Atmosphere & Challenge

An Exploration of Dissonant Player Experiences

by

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AUTHOR'S DECLARATION

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

STATEMENT OF CONTRIBUTIONS

This thesis consists of two papers that were co-authored by myself, my supervisor, Dr. Lennart Nacke, and three others:

Towards a Physiological Profile of Rage Quitting

By: Giovanni Ribeiro, Rina Wehbe, and Lennart E. Nacke

Atmosphere: The Effect of Thematic Audio Fit on Player Experience

By: Giovanni Ribeiro, Katja Rogers, Thomas Terkildsen, and Lennart E. Nacke

Dr. Nacke, Rina Wehbe, Katja Rogers, and Thomas Terkildsen provided research guidance, advice, and proofreading. Ms. Rogers and Ms. Wehbe were invaluable in the experimental design and research ideation process of their respective projects and Mr. Terkildsen contributed to the evaluation and statistical analysis of physiological data.

Surya Banerjee (Department of Statistics and Actuarial Science) helped me decide what the most appropriate statistical tests to run were.

ABSTRACT

Dissonance means an unusual combination of any two things. Two dissonant experiences in video games which could lead to undesirable player states are thematic dissonance and difficulty dissonance. Thematic dissonance potentially annoys players by breaking the atmosphere, and difficulty dissonance by preventing players with low skill from progressing past unbalanced challenges, resulting in rage-quits. This thesis seeks to deepen the understanding of dissonant experiences in video games through two experiments measuring the player experience as affected by different audio and practice conditions respectively. Results indicate that the experience colloquially referred to as a rage-quit is directly affected by avatar death events and game-specific skill and is related to lower levels of heart rate variability (HRV) and higher levels of electrodermal activity (EDA), which implicates feelings of stress. This project successfully advances the definition of video game atmosphere as the level of subjective thematic fit or association between the audio and visual components of a game's setting, and indicates that musical thematic dissonance may lead to higher intensity negative valence facial events.

KEYWORDS: atmosphere, game design, games user research, mixed methods, rage-quit

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LIST OF ABBREVIATIONS

ANOVA Analysis of Variance

EDA Electrodermal Activity

fEMG Facial Electromyography

GEQ Game Experience Questionnaire

GUR Games User Research

HR Heart Rate

HRV Heart Rate Variability

IEQ Immersive Experience Questionnaire

MDA Mechanics-Dynamics-Aesthetics

MOBA Multiplayer Online Battle Arena

PANAS Positive Affect Negative Affect Schedule

PENS Player Experience of Need Satisfaction

PX Player Experience

PXI Player Experience Inventory

SAM Self-Assessment Manikin

SBP Systolic Blood Pressure

SCL Skin Conductance Level

SNS Sympathetic Nervous System

PART I. INTRODUCTION

Dissonance and the Player Experience

A game's public reception is essential to the success and survival of a development studio. As such, developers who wish to grow and maintain the popularity of their game find it beneficial to concentrate on creating an enjoyable player experience (PX). To improve PX, designers can concentrate on emphasizing different facets of the experience and making sure these facets complement each other. Dissonance means an unusual combination of two things. For a cohesive and enjoyable experience, dissonance can be a problem. In this thesis, I explore the effects of dissonance in both the gameplay and audiovisual aspects of games to better understand how dissonance affects negative player experiences. My goal is to inform and alert game developers about possible negative player reactions to dissonant experiences. This thesis explores the effects of two forms of dissonance, not often studied, on the PX: difficulty dissonance and thematic dissonance.

Difficulty dissonance occurs when there is a mismatch between the required skills to progress in a game and the skills the player actually possesses. Think back to a time when you asked a friend to join in on your co-operative game, but your friend has never played this game before. The lack of skills your friend possesses is at odds with the skills required in the situation, resulting in repeated failure to complete the game's objective. Think back to a time when you tried to play the higher levels of a game without first having completed the lower levels. Your skills would be at odds with the situation you find yourself in. Both situations are examples of difficulty dissonance. One way to improve PX is by dealing with difficulty dissonance. By carefully balancing a game's difficulty one can encourage continued play; too difficult and players get frustrated; too easy and players get bored [21]. Consequently, sections of games that result in negative reactions associated with discontinuation of play can be detrimental to player retention. This phenomenon is colloquially referred to as a "rage quit" and is the target of the first study.

Thematic dissonance is the mismatch between the audio and visual elements of the game. An example of thematic dissonance would be if cheerful, upbeat music played during a tense moment in a horror game. In the second study of this thesis, I define atmosphere as the emergent feeling created when visual and auditory components of a video game have strong thematic cohesion and therefore contribute to the same aesthetic. Thematic cohesion is therefore the opposite of thematic dissonance. A broken atmosphere in a game could lead to the suspension of disbelief; an ending to the magic circle which encompasses a player and causes them to act as if they were in the world of the game. Given the possible negative effects of thematic dissonance on the PX and consequently the sales of games, in the second study I explore the effects of breaking atmosphere on the player experience.

Measuring Difficulty Dissonant Player Experiences

Game companies spend many hours and resources on the design, development, and release of games. Regardless of initial reception, one thing that can adversely affect the future success of a franchise is negative word-of-mouth[1]. Although difficulty is a draw for players who enjoy challenging gameplay, it can just as often alienate those who will not purchase or

[1] Mike Fahey. 2013. Word Of Mouth Sells The Most Video Games. (June 2013). Retrieved March 28, 2019 from https://kotaku.com/word-of-mouth-sells-the-most-video-games-5428141

recommend a future game in a franchise, because they do not feel other players will be able to experience enough of the game. Designers need to be able to identify game events that unintentionally result in angry, frustrated, negative reactions from aggravated players so these events can be removed or avoided. A sweet spot must be found where frustration is motivating instead of aggravating. It would be useful to be able to predict discontinuation based on frustration caused by difficulty dissonance. The first step in this endeavour is to understand the stress limits that players are willing to endure during game play and the factors which affect these limits.

Does previous training time affect how long it takes a participant in an unwinnable scenario to quit? To find out, I report the results of a between-subjects experiment. I asked participants to play the first levels of Super Mario 3D World for three different periods of time: 5, 15, and 25 minutes, to create three distinct skill-learning groups. These time periods were chosen because data on how long it takes to develop noticeable differences in expertise does not exist. I, therefore, have chosen small differences in practice duration to ensure that PX differences between even small practice duration differences would be discernible. Through learning [20], these three different practice condition durations should create two or three groups differing in the amounts of skill they possess at the game. This is the independent variable. I then exposed all three groups to the hardest level of the game to maximize the chance of hitting a frustration threshold and quitting the game. I measured (1) how long it took a participant to quit, (2) the increase of normalized skin conductance (SC), and (3) the percentage change in heart-rate variability (HRV) both from a testing phase baseline, with self-assessment manikin (SAM) and positive affect negative affect (PANAS) scores as post-test moderating variables. These measures were chosen to be able to ascertain what emotional engagement factors could predict play session duration, and whether discontinuation was associated with physiological measures of stress. I report results from 11 participants per condition for a total of N= 33. Results show that death frequency, SAM valence score, and SC gain all together predict session duration. It may also may be possible to predict rage quitting by using the proportional change of SC and HRV, tracking player deaths and mood. Such results could be used in the future to help predict and avoid play discontinuation, providing more enjoyable player experiences.

Measuring Thematically Dissonant Player Experiences

Game reviews often refer to atmospheric games as immersive. What draws a player in and what keeps them in the magic circle, playing long hours and feeling that they are part of the world of the game, is immersion. However, to the best of my knowledge, the link between immersion and atmosphere has not been studied before as atmosphere does not even have a set definition. Video game aesthetics are defined in the context of this thesis as a subjective experience, which forms a rarely studied component of player experience. According to the Mechanics-Dynamics-Aesthetics (MDA) framework, aesthetics "describes the desirable emotional responses evoked in the player, when she interacts with the game system" [46]. Building on this definition, Niedenthal further identifies aesthetics as referring to "the sensory phenomena that the player encounters in the game" [78]. Focusing on the visual senses, his other work sheds light on illumination and its use to create patterns of obscurity for the generation of tension [30, 79]. However, sight is only one of the senses with which games interact, hearing is another important one. In this study, atmosphere is defined based on previous descriptions of atmosphere as oulined by Greg Kasavin, who notes that atmosphere is made up of tonal cohesion, internal consistency, and specific detail [52], and Ernest Adams who describes a designer's job when it comes to atmosphere as ensuring that a game is "aesthetically coherent and creates the appropriate mood" [4]. Atmosphere is therefore the emergent experience that occurs when visual and auditory components of a video game have strong thematic cohesion and therefore contribute to the same aesthetic. It stands to reason then that if the audio of a game does not match its visuals thematically, atmosphere would suffer.

Of the modalities which affect the aesthetic experience of games, game audio—as an often-non-functional component of the game sensory experience—is one of the least studied in our field. Recently, other studies have explored the aspects of audio which affect the user experience in VR and found that music influences emotional responses in some players [89]. Indeed, music—when not directly applied to gameplay through karaoke and rhythm games—often carries a "continuity aspect (background), an emotional aspect (spooky vs. comical), and a tempo aspect (fast vs. slow)" [83]. One genre of games in which music is highly relied upon for the creation of aesthetic experience is horror. To the point where we can generalize from one medium to another, there are many psychological theories which attempt to identify the appeal of this genre in film [104, 107]. In the second study, I explore how the thematic dissonance—which I define as not contributing to one coherent aesthetic—of music to a game's setting when manipulated, affects the user experience.

Horror is the ideal genre with which to study atmosphere because it relies fundamentally on sound to drive player experience. Video game atmosphere, from herein referred to as atmosphere, is a subjective experience associated with the player experience of the aesthetic framing of the game setting, which consists of the time, place, and circumstance to which the player finds themselves transported in the game. Previous work has addressed aspects of games which affect atmosphere, but none have tried to define it (as I have done in the first paragraph of this subsection) or used the term with full intent, except Muller et al., who studied the design of visual patterns for the aesthetic experience of games [73]. Further, earlier work in this area has reported no studies, or focus on other aspects (e.g., inducing fear [33]) instead of the experience of atmosphere. Although all this work is valuable, none has attempted to define atmosphere or address the value of music for creating atmosphere. This paper addresses this gap in the literature by advancing an empirically validated definition of atmosphere. It also sheds light on atmosphere's importance to various genres, and how different aspects of music such as tempo and genre influence the atmosphere. For this exploration, I rely on an experiment using Bloodborne [G3] as a stimulus and analysis techniques like those used for affective analyses of music [95]. Bloodborne [G3], as a survival horror RPG that allows for control of various sound settings, is uniquely situated to analyze the effect of musical thematic cohesion on PX. It's desirable characteristics as a stimulus are further outlined in the related work section of the appropriate study. Given prior findings that sound and music influence many gameplay experience dimensions [75], I employ five previously validated questionnaires, some custom Likert-based questions, and physiological measures such as skin conductance (SC), heart rate variability (HRV), and facial electromyography (EMG) to understand the effects of musical thematic cohesion on player experience. The results of this work support the definition of atmosphere proposed here; the emergent experience that occurs when visual and auditory components of a video game have strong thematic cohesion. EMG data collected from the brow muscle also indicates that breaking the atmosphere with dissonant music may impact the player experience adversely when compared to listening to an unrelated voiceover. Various game elements such as setting design, immersion, and music contribute significantly to atmosphere, as does music and some of its elements like mood, tempo, and melody. Atmosphere is reported as a significant consideration in assessing game quality and making buying decisions. Its study is therefore important to GUR practitioners and game designers seeking to understand and improve atmospheric experiences and avoid thematically dissonant experiences which break atmosphere.

Thesis Structure

This thesis is broken up into four parts. In the current section, Part I - Introduction, I discuss the issue of dissonant player experiences, introduce the concepts of difficulty dissonance and thematic dissonance, and illustrate the issues they present to PX. I then discuss the surrounding concepts such as frustration and atmosphere which help us understand and study them. Finally, I delineate the structure of the work and discuss its contribution.

In Part II - Towards a Physiological Profile of Rage-Quitting, I first review existing research on frustration in games and the qualitative and physiological methods of assessment that have been applied in the past to situate the research in the previous literature. I then describe the research, designed to explore and identify the factors which influence the occurrence of a rage quit. Finally, I discuss the results of the mixed-methods study conducted.

In Part III – Atmosphere: The Effect of Thematic Audio Fit on Player Experience, I review existing research on atmosphere, horror game audio, game music, and physiological measures of horror experiences, to establish the work in relation to the previous literature. I then detail the research methods, designed to explore and identify the factors which influence the experience of atmosphere. Finally, I describe the results of the mixed-methods study conducted.

Part IV – Discussion concentrates on interpretation of the results of both the Rage-Quit and Atmosphere studies as well as a discussion of what has been learned about dissonant player experiences as a whole. It concludes with a discussion of the implications to game design and player experience research.

Understanding Dissonant Player Experiences

This exploration of dissonant player experiences contributes to the GUR community an empirically validated definition of atmosphere, a variety of factors which influence its experience, and a predictive framework for discontinuation of play based on unbalanced difficulty. The results show that further work is required to fully understand the effects of atmosphere and undue difficulty on the PX. Evidence indicating the importance of atmosphere to different genres as well as the sonic preferences of players is discussed as are results implicating skin conductance, player death, and mood as predicative of play time. The results advance the understanding of difficulty dissonance (undue difficulty) and thematic dissonance (broken atmosphere/ broken thematic cohesion) in our field and can, therefore, be of use in creating positive future player experiences.

PART II: TOWARDS A PHYSIOLOGICAL PROFILE OF RAGE QUITS

RELATED WORK

Every player has felt the annoyance of failure in a game and the frustration that comes when such an outcome repeats itself continuously. Indeed, previous research has found that games, which through usability problems do not let players meet their psychological need for competence, lead to higher levels of aggressive feelings and may even lead to aggressive behaviour [87]. Similarly, Csíkszentmihályi's work indicates that if a task has a high degree of difficulty and the person in question is poorly skilled at the task; frustration will result [21]. In video games, if a player becomes too frustrated with a game they are likely to stop playing. Players tend to refer to this as a “rage quit,” an emotionally-driven quitting reaction to frustration caused by events in the game. To help developers understand how much challenge is acceptable to players, the experiment described in this paper seeks to establish a player’s rage quit threshold in the human sympathetic nervous system (SNS) while playing video games.

