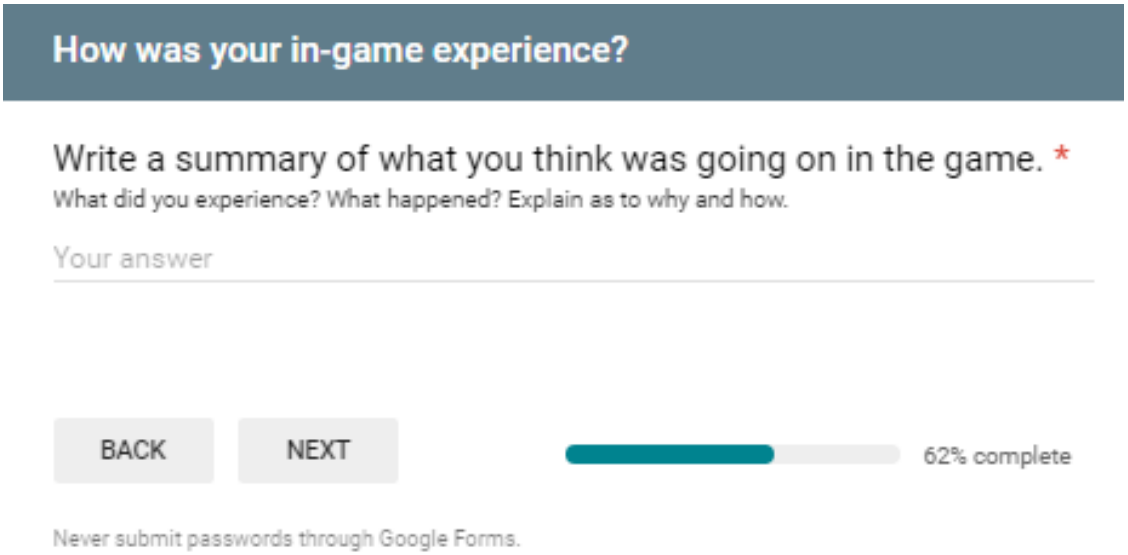
Game instructions;

To move use "W" for forward movement, "A" to turn left, "S" to move backward, and "D" to turn right.
To run or sprint use "Shift".
To look around and move your camera-view use your mouse or touchpad.

Please take your time to play the game until you do NOT wish to continue anymore! To exit the game/visual experience, press "Alt + F4" on a PC or "Cmd + Q" on Mac.

You may proceed with the rest of the questionnaire AFTER you have played the game.

BACK NEXT 50% complete



How was your in-game experience?

Write a summary of what you think was going on in the game. *

What did you experience? What happened? Explain as to why and how.

Your answer

BACK NEXT 62% complete

Never submit passwords through Google Forms.

How was your interpretation?

Based on your explanation of your experience, rate your interpretation. Please do not go back to change your previous answer.

How positive or negative was your interpretation? *

Based on what you described in the previous question, please indicate how negative or positive you feel your overall interpretation of your experience in the game was.

	1	2	3	4	5	6	
Negative	○	○	○	○	○	○	Positive

Associate 3 adjectives with your interpretation of the game experience. *

Relative to your interpretation of your experience previously, choose 3 adjectives that best suit your experience and the content of your description.

- ☐ Happy
- ☐ Exciting
- ☐ Satisfying
- ☐ Joyful
- ☐ Boring
- ☐ Sad
- ☐ Depressing
- ☐ Relaxing
- ☐ Serene
- ☐ Tense
- ☐ Upsetting
- ☐ Distressing

BACK NEXT 75% complete

How are you feeling now?

Indicate your current state of happiness. *

This is the measure of happy and pleasant or unhappy and unpleasant feeling felt by what is seen or experienced, where 1 is "very sad" and 9 is "very happy" as also indicated by the image below.

1	2	3	4	5	6	7	8	9
○	○	○	○	○	○	○	○	○

Indicate your current state of excitement. *

This is the physiological and psychological measure of inactivity or activity relative to what is experienced, where 1 is "calm" and 9 is "excited" as also indicated by the image below.