Linear regression models have displayed moderate performance at predicting discontinuation in play [64]. Previous work has shown that agents will continue to toil if expected progress is being achieved [26]. However, what if expected progress is not achieved? I seek to understand what factors influence a player to continue or give up on a game. This paper explores the relationship between general and specific practice and rage quit events to understand how designers can best prepare players for the intentional challenges they wish to present during gameplay. To identify the appropriate related work for this section I reviewed work on player needs, optimal experiences, quantitative and qualitative measures of PX, and prediction of discontinuation of play. This work contributes to the field of Games User Research (GUR) by defining and identifying attributes of rage quits based on the proposed threshold hypothesis which states: *(H) humans rage quit at the same level of arousal as one another regardless of experience level.*

Frustration and Games

To better situate this work among the foundational work in GUR, I review previous assessments of PX and frustration in games. Some previous work has collected research and attempted to present a unified theoretical approach to PX [74]. This work and other work have stressed the use of mixed-method evaluation techniques for the assessment of PX [111], so in this study, I use both qualitative and quantitative techniques. One popular theoretical approach to study PX is self-determination theory (SDT). SDT posits that competence, autonomy, and relatedness are needs which—when satisfied—result in self-motivation. If these needs are not met, motivation diminishes, as does wellbeing [91]. When SDT was applied to video game play, perceived in-game autonomy and competence were indeed found to be associated with enjoyment [92]. Some work on optimal player experiences, which focused on the use of qualitative methods has brought these findings into question by demonstrating that an overload of challenge can be more enjoyable than being underwhelmed by it [55]. However, still, more recent work on the effects of difficulty on enjoyment has found that feelings of competency help to balance challenge and skill [94]. Indeed, repeated failure to achieve a goal results in frustration. This frustration is felt by players of all genres, lending weight to the idea that unmet mastery needs lead to frustration [97]. This is mirrored in work which suggests that competitive genres such as MOBAs (Multiplayer Online Battle Arena) or Battle Royale are enjoyable while being highly frustrating [48]. Still, other work suggests that challenge in a game and the associated frustration can lead to experiencing *fiero*, a feeling of triumph over a challenge [7, 59]. It is clear then from this conflicting evidence that games can be too hard or too easy, and that—given this duality—the goal is the center, where a player feels both challenged and competent. To help developers better aim for this slice of the experience spectrum, we must better understand the reactions of players when games hit an undesirable level of difficulty, and we must understand what exactly constitutes an undesirable player experience.

Flow is the optimal state of inner experience which occurs when attention is invested in realistic goals and skills match the opportunities presented [21]. A systematic review of quantitative studies of enjoyment found that enjoyment and flow are distinct, and that enjoyment may be independent of challenge [67]. Regardless, frustration has been found to be an important enough part of the player experience (PX) that multiple methods have been devised to detect and respond to it. It has even been further divided into in-game vs at-game frustration [36], as well as positive and negative frustration [69]. In-game frustration is motivating; players experience competence when they overcome challenges. At-game frustration is disheartening; it occurs when games are too difficult and it causes players to disengage from the game. An example of positive frustration can be seen in DayZ [G4], where avoiding the frustration of losing all a player's progress has been found to be a driving motivator to play the game [5]. Frustration as motivation can be seen in recent battle-royale games where the tension of avoiding avatar death and losing all the progress towards victory and loot collected is arguably the point of the experience. Given conflicting evidence that challenge and enjoyment are unrelated, I chose to explore the area of player experience where challenge is an obvious detriment to enjoyment because it results in discontinuation of play.

Physiological Measures of PX and Frustration

In this work, I explore negative frustration as defined by Miller et al.: "frustration that motivates the player to disengage with the game" [69]. When negative frustration is at its highest, it results in the disengagement known as a rage quit. Because this work is interested in physiological thresholds of arousal, in this section I review previous work which concentrates on assessing the PX through physiological measures. Previous attempts to detect such frustration have sometimes focused on touch pressure using phone games [69] and dismissed physiological measures of arousal as too expensive to be viable. This work, however, was conducted over a decade ago, and now such measures merit a second look [70]. Furthermore, previous uses of physiological measures of arousal to access the emotional components of games have proven successful to varying degrees. Using EDA (electrodermal activity) and EMG (electromyography) Nacke and Lindley found that a level designed for combat-oriented flow in a first-person shooter game resulted in high-arousal positive affect emotions [76]. Mandryk et al. found a favourable comparison between modelled emotions using physiological measures and subjective self-reports [65]. Similarly, Drachen et al. found significant correlations between physiological arousal as measured by HR (heart rate) and EDA and self-reported gameplay experience [25]. I investigate physiological markers against self-reports of emotion and measures of engagement from players using validated questionnaires to identify attributes of a rage quit.

Difficulty is a well-studied research area because of its effect on player experience and engagement. As previously noted, if difficulty is high and players feel that they are not competent they experience negative emotions such as aggression [87]. A compatibility between skills and demands however, results in pleasurable flow experience as measured by self-reports, reduced HRV (heart-rate variability), indicating higher mental work load, and stress as indicated by salivary cortisol levels [53]. Similarly, in a study using Tetris Harmat et al. found that an optimal as opposed to a difficult condition is most associated with flow. High flow as measured by self-report was associated with larger respiratory depth and lower low-frequency component of HRV, indicating a relaxed state [40]. Other work using facial electromyography, which studied player experiences of in-game death found that, as the number of deaths increased, the positive player affect was likely to decrease [43]. This was also observed when Kneer et al. controlled difficulty and violence content. Neither had an effect on psychophysiological arousal during play, post game aggressive cognition and aggressive behaviour. However, difficulty did effect emotions as number of deaths predicted positive affect in the low difficulty condition and number of kills was a predictor of affect [56]. This paper aims to find out if eventually player-affect decrease and aggression increase ultimately contribute to enough frustration that the player quits the game.

Previous work has established the use of physiological measures to access the emotional component of player experiences [25, 65, 76] and video game developers have been willing to use these measures in their development and evaluation processes [6, 110]. Work in this area has found that exciting moments are likely to elicit high arousal from players [25]. Furthermore, work with scratch-card players indicates that SC levels rise after near-misses and frustrating losses motivate restarting the game faster than wins do [98]. Such findings have led to the development of rapid evaluation tools such as biometric storyboards [71], which help establish the relationships between game components and physiological activation. Accordingly—in this experiment—players' screens were recorded while they were playing so that the amount of time they take, and the number of virtual deaths they experience before quitting could be measured and their percentage increase in SC and HR above a threshold at the time of quitting the game.

Questionnaire Assessments of PX and Frustration

In addition to quantitative physiological evaluation, there is much to be learned from the various studies using questionnaires to explore player experience. Previous work has used questionnaires to access the effect of challenge-skill manipulations on enjoyment and the components of self-determination as discussed in SDT. It found that exceedingly difficult challenges are more enjoyable than easy/boring challenges, even though feelings of competency were threatened [55]. Such results have been mirrored in studies of chess, which revealed challenging close games are more enjoyable than one-sided games [2]. This has been further illustrated by two studies, which showed that outcome uncertainty increases enjoyment [3]. However, it is conceivable that such effects have a ceiling where repeated failure leads to frustration. Indeed, it has been shown that peak-end effects (assessment being biased in the final minutes of a user's experience) are pronounced in the assessment of game experiences, suggesting that if frustrating losses dominate the end of a play session its assessment can be negatively affected [39]. This would appear to be evidence that designers should not make their final levels much more difficult than the rest of the game. Indeed, previous work has shown repeated losing to be a more significant contributor to frustration and anger than violent content [97]. The above studies assessed frustration through questionnaire methods, but those are not the only qualitative methods available to study frustration. Semi-structured interviews of game developers indicate that frustration can be positive or negative, with negative frustration motivating the player to stop while positive frustration motivates and increases immersion [80].

Mixed Methods Assessment of PX and Frustration

Although quantitative physiological evaluation of gameplay is an accessible and useful technique, it can miss some of the more nuanced subjective information that players can provide. Accordingly, mixed methods which make use of both quantitative and qualitative techniques can shed additional light on the player experience [111]. Studies like those by Chanel et al. use both physiological and qualitative measures to shed light on the relationship between boredom and difficulty [19]. Previous work has shown that integrating multiple sources of data into one visualization can help to comprehend the relationship between multiple data sources [71]. In this study, I use the Positive Affect Negative Affect Scale (PANAS) and Self-Assessment Manikin (SAM) questionnaires to measure the valence of the arousal participants feel while playing. I combine this data with physiological measures such as HRV and SC as well as self-report measures of challenge preference, frustration, and time spent gaming per week to understand player quitting behaviours.

Predicting Discontinuation of Play

In this study, I aim to find out what factors protect against frustration caused by repeated failure to progress so that future attempts to predict discontinuation based on frustration can take the loading of these factors into account. Existing evidence for a difficulty-based frustration response comes from work by Canossa who observed players of Kane and Lynch 2 become frustrated by repeated failures to overcome challenges without achievement or feelings of progression [17]. This work resulted in a computational model capable of raising red flags when player frustration might be signalled by participant behaviour. I build on the foundations of this work by applying mixed method techniques to an analysis of a frustrating portion of a Mario game. Other work, by Neys et al., found that experienced players had the highest levels of motivation and persistence as compared to less experienced players [77]. This fact prompted me to take into account the average number of hours participants played 3D games per week. Given this evidence, methods of predicting frustration and discontinuation have been proposed by researchers. Frustration with a web app for learning was predicted with 79% accuracy using Gaussian process classification and Bayesian inference [51]. Supervised learning algorithms have been used to predict discontinuation of play in Tomb Raider Underworld [G11] to moderate success [64].

Work on Flow suggests that a high degree of difficulty combined with a poorly skilled practitioner results in frustration [21]. As such, work on assessing frustration and other aspects of PX has proliferated, utilizing both physiological and questionnaire measures in mixed methods studies. The result has been conflicting evidence about the role of frustration in player experiences. Combined with previous work which investigated the prediction of discontinuation of play, this lays the foundation for the exploration of factors likely to affect the experience of, and time until a rage quit. The experiment reported in this work draws from years of research into mixed methods assessments of PX and predicting discontinuation of play to design a study which uses practice time and various measures of player affect and arousal to explore the factors which affect rage-quit experiences.

RESEARCH DESIGN

This work seeks to explore whether the average level of SNS activation at which participants “rage quit” during the game’s final level will be significantly different between players with different levels of familiarity with the specific game, 3D games in general, and different preferences for challenging games. It seeks to identify whether a common frustration based quitting range compared to baseline exists for this game as measured through SNS activation. This would establish the upper bounds of acceptable difficulty. I work to establish the average level of frustration required for a player to quit by manipulating player practice time and measuring percentage physiological activation above the baseline at the point that players quit while playing a tough level for which they are unprepared. This seeks to answer the question: At what percentage of frustration-based sympathetic nervous system (SNS) activation above baseline do players with different levels of familiarity with a game quit?

Independent Variables

There is one independent variable with three levels in this experiment: the amount of time the participant had to practice at the game in question. Huang et al. found that players' skill at Halo Reach multiplayer as measured by the TrueSkill system tended to be higher the more matches they played [44]. Accordingly, in this experiment three groups of participants play the first levels of Super Mario 3D World [G13] for three different amounts of time to create differing amounts of experience with the game; thereby operationalizing skill. All three participants then play the final (and hardest) level of the game to maximize their chances of hitting the hypothesized frustration activation threshold and quitting the game. Conducting the experiment in this way allows for slight differences in complexity encountered in the practice phase to influence participant skill, and equal complexity for all participants in the test phase. In this way, the experiment uses a between-subjects, independent measures design in which skill is manipulated by providing participants with differing levels of experience with the game. To achieve the appropriate level of skill participants were separated into three conditions, each providing a different duration of training. In the low-practice condition, the participants have a five-minute training session in which they were permitted to get as far into the game as they could from the first level. In the medium-practice condition participants were permitted an identical training session but for 15 minutes, and in the high-practice training condition participants were allowed 25 minutes of practice. These small differences between the conditions in practice duration allows us greater accuracy in pinpointing the smallest significant amount of practice time needed to affect subsequent test session duration.

Dependent Variables

- The amount of time it took from the beginning of the testing phase for the par-ticipant to quit.
- The increase of normalized SC above baseline that participants experi-enced on average during the testing phase.
- The percentage decrease in HRV from baseline that participants experienced during their testing phase.

This experiment has three dependent variables which were measured during the testing phase. Two of them are measures of SNS activation and are taken to determine if there is a standard level of negative valence activation above their own baseline at which people quit a game. HRV is the calculation of the duration of the interval between heart beats and corresponds to the heart's ability to adapt to various stimuli. One can calculate this variation by looking at each R-peak and calculating variance as a statistical method to accurately assess when R-peaks differ in time between beats. This method allows us to better understand the emotional state of the user. Comparing percentage change from baseline was chosen over frequency domain analyses for its simplicity for use by practitioners and because low HRV is already associated with a body's reduced ability to cope with stressors [54]. To analyze SC data, I first normalized SC increase in the following way: I subtracted the average SC within the final moments of play (measured in μS) from the minimal SC reached during baseline measures. I then divided the result by the product of the subtraction of the minimal SC level reached from the maximum SC level reached. This is accurately summed up in the following formula:

Normalized SC increase

- over last 2 minutes = (SCLlast2minavg - SCLmin) / (SCLmax - SCLmin).
- over last 10 seconds = (SCLlast10secavg - SCLmin) / (SCLmax - SCLmin) [13].

Moderating Variables

The 13 moderating variables are: participant's level of challenge-liking [94], how many times they died per minute in the testing phase, how many points and stars were collected in the practice phase, how much time they spend 3D gaming per week, the amount of character deaths participants suffered while playing through each phase of the experiment, how much they enjoy challenge in their games, the positive and negative affect scores on the PANAS, and the scores on the dominance, valence, and arousal subscales of the SAM questionnaire. This data was collected because all 13 variables may moderate the time it takes for participants to rage quit from the game. Death's per minute in the test phase specifically functions as an operationalization of task efficiency and play challenge because it represents a normalized count of participant failure. Much like players in the high-practice condition, players who spend more hours per week playing 3D games were expected to take longer to quit because they are more likely to have experience dealing with game-based frustration [77] (see table one). Participant's degree of agreement with the statement ''I like it when video games are really hard to beat'' measures how much participants enjoy challenge in their video game experiences [94]. Players high in challenge-liking are expected to take longer to reach frustration levels of SNS activation than other players. The amount of coins and stars participants collected during their practice phase is collected to gauge the engagement of the participant with the game's rewards. Of course, since participants in different conditions are given different amounts of time in the practice-phase, all measures collected during the practice-phase will be normalized to a per level basis. Score on the Positive Affect and Negative Affect dimensions of the PANAS [20] along with responses to the SAM [12] help determine the valence of the player experience.

Table 1. Difficulty Dissonance Hypotheses.