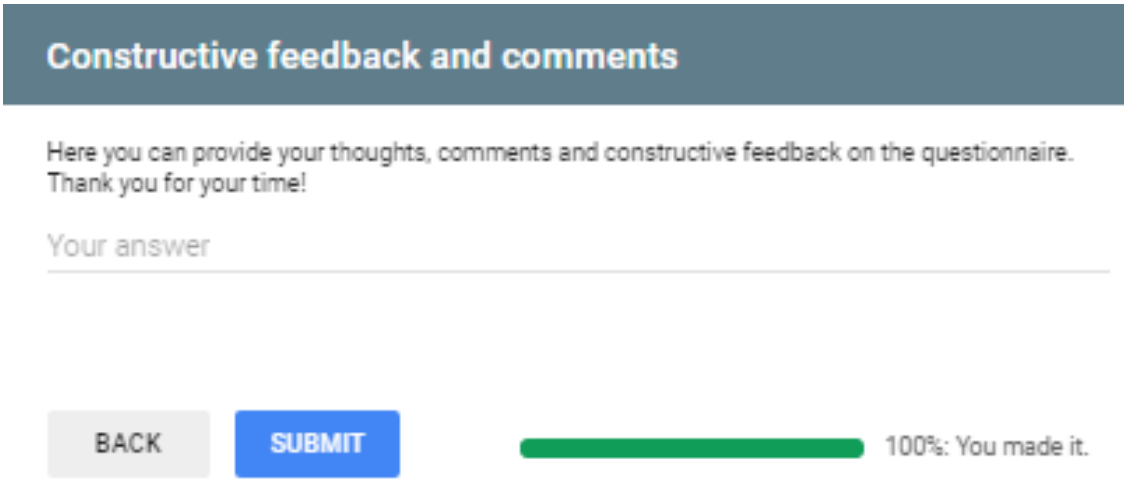
1	2	3	4	5	6	7	8	9
○	○	○	○	○	○	○	○	○

Indicate to what extend you feel this way right now. *

Indicate on a scale of 1-5, where 1 is "not at all" and 5 is "extremely", the degree of which you associate with the following feelings right now, that is, at the present moment.

	Not at all	A little	Moderately	Quite a bit	Extremely
Active / Engaged	○	○	○	○	○
Afraid	○	○	○	○	○
Alert / Aware	○	○	○	○	○
Attentive	○	○	○	○	○
Ashamed	○	○	○	○	○
Determined	○	○	○	○	○
Nervous	○	○	○	○	○
Hostile	○	○	○	○	○
Inspired	○	○	○	○	○
Upset	○	○	○	○	○

BACK NEXT 87% complete



13.4 FEEDBACK – FINAL EXPERIMENT

Constructive feedback and comments (irrelevant feedback had been excluded)

1.	*I happened to get out of the "arena" where there were no colliders, not sure if that was intended? - Might have ruined what I was doing, but I couldn't get back in.*
2.	*I would have liked to get a description here afterwards if there would be more to the game or not. And then also to be able to include more adjectives than the three I HAD to choose, as I didn't feel completely content with my third choice, but the rest fitted even worse.*
3.	*The game lagged much because of my slow computer. Made exploring a Little difficult, but still feasible and interesting. The cave collapse made me jump and the bird sounds almost stopping singing was a little nerve-wracking though when nothing happened it helped me relax again. Overall the experience was an odd mix of relaxing and tense.*
4.	*For the "How positive or negative was your interpretation?" question, I did want to answer something in the middle as I didn't feel my interpretation to go in any direction.*
5.	*It was a good and short questionnaire, only, I caught myself trying to compare myself to the moments before rather than in the given minute. The text on that*

	was not reminding. It is also a bit annoying that the big sections tell you that you are doing something wrong, when you are actually just starting to do the task given to you.
6.	*I manage to get outside, by jumping. That is what I enjoyed the most. Doing QA (Quality Assurance) stuff, I have screenshots to prove it.*
7.	*A bit of grammar corrections in the first section would not go amiss.*
8.	*The loud footstep and jump sounds affected what would otherwise have been a joyful experience.*
9.	*Great work with making an environment.*
10.	*Nice environment, unsure what the purpose was. Mix of survival and medieval themes.*
11.	*The footsteps sound weird, sorry I'm a sound guy. It's like he's walking on something concrete but it was grass!? also nice to have general movement in all the nature and the light shining through the trees was nice!*
12.	*Pretty good, well made graphics.*
13.	*I thought the questionnaire was thorough.*
14.	*Difficult to select 3 adjectives right after. last one didn't really fit but I had to pick one. I don't exactly know the purpose but maybe that's good.*

13.5 GROUP A INTERPRETATIONS – FINAL EXPERIMENT

Player Experience	*Summary of interpretation and emergent narrative*
1. *Experienced*	You have arrived to place where there are, 2 swords, 3 statues, a graveyard and a small camp. So I guess I have been in a fight, and running away from the fight, to get back to my sacred place, to rest. Maybe the 3 statues are gods, and that protects me. I also have lost my family, the graveyard thing. But the colors were very bright, so I guess it is a happy place?
2. *Experienced*	I was a single explorer (not too adventurous), who had set up camp in a tranquil patch of green, inside a small valley. It seemed like a battle had taken place, in which the owner of a sword had defeated a beast. I was looking to explore the different statues and tombstones in the valley.
3. *Experienced*	I got trapped inside of some rocky area due to landslides. No idea why though, I just wanted to get out. :(
4. *Experienced*	I was in a small wood, with rocks all around. Found it very peaceful. I think I was a guy that have sheltered in the woods to be by my self
5. *Experienced*	Just some casual camping. Walking around in the sun and exploring the environment.
6. *Experienced*	You where campaign in a tent, at some kind of place, where there where 3 stone statue men, a killed dragon and some grave stones. Besides that, perhaps the stone ring tried to kill you, by making all escapes stop you going out. But I managed to climb the mountains and get out from the ring.

7. Experienced	I imagine that I'm some sort of nomad knight. I made camp inside the circle of stones to get some shelter for the night, but when I woke up I couldn't get out of it. When I came here there was a monster that I slayed and it's still in one of the entrances, but somehow I still need to recover from the fight since I cannot take up the sword again. I tried to find a way out, but I was lost in there for now.
8. Experienced	It was a walking simulator with a few key locations that was supposed to tell some kind of story.
9. Experienced	I was a lumberjack who apparently had an identity crisis because the rocks kept falling down in paths, perhaps an indication that the lumberjack wanted to become a rock cutter instead?!
10. Moderate	it's clear that I somehow got stranded over there. I wanted to go out of the constrained area - met some (expected) invisible walls. I would have liked to know more about those swords and the gravestones...and maybe do something with the mushrooms. All in all, it was a pretty nice environment I could do nothing in, but look around a constrained area.
11. Moderate	So I was exploring the environment, the very extreme boundaries of the environment (on top of the rocks etc.). And that every time I made an attempt to escape from the environment I was contained within I was blocked off and prevented from doing so.
12. Moderate	I was stuck in a place without exit.
13. Moderate	A battle took place long ago over some stone heads. I'm trapped in a small canyon and the birds are going nuts.

14. Moderate	It seems like a minimal part of any RPG game. The area was limited by mountains and by rocks falling down into the tunnels, so I could not go very far. I also could not interact with any objects, even though there were two swords.
15. Moderate	Are you dead? are you in heaven? is this a grave? how did I get here? Illusion of life trapped at the fireplace at which you have been summoned. going through to explore graves and dead, but yet in a beautiful setting brighten it all up, as if the trapped illusion of life is calm and collected with no worries.
16. Moderate	Someone camping and trapped in the valley. Then there was something with the swords, since there was both one at the grave and in the skull, but I don't know why or what it meant. I don't know if the statues also meant something
17. Moderate	Nice, but lagged due to old laptop. The caves collapsing made me jump a Little and when I entered the second cave (not the one with the skull) all the sounds of the birds and such lowered drastically in volume. Was very eerie. Not sure if bug. It was nice to walk around and explore, the sound design was great!
18. Moderate	Someone/the player is on a camping trip, where something goes wrong - the player can't get out, since stones keeps blocking the exits. A beautiful place that turns out to be a bit creepy.
19. Very little	I have no idea, but I think some old warrior died and are buried.
20. Very little	I was walking around in the game to see what I could. It was fine. I didn't know what would happen, so it was exiting.

21. None	Besides the fact that I walked around and looked at the nature and heard the birds, not so much happened. A rock fell and blocked the road ahead. There was an empty tent, an extinguished bonfire and an animal that had been killed with a sword. Water running ... Do not know why.
22. None	I saw that the game gave me the experience of being, a fun game at the beginning, where it was bright and nice, but as I came closer to a place where I thought was an exit, I saw that it turned to be dark and closed place. I couldn't find a way out, sometimes stones fall down, so I couldn't get through.