<table>
<tr><th colspan="2">Hypotheses</th><th>Research Gap Addressed</th></tr>
<tr><td>H1</td><td>Participants in different practice conditions will not quit at statistically different levels of increase in SC.</td><td>Work on difficulty has previously shown that controller touch pressure during a frustrating play-through is highest in response to in-game frustration (i.e., caused by challenges) [69]. There is a lack of work on SC increase over baseline levels at the time of quitting. Work by Bruun et al [16] has shown that SC peaks are highest when a user is frustrated and less in control of the situation. We have a zero-effect hypothesis because users experienced the same stimuli and therefore the same in-game frustrations and the same quitting behaviours [77]</td></tr>
<tr><td>H2</td><td>Length of practice condition is expected to positively affect the duration of the test phase.</td><td rowspan="2">Huang et al. found that players' skill at Halo Reach multiplayer as measured by the TrueSkill system tended to be higher the more matches they played [44]. They also found that players take breaks more often when they lose. However, this work does not pinpoint the smallest significant amount of practice time needed to affect subsequent desire to play in the face of insurmountable challenges. It also does not address the effect of global video game practice on resilience against negative frustration towards a specific game.</td></tr>
<tr><td>H3</td><td>Those who spend more time per week 3D gaming are expected to take longer to quit the testing phase.</td></tr>
<tr><td>H4</td><td>Those player who enjoy challenge more are expected to longer to quit the testing phase.</td><td rowspan="2">Given conflicting evidence that challenge and enjoyment are unrelated [67], we chose to explore the area of player experience where challenge is an obvious detriment to enjoyment because it results in discontinuation of play. We therefore want to know if the amount frustration experienced at the time of quitting is related to how long they have been playing the practice phase, and whether enjoyment of challenge in games overall protects against reaching a quitting level of negative frustration at a specific game.</td></tr>
<tr><td>H5</td><td>Players who report lower levels of frustration at the time of quit-ting are also expected to take longer to quit the testing phase.</td></tr>
</table>

Participants

The inclusion criteria for this experiment required that all participants have normal or corrected to normal vision, are people who play at least one hour of video games per week and who have never played the Wii U title: Super Mario 3D World [G13] or the Nintendo 3DS title Super Mario 3D Land [G12]. These criteria ensured all participants have a similar level of inexperience with the mechanics of these two similar games. Thirty-nine participants took part in this study. Of those, one participant was excluded from analysis because they did not quit playing the game within one hour of starting the test phase, and five were excluded because one aspect or another of their data was corrupted or unavailable. The randomly allocated 11 participants per condition for a total of N= 33. This sample size is in line with many other studies of physiological measures published at CHI and other venues, specifically [43], [76], and [25], all of which had smaller sample sizes. Participants had an average age of 24.18 years, and 81.8% of them were male. Participants were recruited through posters and were compensated with entrance into a raffle to win one of two $50 Amazon gift cards. The purpose of the experiment was not revealed to participants because knowing their quitting behaviours were being studied was likely to change these.

METHOD

This experiment requires a Wii U, a Wii Remote and Nunchuck, and the game Super Mario 3D World [G13]. The final level of the game (Champion's Road) was chosen as the testing level because of several factors explained below that made this level difficult, which probably explains why it is the last level. The level was selected as most likely to cause all participants to rage quit because of its high difficulty. This prediction proved successful when only one of the 39 participants run (including those whose data was not used) failed to quit. The experiment also required the collection of SC and HR data which was accomplished using the Biopac System made up of the Amplifier and wrist-mounted Bionomadix transmitter, as well as a computer which recorded these data. A camera pointed at the TV, where players were playing was also used to capture the play session, enabling the researchers to collect gameplay data. The testing room in which the experiment took place was designed to look and feel like a living room for ecological validity. It contained a couch facing a 165 cm wide television with surround sound audio speakers at 191 cm from the couch.

Study participants were asked to play Super Mario 3D World [G13] for 70–90 minutes depending on assigned practice condition. Once participants were in the testing environment, they filled out a pre-test questionnaire and were fitted with SC and HR electrodes to their fingers, wrist, and forearms. As suggested by [13], participants were then asked to sit quietly for two minutes during which baseline EDA data was recorded. The 65-inch screen TV was then turned on to reveal the start screen of Super Mario 3D World [G13].

Practice-Phase

Each participant was then asked to practice for a certain number of minutes depending on their experimental condition (5, 15, or 25 minutes). All participants were told how long they had to practice and started a new game from the first level as Mario. They were given the opportunity to go as far as they could into the game during their practice phase. At the end of the allotted practice time the participant was asked to close their eyes while the experimenter set up the next portion of the experiment.

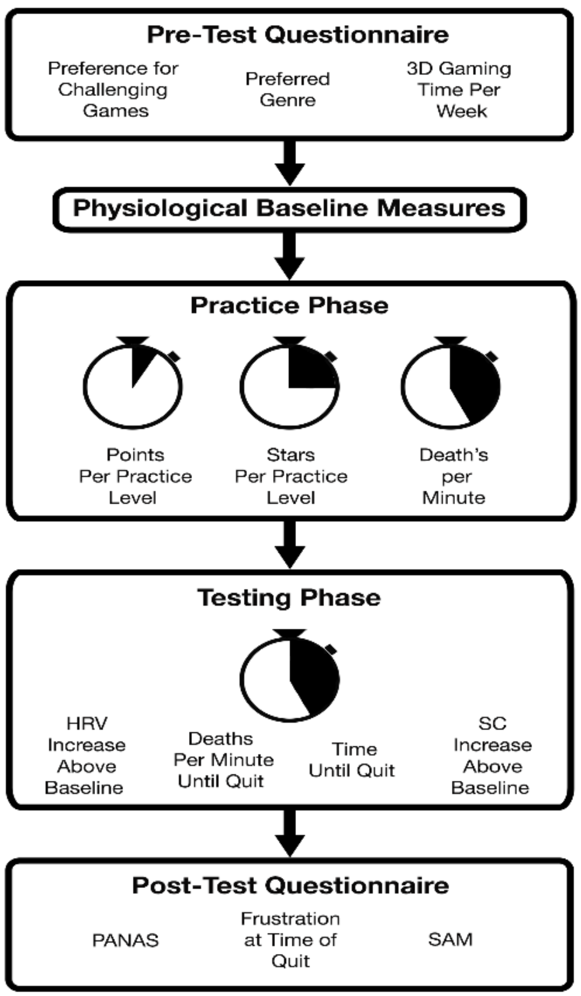


Figure 1: Rage-quit experiment procedure.

Testing-Phase

While the participant has their eyes closed the experimenter loaded a save file which has the final level of the game (Crown-Crown: Champion's Road) unlocked and moved the player's character through the over-world to the final level. This level is chosen to maximize the chance that participants will reach the required level of frustration to quit playing the game. Factors in this level which ensure a high level of difficulty include:

- No mid-level checkpoint from which players can start if they died.
- A requirement of functional knowledge of the game's high-level skills such as special jumps over long gaps and running over small gaps.
- A wide variety of enemy types.

Participants were then told to open their eyes and "Play this level for however long you want. Just let me know when you do not want to play anymore." After the testing phase participants were asked to fill out the post-test questionnaire which included the item on challenge-liking as well as asking for preferred video game genres and the amount of time spent playing 3D games per week. This is done at this time instead of at the beginning of the experiment to avoid priming effects. Participants were also asked to answer in one sentence in their own words why they stopped playing (see table two).

Table 2: Participant responses to the prompt: "Explain in one sentence why you stopped playing the game." Highlighted participants had negative reactions/reasons.

P#	Participant responses to the prompt: "Explain in one sentence why you stopped playing the game"
1	I have other work to do; otherwise I would have played until I got TOO frustrated.
2	I had to set myself a goal of at least clearing the first 'segment'; that is, reaching the first clear pipe. Having accomplished that more than once, I decided to call it
3	There wasn't a checkpoint after the first section so it would take too long to keep trying
4	I stopped playing the game due to becoming slightly annoyed as well as bored
5	Beyond my ability to finish or play without constantly training through a variety of levels. - I feel Dark Souls was easier
6	I'd thought I had an idea for how to get past the disappearing platform sequence, it didn't work as I planned, and so I figured it was a good time to take a break, given the length of time I'd already played.
7	As I realize that I may take much longer time to actually pass the game, I deal like it is not that much worthy for insisting on and on to that stage
8	Felt like it was a time waster. I have a paper due and a 2nd meeting at 4:30. Scheduled time. Mario a little boring. not my type of game. I see it as kids game
9	Because I have to leave, but if I had been in my house I probably wouldn't have stopped until I completed the level.
10	I want to continue playing, but I felt this level is very HARD to complete and just stopped
11	I didn't get the chance to warm up/practice on the easier levels so I felt that the hard level was too difficult for me.
12	Because I am more comfortable playing video games in my room
13	The last level was so had that I wasn't making any progress after playing it 15x times.
14	WAS NOT FUN
15	I didn't see any progress. No checkpoint in sight. Didn't want to spend more time.
16	I thought I died 5 times in a row on this "football" players without working progression and I needed a mental reset.
17	I felt like the progression I was going to make had plateaued, and to make further progression would take a lot of time.
18	I was making little progress after multiple attempts which I found to be frustrating.
19	I found it difficult to get past the initial hardness
20	I felt I had made a satisfactory amount of progress throughout the stage
21	I feel sorry for the person waiting because I knew it would take me a couple of hours to get anywhere.
22	I am taking too long to progress!
23	I couldn't beat the level as I required more practice with the controls, and I was a little frustrated that I was dying at the same spot.
24	The part of the level with the football guys was tricky and I kinda had to pee.
25	I realized that the game does not let you pass a certain point unless you have a certain ability to clear the path.
26	I died a lot of times at the same spot so I felt I wouldn't be able to beat it.
27	I was getting too frustrated because I couldn't get the timing right on the jumps.
28	I felt like there was no way I could progress.
29	I need to go eat lunch with a friend before its too late.
30	The game was not saved automatically.
31	I didn't want to take up more time to learn the following mechanics to beat the level.
32	Because I was too much irritable.
33	I felt I did not have the experience or ability to finish the level.

RESULTS

"Why you stopped playing the game"

Evidence that the final level resulted in quits stemming from frustration comes from 21 of 33 participants mentioning frustration, annoyance, lack of progress, too much difficulty, or the desire to give up in their response to the above prompt (highlighted in table two). Some typical responses include: "I was making little progress after multiple attempts which I found to be frustrating" (Participant 18), "Because I was too much irritable." (P23), "I didn't get the chance to warm up/practice on the easier levels so I felt that the hard level was too difficult for me" (P11), and "I was getting too frustrated because I couldn't get the timing right on the jumps" (P27). All responses are available in table two.

Testing Hypotheses 1 to 5 with ANOVA

To evaluate H1 - H5, I conducted multiple one-way ANOVA (analysis of variance). An ANOVA analyzes the difference between different group means for significance. For each ANOVA conducted I used Levene's test to check the ANOVA's assumption of equality of variances. All tests of equality of variance passed, indicating the assumption was correct. Furthermore, given a roughly 45-degree line on the quartile-quartile plots of the residuals of the dependent variables for every level of the independent variables the ANOVA pass the normality assumption. Table three shows the results of the ANOVAs conducted, as well as the results of the equality of variance tests.

Table 3. ANOVA testing for main effects of practice condition, hours spent gaming per week, challenge preference, and level of frustration at the time of quitting on normalized SC increase and time to quit.

Hypo theses	Dependent Variable	Levene's test for equality of variance	Independent Variable	df	F	Sig.	η^2
H1	SC (10s)	$F(2,26) = 1.190$, $p > 0.05$	Practice Condition	(2, 26)	1.114	0.343	0.079
	SC (2m)	$F(2,26) = 0.917$, $p > 0.05$		(2, 26)	0.363	0.699	0.027
H2	Time to Quit	Equal sample size in each condition		(2, 30)	3.293	0.051	0.180
H3		$F(4,28) = 0.758$, $p > 0.05$	Hrs/Week Gaming	(2, 28)	0.697	0.601	0.091
H4		$F(4,28) = 1.829$, $p > 0.05$	Challenge Preference	(4, 28)	3.068	0.032	0.305
H5		$F(4,27) = 1.444$, $p > 0.05$	Frustration Level	(5,27)	0.255	0.949	0.040

Hypothesis One – Practice Time and Skin Conductance

Results of the ANOVAs indicate that that H1 should not be rejected, as the different practice conditions did not result in different levels of skin conductance increase in the last 2 minutes or ten seconds before the rage quit, $F(2,26) = 0.363$, $p > 0.05$, and $F(2,26) = 1.114$, $p > 0.05$ respectively. Given missing data from the last two minutes of play for two participants in the 15-minute practice condition and two in the 25-minute practice condition, I used Levene's test to check for equality of variances (see table three). To further analyze the differences between conditions three independent samples t-tests were conducted comparing all three combinations: 5m vs 15m, 5m vs 25m, and 15m vs 25m. Results indicate that the difference in SCL level (over the last 2 minutes or ten seconds of play) between participants in each of the three conditions were not statistically significantly different from one another. Results for the comparison between the three combinations over the last ten seconds of play are *t(18) = 1.055, p > 0.05, t(18) = -0.321, p > 0.05, and t(14.629) = -1.599, p > 0.05* respectively.

Hypothesis Two – Practice Time and Test Session Duration

Normality of variance was assumed for this analysis because of equal sample size in each condition. The results of the ANOVA indicates that H2 should be rejected, as the different practice conditions did not result in statistically different lengths of play time during the test phase before the rage quit, *F(2,30) = 3.293, p > 0.05*. However, to follow up, I conducted an independent samples t-test to evaluate whether there were any significant differences in time taken to quit between conditions. Results indicate no significant difference between those in the 5-minute condition and those in the 15-minute condition *t(20) = -2.03, p > 0.05*, nor between those in the 15 minute condition and those in the 25-minute condition *t(20) = -0.274, p > 0.05*. However, a significant difference was observed between those in the 5-minute condition and those in the 25-minute condition *t(20) = -2.871, p = 0.009* (see figure two).

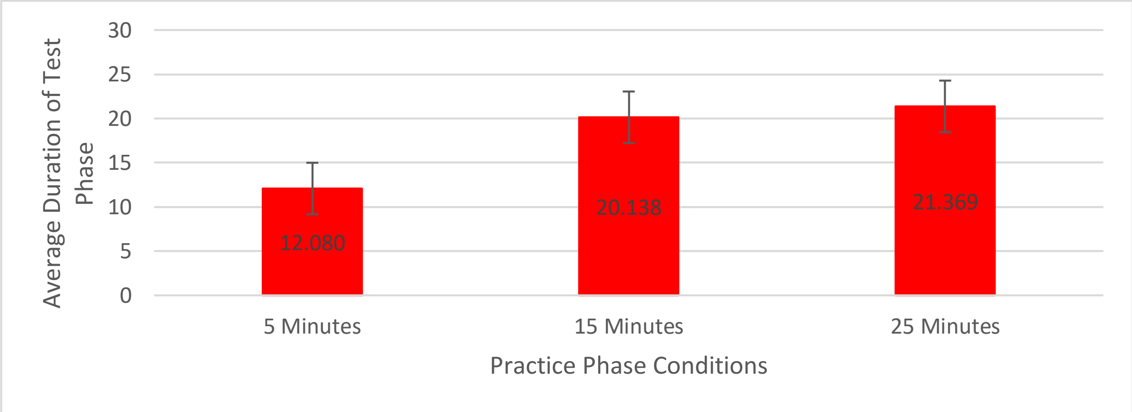


Figure 2: Average test phase duration in minutes for each practice phase condition. Error bars represent the 95% confidence interval.

Hypothesis three, four and five– Gaming Time per Week, Challenge Preference, Frustration, and Play Session Duration

Given that participants self-reported how much time they spent gaming per week, challenge preference, and how frustrated they were with the test level, I used Levene's test to check for equality of variances for the ANOVA evaluating H3 to H5. It showed that the variances for the time it takes to quit were equal (see table three). Results of the ANOVA indicate that H3 and H5 should be rejected, as different amounts of time playing 3D games per week, $F(4,28) = 0.697$, $p > 0.05$ and self-reported frustration levels while playing the test level, $F(5,27) = 0.255$, $p > 0.05$, did not result in statistically different lengths of play time during the test phase before the rage quit.