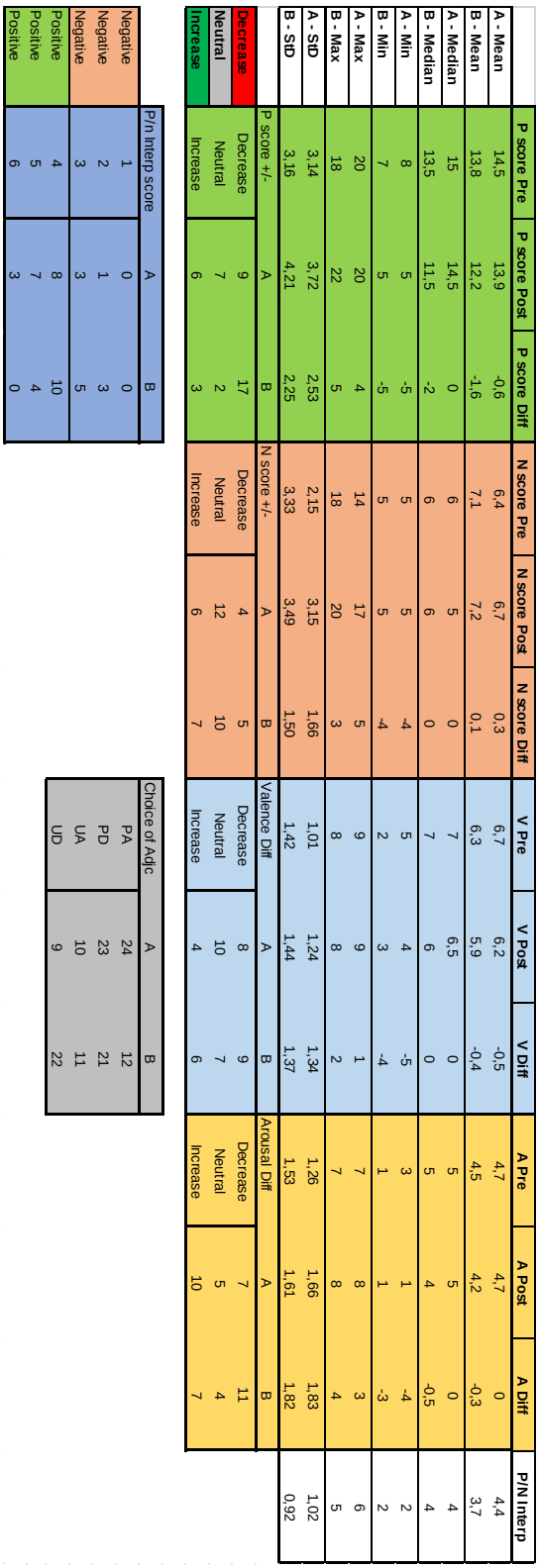
13.6 GROUP B INTERPRETATIONS – FINAL EXPERIMENT

Player Experience	*Summary of interpretation and emergent narrative*
1. *Experienced*	I could walk around in a grove, but couldn't leave. Sun was shining and birds were chirping.
2. *Experienced*	I was a camper with a huge axe. I wanted to get out of the groove which I was camping in, but stones fell down and I was trapped. Too bad there were only swords around and no shovel to dig me a grave next to the others.
3. *Experienced*	I was placed in a pleasant, calm environment which at first glance seems expansive and open for exploration. However, when attempting to explore outside the boundaries of the area through the caves the paths led to, I was hindered by a falling rock. I am guessing the purpose of the game is to test player frustration with being limited in such a way, especially since I was not able to interact with anything.
4. *Experienced*	I woke up near a camp (my camp?) and some large statues and gravestones were around, and when I approached the exits, large rocks blocked my way.
5. *Experienced*	You have traveled to a small valley in search of something. The valley is the final resting place of a group of brave warriors who have gone out to slay an evil dragon. In the fight, you have managed to kill the dragon, but your fellow warriors are dead. You have stayed behind to bury their bodies, but as you try to leave the valley the exits seal off, trapping you in the valley forever.
6. *Experienced*	I was locked in between some rocks and time passed? From X am to X pm? The bird chirping faded away!
7. *Experienced*	Someone was camping and got trapped. Also there was swords and skulls.