Results of the ANOVA indicate that H4 should not be rejected, as different preferences for challenge did result in statistically different lengths of play time during the test phase before the rage quit, $F(4,28) = 3.068, p = 0.032$ (see figure three).

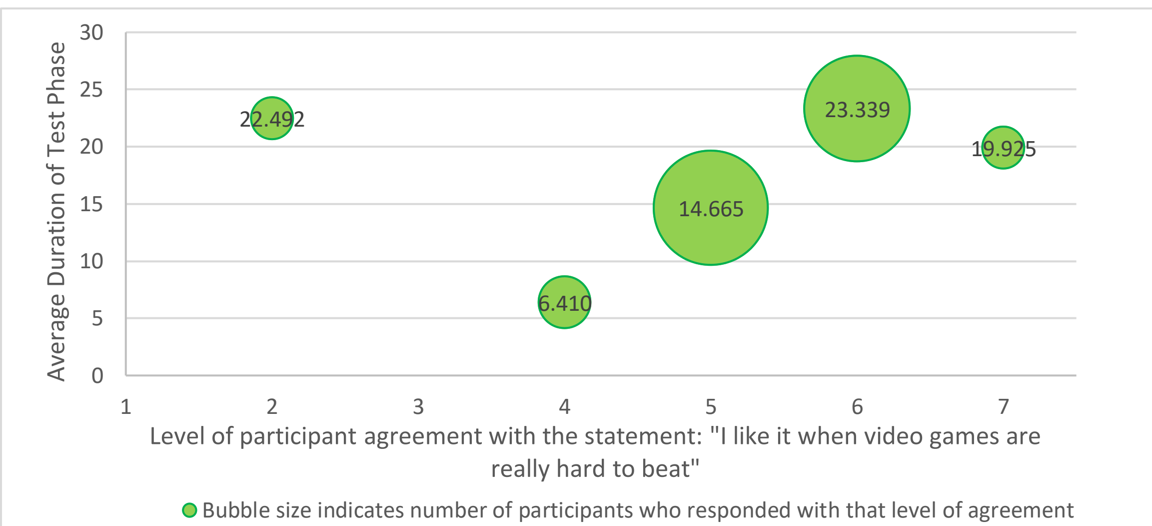


Figure 3: The relationship between test phase duration and challenge preference as reported in a Likert scale (1-7).

Participants were asked to rate their level of agreement with the question: I like it when video games are really hard to beat" on a scale with 1 labeled as "Strongly Disagree" and 7 as "Strongly Agree".

Multiple Linear Regressions

Table 4: Which predictive variables were used in each multiple regression analysis.

Predictive Variables Present in Multiple Regression Analysis	**Multiple Regression Analysis Dependent Variable**		
	Time to Quit	Normalized SC levels seconds before quitting	Change in HRV from baseline
Time to Quit		✓	✓
Normalized SC levels ten seconds before quitting	✓		✓
Change in HRV from baseline levels	✓	✓	
Practice condition	✓		
Participant sex	✓		
Participant age	✓		
Negative affect scores	✓		
Positive affect scores	✓		
SAM dominance scores	✓		
SAM arousal scores	✓		
SAM valence scores	✓		
Deaths per minute in the test level	✓		
Deaths per minute in practice levels	✓		
Reported frustration at time of quit	✓		
Preference for challenge in games	✓		
Points collected per practice level	✓		
Stars collected per practice level	✓		
Time gaming per week	✓		

Multiple regressions are a predictive analysis capable of explaining the relationship between multiple independent variables and a continuous dependent variable. The R^2 statistic which is generated by these models represents the proportion of variance in the dependent variable explained by the independent variables. Positive R^2 values indicate strong relationships. Three multiple linear regression analyses (herein referred to as a multiple regression) were run to predict the time it will take participants to quit, increase in normalized SC over the last 10 seconds of play, and HRV above baseline in the last two minutes before participants quit. Predictive variables included in all multiple regressions conducted for this project appear in table four.

Predicting Time to Quit

The Durbin-Watson test for independence of observations finds that data is not auto-correlated when the Durbin Watson statistic is between 1.5 and 2.5. In this case it found that the data is not auto-correlated as the Durbin-Watson Statistic equaled 1.738. Results indicate that the variables included as predictors statistically significantly predicted time taken to quit, $F(17, 10) = 3.794, p < .05, R^2 = .866$. Death's per minute in the testing level, SAM valence score, and skin conductance over the last ten seconds of play in the test level added statistically significantly to the prediction, $p < .05$. Practice condition, deaths per minute in the practice levels, points per practice level, and participant sex were all not statistically significant at $p < 0.1$. A second regression analysis using only the three significant predictors mentioned above was also conducted, $F(3, 27) = 8.682, p < .05, R^2 = .520$. A graph of the correlation between the unstandardized predicted value and time to quit can be seen in figure four.

Predicting Normalized SC Increase

The Durbin-Watson test for independence of observations was conducted, finding that the data is not autocorrelated (*1.737*). These variables did not statistically significantly predict normalized SC increase above baseline over the ten seconds before participants quit, *F(17, 10) = 1.612, p > .05, R2 = .733*. Time taken to quit the test level was the only factor that added statistically significantly to the prediction, $p < .05$. SAM valence score, deaths per minute in the test levels, and negative affect score were all not statistically significant at $p < 0.1$.

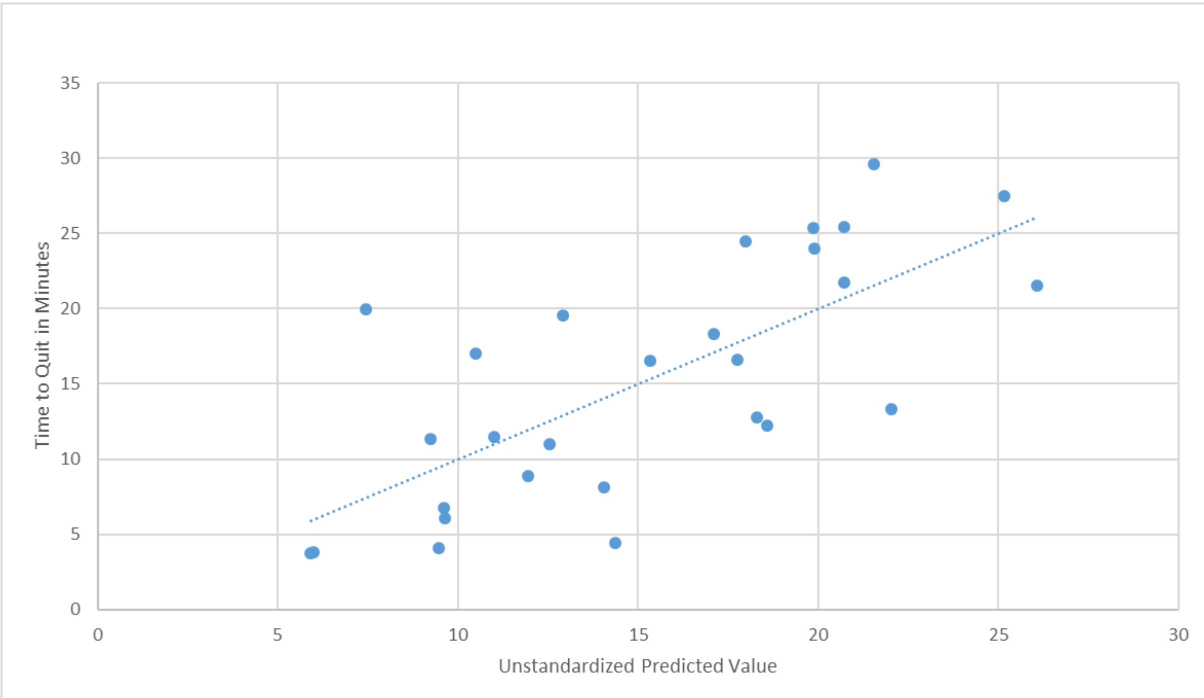


Figure 4. Correlation between the time taken for participants to quit in minutes and the predicted unstandardized time it would take for participants to quit.

This was derived from normalized SC increase at the time of quitting, deaths per minute in the testing level, and SAM valence score (R^2= 0.520, y = x).

Predicting Normalized HRV Increase

HRV was calculated by taking the standard deviation of each participant's heart rate. The Durbin-Watson test for independence of observations was conducted, finding that the data is not auto-correlated (*2.035*). These variables did not statistically significantly predict

HRV level above baseline in the last two minutes before participants quit, *F(16, 11) = 10.617, p > .05, R2 = .473*. No variables added statistically significantly to the prediction.

Exploring Correlations

To further explore the non-hypothesized relationships between the collected data bivariate Spearman's rank correlation coefficients were calculated for each relationship (table 5). This was done to better understand which factors may be linked, and to motivate future studies with observed relationships which merit further analysis. Significant correlations are discussed as needed in the next section.

Table 5. Bivariate spearman correlations.

	PracticeTime	P_Age	Time2Quit_min	HrPerWeek_Gaming	FrustrationLvl	ChallengePreference	PositiveAffScore	NegativeAffScore	DperMinPractice	PointsPerPracticeLvl	StarsPerPracticeLvl	DeathsPerMinTestLvl	SAM_happiness	SAM_arousal	SAM_dominance	HRVPercIncrease_BaselineToTest	(SCLIst10secavg - SCLmin) / (SCLmax-SCLmin)
PracticeTime	1																
P_Age	-0.170	1															
Time2Quit_min	.391*	0.174	1														
HrPerWeek_Gaming	0.134	-0.320	0.139	1													
FrustrationLvl	0.168	-0.111	0.037	0.055	1												
ChallengePreference	0.136	-.346*	0.230	0.266	-.407*	1											
PositiveAffScore	0.293	-0.210	0.294	0.081	-0.143	.464**	1										
NegativeAffScore	-0.033	0.116	-0.080	0.026	.644**	-.376*	-0.129	1									
DperMinPractice	-0.078	0.212	-0.265	-0.283	0.232	-.352*	-0.065	0.338	1								
PointsPerPracticeLvl	.423*	-0.249	0.244	0.227	-0.242	.392*	0.232	-0.205	-.360*	1							
StarsPerPracticeLvl	.429*	-0.300	0.161	.383*	0.115	0.143	0.002	0.138	-0.163	.727**	1						
DeathsPerMinTestLvl	-0.334	0.216	-.670**	-.363*	0.168	-.575**	-.388*	0.305	.553**	-.431*	-.400*	1					
SAM_happiness	0.242	-0.238	0.123	0.137	-.388*	.484**	.504**	-.552**	-0.173	0.322	0.193	-.508**	1				
SAM_arousal	0.116	-0.327	-0.026	-0.044	0.298	0.021	.423*	0.328	-0.067	-0.012	-0.058	0.016	0.052	1			
SAM_dominance	0.042	0.007	-0.145	-0.047	-.459**	0.261	0.258	-0.181	-0.001	0.055	-0.162	0.000	0.230	0.032	1		
HRVPercIncrease_BaselineToTest	-.378*	0.039	0.086	-0.029	-0.107	0.002	0.046	-0.141	-0.193	-0.158	-0.316	-0.070	0.054	-0.157	0.030	1	
(SCLIst10secavg - SCLmin) / (SCLmax-SCLmin)	0.045	0.123	-0.268	-.392*	-0.019	-0.288	-.371*	-0.287	0.099	0.015	-0.095	0.232	-0.165	-0.314	-0.043	0.039	1

Green cells show significant correlations at the 0.05 level (2-tailed), and red cells show significant correlations at the 0.01 level (2-tailed)

PART III: ATMOSPHERE – THE EFFECT OF THEMATIC COHESION ON PLAYER EXPERIENCE

RELATED WORK

Previous research suggests that audio has effects on player emotions [89, 27] and is capable of both enhancing and disrupting immersion [45, 93]. Music more specifically, is capable of inducing emotion through a variety of mechanisms [50, 9, 85]. In a study of players' affective state prior to and after scary events in a game, music was rated as the third scariest element after shock and sound [105]. When it comes to creating fear, suspense, and anxiety in games, there are different recommendations when it comes to sounds effects [103], but few when it comes to music. Past work on films has concluded that an association exists between the musical avant-garde, loosely defined as favoring experimental ideas, and horror media [42]. Applying this concept to games, Helen Mitchel conducted interviews with survival-horror game composers and audio directors and thereby demonstrated the preference of such people for avant-garde techniques to create tension [72]. This is important because it has shown to be cohesive with the genre, which makes it interesting to explore why, and what happens when thematic cohesion is manipulated. However, I am not aware of any work that explores the effects of music's thematic cohesion on the player experience. In this work, I explore atmosphere as an experience stemming from the thematic cohesion between the audio environment of play and the visual elements of a game's setting. To do this, I use Bloodborne [G3], a dark, Victorian-era inspired survival horror game by FromSoftware.

Considering the correlation between absorption and the enjoyment of negative emotions evoked by music [35], and the need to study the interplay between positive and negative affect in games [68, 10, 5], Bloodborne [G3] is a suitable survival-horror game to analyze the effect of musical thematic cohesion on unwanted emotions such as frustration, and wanted emotional states like enjoyment and immersion. Thus providing a comprehensive overview of the effects of atmosphere on the PX. Its setting and difficulty are ideal for experiencing fear, emotional challenge [31], and gameplay challenges triggering fear of losing points when players die [5]. Bloodborne [G3] is also ideal for this study because it allows for changing audio settings.

Atmosphere in Games

Simon Niedenthal defines video game aesthetics as "the sensory phenomena that the player encounters in the game" as well as the "aspects of digital games that are shared with other art forms" [78]. The three main senses players use in interacting with a video game are sight, hearing, and touch. Although touch is an important part of player experience, it is only sight and sound that are shared with similar art forms such as film and theatre. Aesthetics are close in their definition to atmosphere, a term defined by the Oxford Dictionary as "the pervading tone or mood of a place, situation, or creative work" [81]. For Greg Kasavin, writer and designer on Bastion [G1], it is about the game's "unique identity and unique feel". He notes that atmosphere is used to "help create immersion" and is made up of tonal cohesion, internal consistency, and specific detail [52]. Other past work has described a game designer's job in relation to atmosphere as making sure the game is "aesthetically coherent and creates the appropriate mood" with the use of "lighting, colour palette, weather and atmospheric effects, special visual effects, music, ambient audio, and special audio effects" [4].

Although games of various genres, from *Half-Life* [G5] to *Proteus* [G6], can be atmospheric, it is most often discussed when it comes to horror and survival horror games. One paper referring to an "atmosphere of horror" analyzes visual features from a series of classic images [73]. Other literature, although not making claims about atmosphere directly, discus the effects of lighting patterns on motivation, performance, tension, and the ability to elicit emotions respectively [14, 57, 30, 79] One of the few papers which mentions atmosphere in terms of audio notes the "chilling atmosphere" of Silent Hill [G9] and found that audio and visual forewarning intensifies emotional reactions to upcoming frightening events [b].

Horror Game Audio Research

Some who have attempted to explore the audio component of aesthetic experiences of horror games have focused on considering the acoustic ecology of fear [33], the effect of unmelodic ambience on the ability to distinguish sounds as diegetic or non-diegetic [58], warning systems [84], and uncanny sound [38], but have reported no studies. Those who have reported studies focus on the creation of fear instead of the experience of atmosphere. In this line of inquiry, researchers have manipulated audio parameters to find a potential influence on the intensity of fear responses [34]. In a 2010 book chapter Guillaume Roux-Girard looked at the sonic structure of games and how it is used to elicit emotions such as fear and dread. He concludes that to create discomfort and fear, horror games obscure the origin and cause of sounds, preventing players from feeling safe [90]. A similar point is argued by Kromand who explores uncertainty in the diegesis of sound in a survival horror game context and concludes that games like Bioshock [G2] and Silent Hill 2 [G10] veil aural warning cues with broken causality to create distrust in players [58]. Various studies follow in the vein of localizing sound sources: Girard's conclusions are mirrored in a 2015 study which analyzed college students' fear experiences with video games and found that a hyper-awareness to strange sounds was the most reported reaction to fear and that 'surprise' is the biggest contributor to fear [63], and a 2009 study which found that the localization of a sound increases its perceived scariness, with point-like sounds being perceived as scarier than spread sounds. Point-like sounds coming from behind the person were perceived as scarier than those coming from in front of the person [28]. Finally, in a study of perceived strangeness and human likeness of virtual characters was carried out on 100 clip viewers. Results indicated that how human-like a character's voice sounded and facial expression appeared, and the level of synchronization of a character's lip movement to the sound it generated all had an effect on the fear induced [102]. Partly inspired by this paper I assess how thematic desynchronization of music and setting influence player experience.

Although much of past work has focused on diegetic sound, non-diegetic sound such as music also plays an important role in horror games. Chapter 7 of the book Music in Video Games: Studying Play, goes on to describe music as being used to signify a continuous atmosphere of danger. This is because when music is present continually players have no indication of safety and therefore remain tense [24]. As such, both musical conditions in the present paper allow for no time between songs, continuously providing the player with background music. However, does what music is playing matter? What happens to the player experience if the soundtrack does not match the tone of the game? This study aims to answer this question by presenting players with music which does not match the tone set by the visual aspects of the game.

Music and the Player Experience

The MDA framework was developed by Hunicke, LeBlanc, and Zubek to formalize the understanding of games and bridge the gaps between game design, development, criticism, and technical research. The mechanics and dynamics aspects of the framework deal with game components at the level of algorithms, and the multilateral relationship between player inputs and the emergent behaviour of the mechanics, respectively. Aesthetics, the concept from which atmosphere takes shape, deals with desirable emotional responses evoked by interacting with the game [46]. However, desirable does not necessarily mean positive valence emotions [68, 10]. Indeed, individual differences have been found in the enjoyment of music which evokes negative emotions, with such enjoyment being positively correlated with absorption, a similar concept to immersion, and music empathy [35]. Such a result may even be part of the reason why horror games, often containing uncanny music intended to induce negative emotions, [38] are often thought of as immersive, as negative feelings in this context are often found to be desired and enjoyable.

Music listening can influence emotions through a variety of mechanisms including brain stem reflexes, evaluative conditioning, emotional contagion, visual imagery, episodic memory, and musical expectancy [50]. Emery Schubert explored continuous response to musical features by having participants rate their experiences on a two-dimensional emotion space consisting of happy-sad valence, and aroused-sleepy valence [95]. Borrowing from this methodology I assess the emotional response to four sound conditions using the SAM questionnaire [12] and the PANAS [20].

The effect of music on the video game experience has been discussed before at length. A book by William Cheng in 2014 explores the relationship between video game audio and the aesthetic, moral, and socio-political aspects of games [66]. In a 2009 study Cassidy et al.

gave participants the opportunity to play a driving game while listening to self-selected or experimenter selected high or low arousal music. Results indicated that those who self-selected their sound tracks enjoyed their experience more, were more efficient, perceived the lowest distraction and experienced reduced anxiety. Those in the high arousal experimenter selected music condition had the worst experience and performance [18]. The current experiment used a similar model of affective judgements to rate the sound conditions, although I use questionnaires more commonly found in today's papers. In a vein more similar to the present work, Tan et al. also studied the effects of unrelated background music on adventure role-playing games. Unfortunately, this study only assessed performance, finding that the highest scores were earned by those playing with unrelated music from a boom box [101]. This curious finding led me to wonder if affect, enjoyment, and various other aspects of PX are similarly effected by unrelated music. However, music is not the only type of outside audio which players may listen to during gameplay. Podcasts and youtube videos are a popular source of background noise for at least one researcher on this team. As such a podcast condition was included in the present study to assess those experiences, as well as an option for podcasts and Youtube video background added to a question in the online version of the study which asked players to describe their sonic preferences while playing video games.

Although there are no papers on the effects of video game music on atmosphere, a few papers do explore the effects of the presence of a musical score on the gaming experience [49, 96]. Finding various effects, it acknowledges that although not present in their analyses "visual transference, in which the quality of the visual image and/or game situation is imposed upon the musical score when both components are combined into an A-V experience" should be a significant relationship affecting the player experience [61]. In a

2006 follow-up, Zehnder and Lipscomb looked at 159 games of different genres regarding the options they offer players to change elements of sound-like music and sound effects volume. They found that games in which built-in music is central to gameplay, like action/adventure and RPGs, tend to not offer such options, whereas racing and simulation games allow for much more sonic customization [113]. This supports the use of Bloodborne [G3] in the present study, because it is an RPG and a survival horror game, genres where sound is considered central to game play, which allows for the control of various aspects of audio. Another paper, exploring the influence of background music on immersion, found that for gamers with little experience the inclusion of background music does increase immersion [112].

Furthermore, there is also evidence that music influences mouse activity not related to game play and increases feelings of flow [60]. As for performance, Yamada et al. found that participants playing a racing game with it's built-in music or "dark, agitated" experimenter-selected music had lower scores than those in the silent condition [108]. When contrasted with the opposite finding in Tafalla's 2007 work [100] which found men to perform twice as well with a soundtrack, this paints a foggy picture of the effect of music on performance. It is following in the steps of these and various other papers that I attempt to empirically validate the following definition of atmosphere: the subjective feeling that the visual and audio components of a video game have tonal cohesion or fit together thematically "A game soundtrack draws players into the game space's atmosphere with heroic melodies, exotic drums, or spooky white noise", wrote Elferen in a musicological essay on the theoretical implications of video game music. Calling for a greater musicological involvement in this field, Elferen argues that music expands the game's magic circle into the surroundings of the player, helping to underline the uncanny overlap between reality and virtuality [29]. In a more scientific approach, a content analysis of popular video game soundtracks with the goal of classifying soundtrack elements in terms of their potential immersiveness found that music consistently ranks high as a factor affecting aesthetic quality, setting tone, mood, and the inner conditions of avatars. Interestingly, that thesis also found that the accidental repeating of battle music decreased the inner orientation ratings of music for the game *Rise of the Tomb Raider* [G8] [22]. Results such as those have even led to the creation of techniques to conceal musical repetition in games and thereby avoid disintegration of the ambience [8]. Attempts have even been made in the past to automate the creation of tension-filled experiences through sound manipulation [62]. Further study on the evaluation of game music systems has also led to a methodological approach which focuses on music's effect on the game playing experience, how the music is perceived in terms of aesthetic standards, and whether it conveys the intended narrative [86]. By applying music which does not convey the intended narrative of Bloodborne [G3] I hope to establish the effects of failing this evaluation component.

Physiological Measures of Horror

The first psychophysiological studies of horror were conducted on movies. In 2008, Palmer found systolic blood pressure (SBP) to significantly increase between the baseline condition and the film. Such increases were also inversely correlated with fearlessness and positively correlated with cold-heartedness, questionnaire-based measures [82]. Given the difference between playing and watching horror, Blackmore conducted an experiment using EMG to record the startle reflex of participants while they watch a play-through of a game and play the game. Results indicated that player interaction increases the fear state [11]. Although no significant differences were present for EMG and electrodermal activity (EDA) in the 2010 study which inspired this work, significant correlations were observed between EDA and EMG, and some dimensions of the Game Experience Questionnaire (GEQ). The most interesting of these being negative correlations between EDA and flow and between facial EMG and competence in the sound-on/music-off condition [75].

Vachiratamporn et al. analyzed player affect using an annotation tool, EEG, HR, and keyboard-mouse activity before and after scary events in a survival-horror game. Results indicated that heart rate was best for classifying player affect, with a 90% accuracy rate, and that a suspense state prior to the scary event increases the chance that fear will be experienced. For fear to be experienced without prior suspense, it must be caused by surprise [106, 105].

To a limited degree the psychophysiological aspects of video game music have also been explored. One 2004 study of Quake III [G7] players exploring the cortisol levels of players in a silent or built-in music condition found that those who listened to music had significantly higher cortisol levels after the end of the experiment [41]. Another study, this time focusing on fear-related stimuli in an audio-only game found several statistical features of EEG that can differentiate fear from calm [32]. Given the success of HR, HRV, facial EMG, and EDA at detecting components of the audio and fear-related experience of horror games they will be used in this study.

RESEARCH DESIGN

This paper is designed to explore the concept of atmosphere in games. It presents participants with different sound stimuli to explore the effect of atmosphere (thematic cohesion) on player experience. This paper seeks to explore what atmosphere is and whether atmosphere influences arousal and the valence of said arousal during the player experience. It seeks to answer the questions: What is video game atmosphere and how does it affect player experience? Specifically: Does thematic cohesion (i.e., the relationship between sound and visual stimuli) affect the perception of atmosphere and player experience of immersion and other emotional states? What factors within games influence the perception of atmosphere? What is the effect of atmosphere on game quality judgements and purchasing decisions? Three studies were conducted to explore these questions. In the first study, online respondents were randomly assigned to watch one of four Bloodborne [G3] gameplay videos depending on their experimental condition and then responded to a questionnaire in Qualtrics. In the lab study, participants were randomly assigned to one of four audio conditions and asked to play Bloodborne [G3] for 25 minutes. Previous work using EMG suggests that startle reflexes are significantly different between watching and playing horror games [11]. I conducted both experiments to engage larger numbers of participants (online) and to determine if a difference is also present in self-reported emotional responses between watching and playing games.

We designed the experiment around one independent variable representing four conditions in both experiments: what sound played in the background while participants watched or played Bloodborne [G3]. Given the differing lengths of gameplay in the lab experiment and the video in the online experiment, changes were made to the condition to fit the length of the experiment. These changes and the four conditions are outlined in table six. Given findings that music ranks high as a factor affecting various atmosphere-related qualities [22], two dimensions were considered in the creation of the audio conditions: whether music was present, and whether it fit the setting thematically. Accordingly, four conditions were created for the lab experiment in which the music slider in the game was turned down to mute. For the conditions in which music is present, enough songs were chosen to fill the length of the experiment to avoid the negative side effects associated with game music repetition [45, 22, 8]. Surveys were employed to assess the dependent variables (listed shortly); additional questions were asked to shed light on the concept of video game atmosphere and its relationship to various other constructs. These additional questions asked during studies 1 and 2 constitute study 3. Analysis of the responses to these questions are discussed.

Study 1: Online Video Experiment

This study was conducted to study a sample not physically bound to my research institution's home town. I acknowledge that there is a difference between watching and playing a horror game [11], however atmosphere as created by the interplay between auditory and visual elements is something that games and movies share [78], therefore making this a viable source of data on atmospheric experiences. Furthermore, given the increasing popularity of streaming websites such as Twitch, the consumption of games through a passive medium (watching) has never been more relevant and deserving of study. In this between-subjects experiment, participants were recruited online through the r/videogamescience subreddit and asked to answer a demographic questionnaire and then divided into one of the four conditions. The video which they then watched (3 minutes, 18 second duration) was identical for every condition, except for its audio component. It was created using iMovie to cut together pieces of the Youtube video: "Bloodborne [G3] 100% Walkthrough Part 1 – Central Yharnam". Participants then answered several questionnaires.

There are three dependent variables in this experiment (see table seven): The first is how atmospheric the condition was perceived to be, or the level of thematic fit between the audio and setting of the video watched. Three custom Likert questions asked of participants key into this variable. The second is the score on the two dimensions of the PANAS [20]. The third is the level of frustration experienced by viewers during the stimulus as self-reported in a Likert question.

Study 2: In-Lab Gameplay Experiment

The experiment was conducted with a PlayStation 4 console and Dualshock 4 controller. The game used to conduct the study was Bloodborne [G3]; developed by From Software and released in 2015. The first level of the game, (consisting of the Iosefka's Clinic and Central Yharnam locations) was chosen as the testing level because they are the first areas players of the game would encounter and therefore serve as an introduction to the game's setting and themes. Furthermore, given the game's notorious difficulty, the first level was thought to be the most accessible for new players. The experiment also makes use of SC, HR, and Facial EMG sensors, as well as a computer running iMotions, which recorded this and psychometric data. A camera was pointed at the 165cm wide TV, where players were playing to collect gameplay data. The couch faced the TV and was 191 cm from it. The experiment took place in a room containing a couch, speakers, and a TV. It was designed to look and feel like a living room to maximize ecological validity.

There are ten dependent variables in this experiment. Table seven displays the justifications for collecting these variables. The first is how atmospheric the condition was perceived to be, or the level of thematic fit between the audio and setting of the video watched. Two questions key into this variable. Inspired by work modelling perceived emotion in response to music [95], dependent variables two through ten assess emotional and arousal reactions to sonic conditions of gameplay. The second dependent variable is the score on the two dimensions of the PANAS [20]. The third is the level of frustration experienced by players during the game. The fourth, fifth, sixth and seventh are player's responses to the IEQ [47], PENS [88], PXI [1], and SAM [12] questionnaires, respectively. The eighth dependent variable is the increase in SC above baseline of participants during the beginning, middle, and final periods of testing. The ninth is the increase in HR above baseline, and the 10^{th} the facial EMG data.

Baseline and Training

Once participants were in the testing environment, they were told to fill out a pre-test questionnaire on the computer at the experimenter's desk and were then fitted with SC, HR, and fEMG electrodes to their fingers and face (all electrodes were pre-gelled single-use). The participants were then asked to sit quietly for two to five minutes with their hands on their knees and palms facing up. During this time baseline physiological data was recorded to the computer. SC sampling was collected at the iMotions default rate of 128Hz; HR sampling was collected using a plethysmography ear-cuff at the iMotions default rate of 128Hz; and facial EMG sampling was collected with two electrodes at the corrugator supercilii (brow) and two electrodes at the zygomaticus major muscle region (cheek). It used the iMotions default rate of 1024Hz. The experimenter watched the live SC data feed and started recording

Table 6. Independent variable explanation and operationalizations for online and in-lab experiments.