8. Moderate	Campsite, gravesites, swords, environmental mood.
9. Moderate	Nothing really. I was in a place with some stones falling down and trapping me. There was a skull with a sword in it at some point. Then I climbed up the rocks and accidentally got outside the zone, which ended with me falling down into the infinite void.
10. Moderate	I was walking around in a wasteland. I had a small tent, which I guess was mine. I was seeking some form of interaction or purpose in the game but had none. When I tried to escape some boulders fell down and blocked the exits.
11. Moderate	Honestly noting, no goal and nowhere to go... nothing to interact with... I didn't even experience any sort of narrative from the environment. All I can say is that those roads there seem to lead to somewhere did get blocked by falling rocks.
12. Moderate	I was camping, 2 roads out, both roads got blocked by stones falling down - not much going on from there.
13. Moderate	I guess it was some sort of graveyard or former battlefield because of the graves and the swords. I got a Viking-y/Skyrim feel about it. Felt like a tutorial since all you did was walk around.
14. Very little	The game was exciting at first, but then it started to be boring, because all the roads were blocked. I have tried to find a way to move forward but it was not easy.
15. Very little	I have absolutely no clue other than being stuck in that place. Probably some nonverbal storytelling, with a sword, a graveyards and a single tent.
16. Very little	Looking for swords - Kept looking for something else.

17. Very little	I walked around a camp in an area that was closed off by rocks. There were tombstones, a sword in a skull and statues. Nothing really happened.
18. None	I was just walking around. You just had to experience the world. I always get paranoid when I play videogames, the music was calming, but I was still afraid that I was going to get attacked because I do not trust videogames.
19. None	A person who goes exploring in in some kind of world.
20. None	I was irritated since I wanted so much to get out of the mark with cemetery and figures, but I could not. I felt as I was closed in that space.
21. None	I thought that I had to discover the jungle, by trying things that were available, but I wasn't able to do so. Nothing basically happened.
22. None	An Indian guy has been cursed and the surrounding stones won't let him out.

13.7 DESCRIPTIVE DATA CALCULATION BY GROUP – FINAL EXPERIMENT



	P score Pre	P score Post	P score Diff	N score Pre	N score Post	N score Diff	V Pre	V Post	V Diff	A Pre	A Post	A Diff	P/N Interp
A - Mean	14,5	13,9	-0,6	6,4	6,7	0,3	6,7	6,2	-0,5	4,7	4,7	0	4,4
B - Mean	13,8	12,2	-1,6	7,1	7,2	0,1	6,3	5,9	-0,4	4,5	4,2	-0,3	3,7
A - Median	15	14,5	0	6	5	0	7	6,5	0	5	5	0	4
B - Median	13,5	11,5	-2	6	6	0	7	6	0	5	4	-0,5	4
A - Min	8	5	-5	5	5	-4	5	4	-5	3	1	-4	2
B - Min	7	5	-5	5	5	-4	2	3	-4	1	1	-3	2
A - Max	20	20	4	14	17	5	9	9	1	7	8	3	6
B - Max	18	22	5	18	20	3	8	8	2	7	8	4	5
A - StD	3,14	3,72	2,53	2,15	3,15	1,66	1,01	1,24	1,34	1,26	1,66	1,83	1,02
B - StD	3,16	4,21	2,25	3,33	3,49	1,50	1,42	1,44	1,37	1,53	1,61	1,82	0,92