Independent Variable	(Cohesive Music) Bloodborne Soundtrack Condition	(Dissonant Music) Happy Music Condition	(Cohesive No-Music) Silent Condition	(Dissonant No-Music) Unrelated Voiceover Condition
Independent Variable Explanation	The majority of Bloodborne [G3] is devoid of music. It is normally saved for boss battles. To ensure that the music chosen would have a maximal thematic fit to the game, its own soundtrack was chosen to draw music from.	"Overly happy, too fast or busy music can be annoying and cause frustration when it is not suitable for the type of gameplay… Players mention that music is able to completely disturb the immersive experience when the cultural reference is incorrect, for instance when hardcore music is featured in a sad or romantic cut scene" [45]. To ensure maximal dissonance between the dark atmosphere of the game and this sound condition, happy songs from YouTube were chosen.	In this condition no background music was present. It serves three purposes: it utilizes silence which is recognized as a "horror sound" [109], it mirrors how the majority of the game is designed without background music – "Well placed silence and subtlety [to] allow the parts of the game that need to be larger-than life [(boss battles)] to be more powerful because of their contrast next to these areas of silence "[15] - and it fits the dimensional requirements of a control condition.	In this condition a salient sound which was not music had to be chosen. Speech was decided on because "the immersion of the player can be easily disturbed when a speech fragment does not correspond with the setting of the game" [45]. I chose YouTube videos which describe the history of Nintendo and a few of their franchises. These videos were chosen to be at least somewhat attention grabbing as anyone who would sign up for this experiment would have at least a passing interest in video games, and because they are unrelated to the gameplay and setting on Bloodborne [G3]. Furthermore, such videos mirror a way many players play nowadays; with a podcast in the background.
Online Experiment Operationa-lization	In this condition the music in the background was the games main theme: Omen. This ensures maximal thematic fit to the game.	The first song used was found on YouTube under "Upbeat and Happy Background Music – "Something Cute" by FirstNote". It and the My Little Pony: Friendship is Magic theme song were chosen for their upbeat and cutesy sound to ensure a conflict with Bloodborne's visual atmosphere.	No background music present. The video contains the sound present in the gameplay video which was downloaded and edited.	In this condition a few minutes of the YouTube video "History of NINTENDO CONSOLES: From the FamiCom to World Domination!" were played in the background.
Lab Experiment Operationa-lization	Order: *-Omen* *-The Night Unfurls* *-Lullaby for Margo* *-The First Hunter* *-Moon Presence* *-Bloodborne* *-Hail the Nightmare* *-Darkbeast*	Songs from the YouTube video "HAPPY Music - Good Morning Ukulele Music - The Best SUMMER Music" were used. Ukulele music was chosen because of its strong association with sun bathed island settings and a light-hearted atmosphere.	No background music present. This fits the game's atmosphere because the level which the players play already contains little to no background music.	The sound for this condition included the following YouTube videos in this order: "History of NINTENDO CONSOLES: From the FamiCom to World Domination!", "The History of The Legend Of Zelda (ft. PeanutButterGamer) | A Brief History", and "The History of Pokémon | A Brief History"

Table 7. Factors collected through a survey from in-lab and online experiment participants.

Data Collected	Explanation	Online Experiment Variation	Lab Experiment Variation
Thematic fit and Atmosphere	Agreement between responses to 3 Likert questions regarding how much atmosphere the stimulus had, how atmospheric it was, and how much thematic fit there was between the audio and visual elements of the stimulus. Indicates a definition of video game atmosphere as a thematic fit between music and environment.	None	Questions about how "atmospheric" and "how much atmosphere" collapsed into one question.
Atmosphere and Game Elements	Agreement between responses to these three questions in the online experiment should also indicate whether a game being atmospheric and having atmosphere are indeed the same thing, as well as providing data on the importance of specific game elements to the experience of atmosphere and vice versa	None	Questions are collapsed into one with a slash. That question is asked again in regard to games in general.
PANAS [20]	The Positive and Negative Affect Schedule [20] consists of two scales; one for positive affect and one for negative. This is taken in part to determine the valence of the experience.	None	None
Frustration	Participant frustration with the stimulus was determined by adding "Frustrated" to the list of words the PANAS [20] asks about.	None	None
Challenge Preference	Participant agreement with the statement: "I like it when video games are really hard to beat."	None	None
Hours Gaming Per Week	The average amount of hours participants spent per week playing video games.	None	None
Participants preferred Genres	Participants pick the three genres that they prefer out of a list of 16 genres of video games.	None	None
Game Audio Preference	Participants choose from one of six options regarding their audio preferences while playing games. These include: "Listen to your own music or stream music from the internet as well as the game's audio", "Listen to the game's own audio in default mode" and others.	None	None
Importance of Music to Atmosphere	Participants rate on a 5-item Likert scale how important 7 different elements of music are to the experience of the game's atmosphere.	None	None
Atmospheric Value of Different Genres	Participants rate each of 16 genres on how atmospheric they think games in that genre tend to be. Also asks the question in reverse; "How important is atmosphere to your enjoyment of games in the following genres."	None	Does not ask reverse question.
IEQ [47]	The Immersive Experience Questionnaire is a 30-item survey for measuring the experience of immersion in games.	Not present	Present
PENS [88]	Player Experience of Need Satisfaction questionnaire. 21 items keyed into one of three components: competence, autonomy, and relatedness	Not present	Present
PXI [1]	The 57 item Player Experience Inventory includes two scales: one for functional aspects (dynamics), and one for psychosocial aspects (aesthetics).	Not present	Present
SAM [12]	Participants rate their levels of dominance, happiness, and arousal based on a Likert scale of images.	Not present	Present
Atmosphere and Purchasing	Participants rate on a 5-level Likert scale how much a game being atmospheric or having atmosphere affects their decision to purchase a game.	Present	Not present
Atmosphere and Quality	Participants rate on a 5-level Likert scale how much a game being atmospheric affects their perception of its quality.	Present	Not present
Atmosphere Open Question	Participants describe what they believe video game atmosphere is.	Present	Not present

two minutes of baseline data when the phasic output stopped decreasing and became consistent. The 65-inch screen TV was then turned on to reveal the player character holding a gun and an axe, standing in the Hunter's Dream, a location in Bloodborne [G3] where there are no monsters to fight. Each participant was then taught to play the game one button at a time and had the health, stamina, blood echo (points), and respawn systems explained to them. After some time to get comfortable with the controls, all participants were then told to interact with the first teleporting headstone and to pick the 1st Floor Sickroom as their destination. While the level loaded, participants were told they had 25 minutes to simply play the game.

Testing Phase

Participants played Bloodborne [G3] for a period of 25 minutes. This time frame was chosen to ensure enough exposure to the music condition they were assigned to.

Moderating Variables

The four moderating variables are participant's level of challenge-liking [84], how many times they died per minute in the testing phase, and how much time they spend gaming per week. This data was collected because all three variables may moderate player experience during stimuli presentation. Players who spend more time gaming each week are expected to become more frustrated by the dissonant conditions because they are more likely to have experience dealing with game-based frustration [72]. A similar effect is expected with players who do not suffer many deaths. Participant's degree of agreement with the statement "I like it when video games are really hard to beat" measures how much participants enjoy challenge in their video game experiences [84]. Players high in challenge-liking are expected to report more positive experiences in the lab experiment because the game is challenging.

Study 3: Player's Understanding of Atmosphere

To explore what atmosphere is, I asked participants in both the online and in-lab studies to answer Likert questions about how much different game elements and sound factors contribute to atmosphere, and the atmospheric value of different genres. I also asked online respondents an open-ended question asking them to describe what makes a game atmospheric, as well as Likert questions about the effect of atmosphere on buying decisions and judgements of game quality. Finally, I also asked participants in both experiments to respond to a multiple choice question pertaining to their preferences about their audio environment while playing games.

Participants

The inclusion criteria for both experiments require that all participants have normal or corrected to normal vision, be people who play at least one hour of video games per week, and who have never played Bloodborne [G3] before. This is so that all participants have a similar level of inexperience with the atmosphere of this game. The online experiment had a total of 59 finished responses. Participants had an average age of 25.7 years with a standard deviation of 6.25 years (8 participants did not provide their age), and 83.1% of them self-reported as biologically male. The lab experiment ran 12 participants per condition for a total of N=48. Participants had an average age of 23.5 years with a standard deviation of 5.79 years, and 80% of them self-reported as biologically male. Participants were recruited through posters for the lab experiment and through posts on r/videogamescience for the online questionnaire and were compensated with entrance into a raffle to win one of four $50 Amazon gift cards. Participants were kept naive about the purpose of the experiment, as knowing that their emotional responses to differing atmosphere conditions were being studied was likely to change them.

Table 8. Thematic Dissonance Hypotheses.

Hypothesis	Applicable Experiment	
	Online	In-Lab
H1: Players in the dissonant conditions (thematic cohesion is low and therefore atmospheric fit is expected to be low) will rate their experience as having the lowest thematic fit, atmosphere, or as being less atmospheric than those in the conditions with atmospheric fit.	✓	✓
H2: Players in the dissonant conditions will have higher negative affect scores as measured by the PANAS [20] than those in the conditions with atmospheric fit.	✓	✓
H3: Players in the dissonant conditions will have lower positive affect scores as measured by the PANAS [20] than those in the conditions with atmospheric fit	✓	✓
H4: Players in the dissonant conditions will report higher frustration levels than those in the conditions with atmospheric fit	✓	✓
H5: Usability work by Bruun et al [16] has shown that SC peaks are highest when a user is frustrated and less in control of the situation. Accordingly, I hypothesize that players in the dissonant conditions will experience more frequent peaks in this experiment than those in the conditions with atmospheric fit		✓
H6: Players in the dissonant conditions will experience lower HRV in this experiment than those in the conditions with atmospheric fit		✓
H7: Players in the dissonant conditions will experience more negative valence facial events in this experiment than those in the conditions with atmospheric fit [65]		✓
H8: Players in the dissonant conditions will experience higher arousal as measured by the SAM [12] item in this experiment than those in the conditions with atmospheric fit		✓
H9: Players in the dissonant conditions will experience lower happiness and dominance as measured by the SAM [12] item in this experiment than those in the conditions with atmospheric fit		✓
H10: Players in the dissonant conditions will score lower in aesthetic experience as measured by the PXI [1] than those in the conditions with atmospheric fit		✓
H11: Players in the dissonant conditions will experience less immersion as measured by all components of the IEQ [47] than those in the conditions with atmospheric fit		✓

RESULTS

Testing Hypotheses 1 to 11

Hypotheses 1 through 11 use participant condition as the independent variable. In the online study this is the video watched by the participant. In the in-lab study, the condition is the soundscape during play. To analyze the relationship between the predictive variables described in table eight and participant condition, I planned to conduct multiple one-way ANOVA. For each ANOVA I first check the normality assumption and then conduct Levene's test to check the equality of variances assumption. Given a roughly 45-degree line on the quartile-quartile plots of the residuals of the dependent variables for every level of the independent variables the ANOVA pass the normality assumption. If a Levene's test for equality of variance fails, the Durbin-Watson test for independence of observations is conducted to find out if the data is auto-correlated. If data is not auto-correlated it is analyzed with a multiple regression analysis. If the data is auto-correlated it is analyzed using a Kruskal-Wallis H test. Tables 8 and 9 show the results of some of the ANOVAs conducted, as well as the results of the equality of variance tests.

Hypothesis One – Questions of Atmosphere (Online)

In this analysis the dependent variable was participant answers to Likert questions on "how atmospheric" or "how much atmosphere" or "how much thematic fit" the video was or had. Results of the ANOVA indicate that that H1 should not be rejected, as the different conditions did result in statistically different answers to the question of thematic fit, $F(3,53) = 46.614$, $p < 0.05$ (see figure five). Levene's test showed that the variances for the online responses to the question of thematic fit were equal, $F(3,53) = 1.366$, $p > 0.05$. However, Levene's test also showed that the variances for the atmospheric and atmosphere questions were not equal, $F(3,53) = 4.472$, $p < 0.05$, and $F(3,53) = 4.337$, $p < 0.05$, respectively. The Durbin-Watson test found that neither the data on how atmospheric participants found the video (2.419), nor the data on how much "atmosphere" the participants thought the video had was auto-correlated (2.381). I therefore conducted two multiple linear regressions. Condition did not statistically significantly predict how atmospheric participants found the video, $F(1, 58) = 2.853$, $p > .05$, $R2 = .048$, nor how much atmosphere participants found the video to have $F(1, 58) = 2.449$, $p > .05$, $R2 = .041$. This result is curious however given statistically significant correlations between agreement with the atmosphere question and the atmospheric question ($R2 = .835$), and between the question of thematic fit and atmosphere ($R2 = .546$), and thematic fit and atmospheric ($R2 = .502$). This, coupled with the fact that all three measures follow the same pattern: with the condition including Bloodborne's own sound-track being rated as the most atmospheric (or having thematic fit), the condition containing no extra sound being the second most atmospheric, the condition with an unrelated voiceover rated as third most atmospheric, and the condition including "happy" music being rated as least atmospheric, lends evidence to the definition of atmosphere proposed in this work.

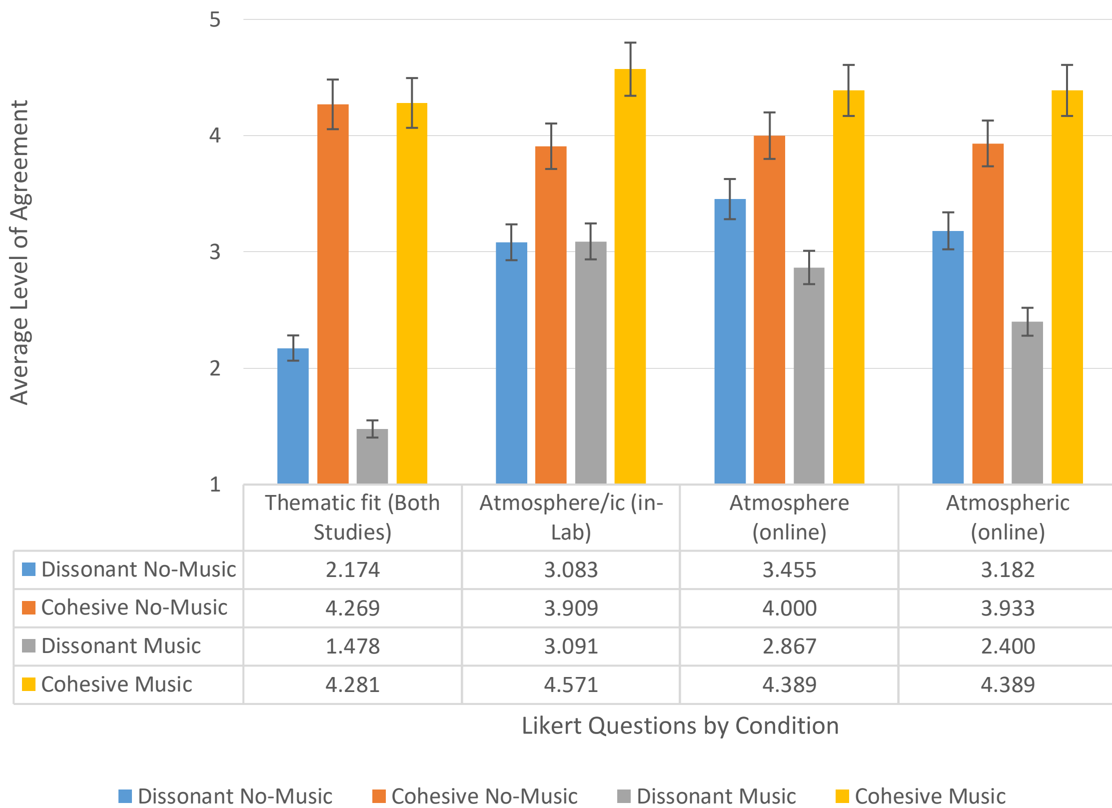
Hypothesis One – Questions of Atmosphere (In-Lab)

In this analysis the dependent variable is participant answers to questions about their game experience "having atmosphere/being atmospheric" or having "thematic fit". Results of the ANOVA indicates that that H1 should not be rejected, as the different conditions did result in statistically different answers to the question of how much atmosphere/ how atmospheric the experience was, $F(3,49) = 10.158$, $p < 0.05$. The question of atmosphere/atmospheric passed Levene's test, $F(3, 46) = 1.235$, $p > 0.05$. However, variances for the question about thematic fit were not equal, $F(3,45) = 21.512$, $p < 0.05$. Furthermore, the Durbin-Watson test found that the data on how much thematic fit participants found their experience to have is auto-correlated (2.763). I therefore conducted a Kruskal-Wallis H test to explore this relationship. It showed that there was a statistically significant difference in thematic fit between the audio and visual environment depicted in the different conditions, $\chi2(2) = 26.777$, $p < 0.05$, with a mean rank thematic fit score of 34.11 for the condition with Bloodborne's own soundtrack playing, 33.25 for the condition with no music or outside sound, 20.71 for the condition with the unrelated voiceover playing in the back-ground, and 9.09 for the condition with happy music. This agreement between the online and in-lab studies' ordering of the different conditions in terms of atmospheric fit lends evidence to the definition of atmosphere proposed in this work (see figure five).

Hypotheses Two and Three – Positive and Negative Affect Scores (Both Experiments)

Positive and negative affect scores as measured by the PANAS are the dependent variables for hypotheses two and three respectively. For the online experiment Levene's test showed that the variances for the negative affect scores were equal, $F(3, 55) = .780$, $p > 0.05$, but not for the positive affect scores $F(3,55) = 4.216$, $p < 0.05$. Results of the ANOVA indicate that H2 should be rejected, as the different conditions did not result in statistically different negative affect scores, $F(3,58) = 1.051$, $p > 0.05$. The Durbin-Watson test found that the data on positive affect score is not auto-correlated (1.807). The result of the regression analysis indicates that H3 should also be rejected, as condition did not statistically significantly predict positive affect score, $F(1, 58) = 1.256$, $p > .05$, $R2 = .022$.

For the in-lab experiment Levene's test showed that the variances for the positive affect and negative affect scores were equal, $F(3, 46) = 1.595$, $p > 0.05$, and $F(3,46) = 1.579$, $p > 0.05$, respectively. Results of the ANOVA indicates that H2 and H3 should be rejected, as the different conditions did not result in statistically different positive affect scores, $F(3,49) = .452$, $p > 0.05$, or negative affect scores $F(3,49) = 1.371$, $p > 0.05$.



	Thematic fit (Both Studies)	Atmosphere/ic (in-Lab)	Atmosphere (online)	Atmospheric (online)
Dissonant No-Music	2.174	3.083	3.455	3.182
Cohesive No-Music	4.269	3.909	4.000	3.933
Dissonant Music	1.478	3.091	2.867	2.400
Cohesive Music	4.281	4.571	4.389	4.389

Figure 5. Average response on a Likert-scale (1-5) for the following questions by thematic dissonance condition. Error bars represent the 95% confidence interval.

Thematic Fit (Data averaged over online and in-lab experiements): How well did the audio [element of the video/ you heard] fit the theme of the visual environment and setting depicted?

Atmosphere/ic (Data from in-lab experiement): To what extent would you describe your game experience today as atmospheric or as having atmosphere?

Atmosphere (Data from online experiement): To what extent would you describe the gameplay video you just watched as having atmosphere?

Atmospheric (Data from online experiement): To what extent would you describe the gameplay video you just watched as atmospheric?

Hypothesis Four – Frustration (Both Experiments)

Frustration as measured by a Likert question is the dependent variable. In the context of the online experiment Levene's test showed that the variances were equal, $F(3, 55) = 1.781$, $p > 0.05$. Results of the ANOVA indicate that H4 should be rejected, as the different conditions did not result in statistically different levels of frustration, $F(3,58) = .763$, $p > 0.05$. In the context of the lab experiment Levene's test showed that variances were not equal, $F(3, 46) = 3.284$, $p < 0.05$. The Durbin-Watson test determined that the data on frustration is not auto-correlated (1.621). The result of the regression analysis shows that H4 should be rejected as the condition did not statistically significantly predict frustration levels, $F(1, 49) = .057$, $p > .05$, $R2 = .001$.

Hypotheses 5 and 6 - SC peaks/min and HRV increase over baseline – (Lab Experiment)

Skin conductance peaks per minute and heart rate variability percentage increase above baseline are the dependent variables of hypotheses five and six respectively. Levene's test showed that the variances for skin conductance peaks per minute and heart rate variability percentage increase above baseline were equal, $F(3, 44) = .369$, $p > 0.05$ and $F(3,45) = 2.346$, $p > 0.05$ respectively. Results of the ANOVA indicates that H5 and H6 should be rejected, as the different conditions did not result in statistically different skin conductance peaks per minute, $F(3, 47) = .089$, $p > 0.05$, or heart rate variability percentage change above baseline, $F(3,48) = 1.062$, $p > 0.05$.

Hypothesis Seven – Cheek and Brow EMG Activation (Lab Experiment)

Various measurements of EMG activation at the corrugator supercilii (brow) and the zygomaticus major muscle region (cheek) are the dependent variables. These measurements included normalized average EMG signal, normalized EMG amplitude average, EMG peaks per minute, and EMG event duration. Table nine shows that each of these measures possesses equal variance and reports the results of the ANOVA conducted. Results of the ANOVA indicate that H7 should be rejected, as the different conditions did not result in statistically different measurements at the brow and cheek muscles. However, normalized EMG amplitude average at the brow muscle did vary significantly with condition. A post-hoc Tukey HSD test was therefore conducted, finding that the dissonant music and dissonant no-music groups differed significantly at $p < .05$; the two thematically cohesive groups did not differ significantly from the other two groups (see figure six). I assess this result in the following discussion section.

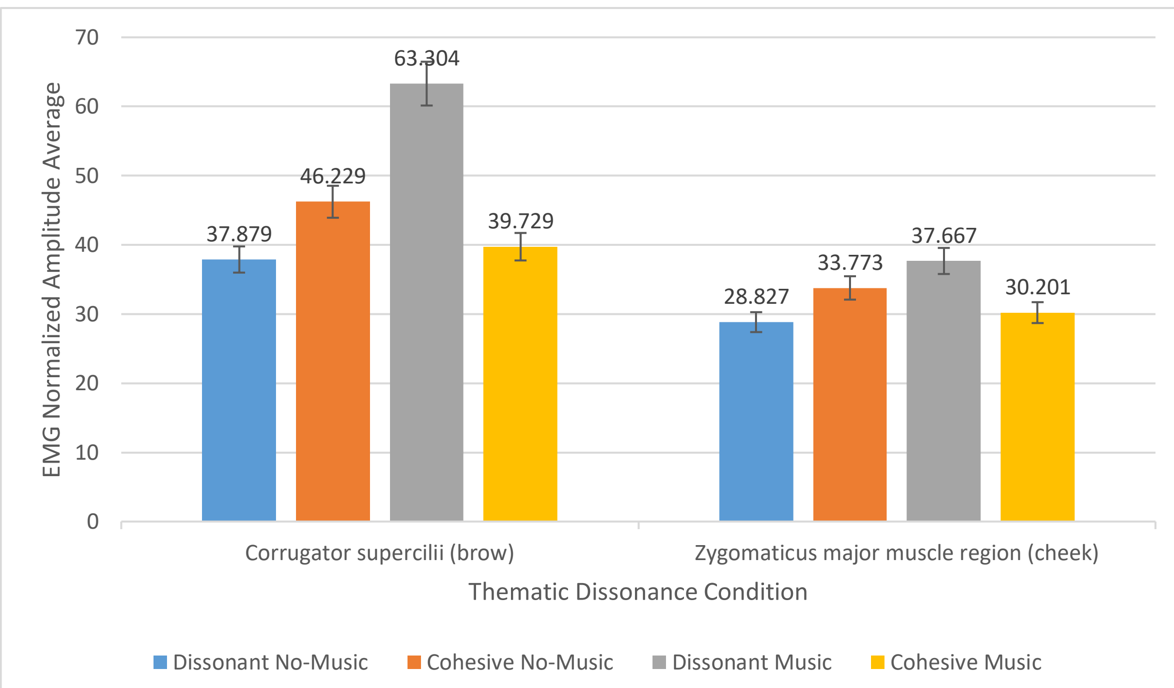


Figure 6. Normalized EMG Amplitude Average at the brow and cheek muscles for each thematic dissonance condition. Error bars represent the 95% confidence interval.

Normalizing the filtered EMG signal amplitude was done by using the following formula: EMG(n) = ((EMG(n)-EMG(min)) / (EMG(max) - EMG(min)))* 100

(Where N is the sample)

Table 9. Reporting tests on facial electromyography measures.

Muscle Region	Measure	Reporting Levene's test	Reporting ANOVA
Corrugator supercilii (brow)	Normalized average EMG signal	*F(3, 44) = 2.434, p > 0.05*	*F(3, 47) = .660, p > 0.05*
	Normalized EMG amplitude average	*F(3, 33) = .273, p > 0.05*	*F(3, 36) = .3.855, p < 0.05*
	EMG peaks per minute	*F(3, 33) = .738, p > 0.05*	*F(3, 36) = 1.241, p > 0.05*
	EMG event duration	*F(3, 33) = 1.073, p > 0.05*	*F(3, 36) = .909, p > 0.05*
Zygomaticus major muscle region (cheek)	Normalized average EMG signal	*F(3, 44) = 1.351, p > 0.05*	*F(3, 47) = 1.164, p > 0.05*
	Normalized EMG amplitude average	*F(3, 33) = 2.369, p > 0.05*	*F(3, 36) = 1.251, p > 0.05*
	EMG peaks per minute	*F(3, 33) = .796, p > 0.05*	*F(3, 36) = .054, p > 0.05*
	EMG event duration	*F(3, 33) = 1.467, p > 0.05*	*F(3, 36) = .817, p > 0.05*

Table 10. The effect of thematic fit condition on various measures of player experience.

Measure	Reporting Levene's test	Reporting ANOVA
PENS Competence	*F(3, 46) = .378, p > 0.05*	*F(3, 49) = .691, p > 0.05*
PENS Autonomy	*F(3, 46) = 1.042, p > 0.05*	*F(3, 49) = .745, p > 0.05*
PENS Relatedness	*F(3, 46) = .469, p > 0.05*	*F(3, 49) = 1.121, p > 0.05*
PENS Presence/Immersion	*F(3, 46) = .749, p > 0.05*	*F(3, 49) = 1.092, p > 0.05*
PENS Intuitive Controls	*F(3, 46) = .117, p > 0.05*	*F(3, 49) = .062, p > 0.05*
PXI Meaning	*F(3, 46) = 1.009, p > 0.05*	*F(3, 49) = .166, p > 0.05*
PXI Mastery	*F(3, 46) = 4.658, p < 0.05*	*N.A*
PXI Curiosity	*F(3, 46) = 1.439, p > 0.05*	*F(3, 49) = .1.861, p > 0.05*
PXI Immersion	*F(3, 46) = .885, p > 0.05*	*F(3, 49) = 1.430, p > 0.05*
PXI Autonomy	*F(3, 46) = .159, p > 0.05*	*F(3, 49) = 1.096, p > 0.05*
PXI Aesthetics	*F(3, 46) = 1.660, p > 0.05*	*F(3, 49) = 1.227, p > 0.05*
PXI Goals and Rules	*F(3, 46) = .591, p > 0.05*	*F(3, 49) = .859, p > 0.05*
PXI Audiovisual Appeal	*F(3, 46) = 2.765, p > 0.05*	*F(3, 49) = 1.983, p > 0.05*
PXI Challenge	*F(3, 46) = .538, p > 0.05*	*F(3, 49) = .789, p > 0.05*
PXI Ease of control	*F(3, 46) = .331, p > 0.05*	*F(3, 49) = .051, p > 0.05*
PXI Progress Feedback	*F(3, 46) = .265, p > 0.05*	*F(3, 49) = .091, p > 0.05*
PXI Dynamics	*F(3, 46) = .593, p > 0.05*	*F(3, 49) = .816, p > 0.05*
IEQ Single question immersion item	*F(3, 46) = 2.933, p < 0.05*	*N.A*
IEQ Immersion score	*F(3, 46) = .929, p > 0.05*	*F(3, 49) = .957, p > 0.05*
IEQ Challenge	*F(3, 46) = .658, p > 0.05*	*F(3, 49) = .996, p > 0.05*
IEQ Control	*F(3, 46) = 1.879, p > 0.05*	*F(3, 49) = .266, p > 0.05*
IEQ Real World Dissociation	*F(3, 46) = 1.735, p > 0.05*	*F(3, 49) = 1.765, p > 0.05*
IEQ Emotional Involvement	*F(3, 46) = 0.533, p > 0.05*	*F(1, 48) = 0.308, p > 0.05*
IEQ Cognitive Involvement	*F(3, 46) = 0.169, p > 0.05*	*F(1, 48) = 0.919, p > 0.05*

Hypotheses 8 and 9 – SAM Arousal, Dominance, and Happiness (Lab Experiment)

SAM Arousal, SAM Dominance, and SAM Happiness are the dependent variables of hypotheses eight and nine. Levene's test showed that the variances for SAM Arousal, $F(3, 45) = .876$, $p > 0.05$, SAM Happiness, $F(3,46) = 2.542$, $p > 0.05$, and SAM Dominance, $F(3,46) = 2.630$, $p > 0.05$ were equal. Results of the ANOVA indicates that H8 and H9 should be rejected, as the different conditions did not result in statistically different SAM Arousal, $F(3, 48) = 1.329$, $p > 0.05$, SAM Happiness, $F(3,49) = .572$, $p > 0.05$, and SAM Dominance, $F(3,49) = 2.372$, $p > 0.05$ scores.

Hypotheses Ten and Eleven– Lab Experiment

Various measurements derived from the PENS, IEQ, and PXI questionnaires are the dependent variables. Table ten shows that most of these measures possesses equal variance and also reports the results of the ANOVA conducted. Results of the ANOVA indicate that H10 should be rejected, as the different conditions did not result in statistically different responses. Because PXI Mastery and the IEQ's single question on immersion failed Levene's test, I conducted a Durbin-Watson test. It found that the data on PXI Mastery is not auto-correlated (1.562) and the data on the IEQ's single question on immersion is not auto-correlated (1.867). The result of the additional regression analysis shows that H10 and H11 should be rejected as the condition did not statistically significantly predict PXI Mastery, $F(1, 49) = .425$, $p > .05$, $R2 = .009$, or the IEQ's single question on immersion, $F(1, 49) = 1.069$, $p > .05$, $R2 = .022$.