Decrease
Neutral
Increase

P score +/-	A	B
Decrease	9	17
Neutral	7	2
Increase	6	3

N score +/-	A	B
Decrease	4	5
Neutral	12	10
Increase	6	7

Valence Diff	A	B
Decrease	8	9
Neutral	10	7
Increase	4	6

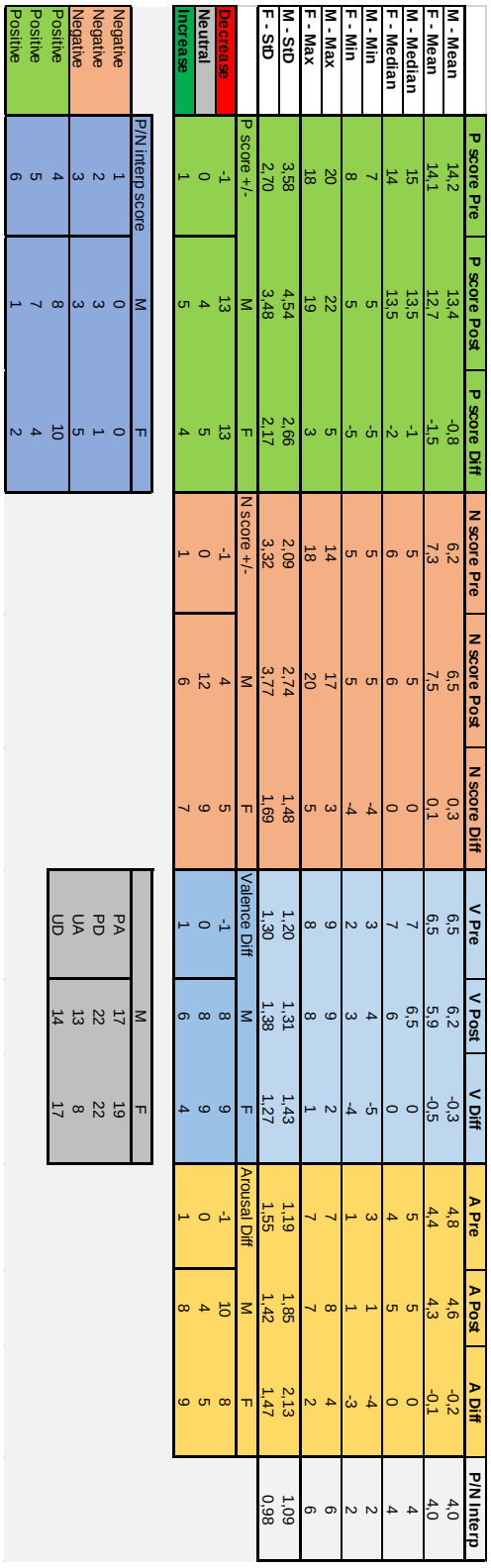
Arousal Diff	A	B
Decrease	7	11
Neutral	5	4
Increase	10	7

P/n Interp score	A	B
1	0	0
2	1	3
3	3	5
4	8	10
5	7	4
6	3	0

Negative
Negative
Negative
Positive
Positive
Positive

Choice of Adjc	A	B
PA	24	12
PD	23	21
UA	10	11
UD	9	22

13.8 DESCRIPTIVE DATA CALCULATION BY GENDER – FINAL EXPERIMENT



	P score Pre	P score Post	P score Diff	N score Pre	N score Post	N score Diff	V Pre	V Post	V Diff	A Pre	A Post	A Diff	P/N Interp
M - Mean	14,2	13,4	-0,8	6,2	6,5	0,3	6,5	6,2	-0,3	4,8	4,6	-0,2	4,0
F - Mean	14,1	12,7	-1,5	7,3	7,5	0,1	6,5	5,9	-0,5	4,4	4,3	-0,1	4,0
M - Median	15	13,5	-1	5	5	0	7	6,5	0	5	5	0	4
F - Median	14	13,5	-2	6	6	0	7	6	0	4	5	0	4
M - Min	7	5	-5	5	5	-4	3	4	-5	3	1	-4	2
F - Min	8	5	-5	5	5	-4	2	3	-4	1	1	-3	2
M - Max	20	22	5	14	17	3	9	9	2	7	8	4	6
F - Max	18	19	3	18	20	5	8	8	1	7	7	2	6
M - StD	3,58	4,54	2,66	2,09	2,74	1,48	1,20	1,31	1,43	1,19	1,85	2,13	1,09
F - StD	2,70	3,48	2,17	3,32	3,77	1,69	1,30	1,38	1,27	1,55	1,42	1,47	0,98

Decrease
Neutral
Increase

P score +/-	M	F
-1	13	13
0	4	5
1	5	4

N score +/-	M	F
-1	4	5
0	12	9
1	6	7

Valence Diff	M	F
-1	8	9
0	8	9
1	6	4

Arousal Diff	M	F
-1	10	8
0	4	5
1	8	9

P/N interp score	M	F
1	0	0
2	3	1
3	3	5
4	8	10
5	7	4
6	1	2

	M	F
PA	17	19
PD	22	22
UA	13	8
UD	14	17

Negative
Negative
Negative
Positive
Positive
Positive

13.9 DIGITAL APPENDIX

For more detailed data and access to both playable prototype versions, please refer to the digital appendix through the provided URL or attached CD-ROM.