Study 3: Player Understanding of Atmosphere

We conducted a variety of analyses to better understand the aspects of games which are tied to the concept of atmosphere. Participants were asked to rate how much a specific sound component or game component influenced their experience of atmosphere, and how atmospheric games in different genres tended to be, both on a scale from 1 to 5. Because the data is ordinal and presumably non-parametric, a One-Sample Wilcoxon Signed Rank Test was conducted for each question. It compared the observed median to the hypothesized value of 3, which signified a moderate effect on atmosphere, moderate importance to one's experience of atmosphere, or a genre is moderately atmospheric. These results, along with the average and standard deviation of the responses to each question can be viewed in table eleven. Participants were also asked to rate how much a game having atmosphere or being atmospheric influences their perception of its quality or their intentions to buy it, and analyzed this data with One-Sample Wilcoxon Signed Rank Tests is the same way. Finally, participants were asked a multiple choice question about their preferences towards their audio environment while playing games.

Participants rated how important to a game's atmosphere various components of music were. Tempo, rhythm, genre, melody, and instrumentation all had median ratings of 4, with mood having a median of 5. All six of these components were found to be rated significantly higher than the expected median of 3. Lyrics was the only other musical factor explored, and was found to have a median rating of 2 which was significantly lower than the expected median of 3.

Participants also rated to what extent different gameplay factors affect their experience of the game's atmosphere or their experience of the game as atmospheric. Music, setting design, and immersion all had median ratings of 5. Story/Narrative, sound effects, environmental noise, colour palate, enemy design, level design, sense of presence, flow, and graphical style all had median ratings of 4. All 12 of these components were found to be rated significantly higher than the expected median of 3. The presence of fog, high definition, and genre were all found to have medians not statistically different from the expected value of 3. Multiplayer was the only other game component explored, and was found to have a median rating of 1 which was significantly lower than the expected median of 3.

Finally participants rated how atmospheric games in different genres tend to be. Horror and survival horror had median ratings of 5. Action, adventure, and role playing games all had median ratings of 4. First person shooter had a median rating of 3, however it and the five other components listed above were found to be rated significantly higher than the expected median of 3. Platformer, MMO, third person shooter, and flight were all found to have medians not statistically different from the expected value of 3. Racing was also found to have a median of 3 but was statistically significantly lower than the expected value. Other genres which were rated significantly lower than the expected value of 3 include sports, strategy, and fighting which were rated with a median of 2, and mobile and family games were rated with a median of 1.

Table 11. Average, median, and standard deviation of game component's relationship to atmosphere as rated on a Likert scale. One Sample Wilcoxon Signed Rank Tests found components highlighted in green were significantly higher than the median value of 3. Those highlighted in red were significantly lower than that median value.

Component	M	SD	Median	Wilcoxon
Musical Components				
Tempo	4.11	0.90	4	p<0.05
Mood	4.49	0.68	5	p<0.05
Rhythm	3.82	0.90	4	p<0.05
Genre	3.83	1.12	4	p<0.05
Melody	3.78	1.07	4	p<0.05
Instrumentation	4.16	0.87	4	p<0.05
Lyrics	2.33	1.30	2	p<0.05
Game Components				
Story/Narrative	3.74	1.36	4	p<0.05
Music	4.34	0.93	5	p<0.05
Sound Effects	4.34	0.77	4	p<0.05
Environmental Noise (i.e wind, birds chirping)	4.13	0.96	4	p<0.05
Colour Palate	4.08	0.86	4	p<0.05
Presence of Fog	3.16	1.18	3	.167
Multiplayer	2.07	1.35	1	p<0.05
High Definition	3.21	1.39	3	.144
Enemy Design	4.19	0.84	4	p<0.05
Setting Design	4.52	0.66	5	p<0.05
Level Design	4.14	0.92	4	p<0.05
Immersion (a mental state of absorption in the current experience)	4.34	0.89	5	p<0.05
Sense of presence (the feeling of being there)	3.99	1.08	4	p<0.05
Flow (extreme focus, sense of control, distortion of the experience of time)	3.95	1.04	4	p<0.05
Graphical Style	3.91	1.03	4	p<0.05
Genre	3.20	1.18	3	.110
Game Genres				
Sports	2.33	1.15	2	p<0.05
Platformer	2.82	1.02	3	.082
MMO (Massively Multiplayer Online)	3.21	1.27	3	.111
Horror	4.64	0.76	5	p<0.05
Survival Horror	4.60	0.79	5	p<0.05

Action	3.55	0.88	4	p<0.05
Adventure	4.01	0.84	4	p<0.05
First-Person Shooter	3.31	1.10	3	p<0.05
Third-Person Shooter	3.13	0.99	3	.172
Strategy	2.50	1.06	2	p<0.05
Racing	2.66	1.17	3	p<0.05
Fighting	2.18	1.02	2	p<0.05
Mobile	1.26	0.57	1	p<0.05
Family Game	1.44	0.69	1	p<0.05
Flight	2.83	1.24	3	.137
RPG (Role Paying Game)	4.25	0.83	4	p<0.05

We also asked the online participants questions regarding the relationship between atmosphere, game quality, and purchasing decisions. When asked in a Likert question ranked from (1) Not at all, to (5) A great deal/a lot, how much a game's atmosphere (M = 3.57, SD = 0.95) or a game being atmospheric (M = 3.52, SD = 0.95) would influence their decision to buy it, online respondents had a median response of 4. When asked whether a game being atmospheric influences the perception of its quality from (1) Does not affect it at All to (5) Strongly Affects it, participants had a median response of 4 (M = 4.05, SD = 0.95). The One-Sample Wilcoxon Signed Rank Test found that participant responses to all three questions were statistically significantly higher than the median scale value of 3 ($p<0.05$).

Participants in the study were also asked about their audio preferences while playing games most of the time. 55.1% of all respondents reported preferring to listen to the game's own audio in default mode. 27.1% of respondents reported listening to the game's own audio but with music or sound effects options changed. 8.4% listen to their own music or stream music while listening to the game's audio. 2.8% listen to their own music or stream music with the game's audio off. 4.7% listen to a YouTube video, TV show, or podcast with the game's audio on, and 1.87% listen to a YouTube video, TV show, or podcast with the game's audio off.

When asked to describe what makes a game atmospheric, participants had a variety of diverse answers. Many participants provided answers in-line with this study's definition of atmosphere including P3 who said "A combination of imagery and sounds which complement each other well" P12 who said "A blend of mechanics, graphical elements, and sounds that work with each other to provide the most cohesive experience possible", and P27 who said "How things look, whats currently happening in the story, the mu-sic/sound effects that are playing to set the current mood" Three of 59 participants did not answer the question. All responses are available on table twelve.

Table 12. Participant response to the prompt: What makes a game atmospheric in your opinion?

P#	What makes a game atmospheric in your opinion?
1	A well developed game that pays attention to details and all the elements work cohesively
2	Immersion of the story line with help from audio
3	A combination of imagery and sounds which complement each other well.
4	Being able to feel that you are in the game's world
5	Above all, the attention to detail: those little things that, would they be not present, you'd know something's wrong, but wouldn't know what.
6	How every little part of the game (story, sound, music etc.) fit together
7	A game is atmospheric when its components blend together in an organic way, making it feel easy to get into its worl, narrative, etc.
8	Its style, ots use of music, ots settings and characters. When you play The Order 1886 you actually feel like your in victorian london
10	music, setting, narrative, environment-, and enemy design
12	A blend of mechanics, graphical elements, and sounds that work with each other to provide the most cohesive experience possible
13	a defined visual and audial stlye
14	Of things that makes a game feel realistic.
15	Sound, music and design that makes you immersed in the experience (especially at specific moments such as finding a clue, fleeing or battling a boss)

16	A game that has real time decisions(a turn based game is downright better WITHOUT atmosphere)and the very world of the game is awaiting such decisions
17	Every part of the game has to serve the purpose of suspending disbelief for the player.
18	atmosphere for me has to do with the believability of the scenario and the setting/surround/sounds all playing into the theme
19	The combination of sounds, design across all boards and general feeling of gameplay
20	The theme and the art/music styles being in sync. If they work well together its great, if not its poor.
21	The better a game can emulate the different layers of sound, and to use the lighting and other postproc. to enhance the desired feeling.
22	Textured characters, music that is queued with the environment, ability to interact with the environment, small details
23	Consistency among all the elements described above.
25	I think that to make a game atmospheric you have to take into account more attributes than game design and visuals, writing and narrative for ex.
26	immersion
27	How things look, whats currently happening in the story, the music/sound effects that are playing to set the current mood.
28	Being thematically consistent, at least per area. (no rainbows in a gloomy environment, etc)
29	You just asked this in 300 ways - please consider shortening your measures
30	Interplay of graphical style, music, intensity of immersion, and setting
31	Timing. Historically accurate pieces. Colors. Music (time, rhythm, intensity). Silence. Background design and forefront design that isn't distracting.
32	Combination of visuals, the feeling of various environmental elements (sounds, visuals, objects), and the feeling of being there and it affects you.
33	The setting, lighting and sound effects.
34	The right combination of gameplay, visuals, and music
35	Setting
36	Having music and sound effects that fit with the setting and intended mood of the game. Music can make or break a game's atmosphere.
37	STICKING TO A SET OF RULES ESTABLISHED FOR A PARTICULAR UNIVERSE AND STICKING TO THEM. HAVING HINTS OF MORE THAN THE NORMAL STORY EXISTING IN THE WRLD
38	Feeling absorbed into what is going on in the game, and every part contributing to what is going on.
39	A consistent aesthetic between the entire game (or franchise) which is complimented by all other aspects of the game.
40	The fact that you feel both in the game and a part of it. And that you feel you understand not only the characters but their storylines too.
41	Hard question. Presentation? Definitely music, naritive and aestetics
42	Creating the right emotions in the player for the setting of the game e.g. Scared in a horror game, amazed in an open world adventure

43	The mood of the musics, the environment that it utilizes, and the mechanics the game employs are all factors that cantribute to atmosphere
44	Qualities of a setting beyond the obvious
45	The way several elements of a games design come together to feel like a cohesive world.
46	Consistency of theme between the aforementioned aspects (story, music sound effects, etc.) in order to make a point or tell a story
47	Highly polished aesthetic and music. Non-intrusive but interesting story. "Blank slate" protagonist with an ambiguous personality: E.G. Freeman, Samus
48	Entering a fantasy world, anything that allows for adequate suspension of disbelief to me as the player.
49	Setting a mood, establishing a real physical world or space that is consistent and interesting.
50	everything sounds and looks like it makes sense together at all on it flows well
51	feeling you are in the world
52	The sum of the music, visuals, and tone within a game. Can contribute to feelings of excitement, horror, or unease.
53	When all aspects of the game feed into each other in way that makes them all seem to belong together.
54	In my opinion the setting , game flow and the story are the key parts of an atmospheric game but effects like fog , or music are important too
55	The immersion factor, the way the music combines and accompanies what you see, and the overall sound design.
56	When the designers are able to convey how they feel, and it matches how I feel when playing
57	Having a well put together environment with audio and interactions to match
58	Well designed and timed audio - either diagetic or non-diagetic
59	Complimentary audiovisual qualities that produce an affective response from players.

PART VI. DISCUSSION

Dissonance means tension resulting from the combination of two disharmonious elements. Dissonant player experiences are negative player experiences borne from the disharmonious mismatch between game elements and the ingrained expectations of players. There are various forms that dissonant PX can take, including difficulty dissonance and thematic dissonance. Difficulty dissonance is the mismatch between the skills necessary to overcome an in-game challenge, and the skills currently possessed by the player. Thematic dissonance is the mismatch between audio and visual elements of a game.

Difficulty dissonance aggravates PX by annoying or irritating the player until they discontinue play. Studying the practice time necessary to impart a protection from stress in a difficult portion of the game can help designers avoid this pitfall and promote determined gamers. Thematic dissonance would occur for example when, a dark, mature character appears in a colourful game world, or when a happy, exciting song plays in a scary, desolate game world. Thematic dissonance usually negatively impacts PX by breaking atmosphere, which takes players out of the game. However, there are examples one can find where breaking the fourth wall extends the game's atmosphere to the real world, which can be enjoyable.[2] Studying and defining atmosphere by controlling sound conditions can help future games interested in building strong atmosphere know what to concentrate on.

Overt dissonant PX consequences such as play discontinuation resulting from difficulty dissonance can be predicted using a combination of questionnaire and

[2] Steven Conway. 2010. A circular wall? Reformulating the fourth wall for videogames. Journal of Gaming & Virtual Worlds 2, 2 (2010), 145–155. DOI:http://dx.doi.org/10.1386/jgvw.2.2.145_1

physiological measures, but deciphering the qualitative effects of more subjective experiences like thematic dissonance likely requires larger sample sizes. The results of the studies presented in this work indicate that dissonant player experiences are complex and can affect player experiences negatively. However, dissonant PX can be detected and studied using physiological measures such as skin conductance, heart rate variability, and electromyography, as well as questionnaire measures. Armed with this information we can more accurately predict the conditions which will result in dissonant player experiences and avoid them accordingly, generating more enjoyable and longer lasting player experience.

Rage Quits – A Study of Difficulty Dissonance

In the context of the rage-quit study, H1 was supported because participants in low practice conditions did not quit at higher or lower SC activation than those in the high or medium practice condition. This provides evidence for the hypothesized quitting threshold, which could be used when testing games and setting difficulty curves. H2 was partly supported as the hypothesized relationship between the three conditions was followed but failed to reach significance in the ANOVA analysis. Follow up t-tests however did indicate that those in the high practice condition quit after a significantly longer period than those in the low practice condition. This implies that a difference of 20 minutes of practice in an easy level has a significant effect on time persisting at a difficult level. To the extent that we are able to generalize to other gaming activities, this would suggest that patience for persisting is tied to previous time spent practicing. In this work, I outline a method which can be used with other games for uncovering the shortest difference in practice time necessary to affect player persistence. This is important because it helps developers assess how much practice time in low-threat areas is needed for players to be willing to persevere against significant challenges later in the play session, allowing for levels designed to improve player patience and enjoyment. H3 was not supported as those who 3D game more often do not take longer to quit than those who do not. This suggests a decreased importance for global practice time when compared to specific practice time. H4 was supported with those preferring challenge in their games being more likely to take longer to quit in the testing phase. This is evidence of the importance of personal preferences when it comes to game difficulty. H5 was not supported as self-reported levels of frustration could not predict time to quit. This surprising result is discussed in greater detail below. The results indicate evidence of a negative arousal threshold as well as commenting on factors which effect the time it takes to reach said threshold.

Atmosphere – A Study of Thematic Dissonance

Hypothesis one predicting that players in the dissonant conditions would rate their experience as having the lowest thematic fit, atmosphere, or as being less atmospheric than those in the conditions with atmospheric fit was not rejected because different conditions resulted in statistically different answers to the question of thematic fit both in the online and in-person experiments. Furthermore, participants in-lab also significantly differed in their rating of the amount of atmosphere they experienced by condition. This, combined with the fact that the order of conditions from least atmospheric to most follows the same pattern as conditions ordered from least thematic fit to most, lends evidence to the definition of atmosphere championed by this thesis: the emergent experience that occurs when visual and auditory components of a video game have strong thematic cohesion and therefore contribute to the same aesthetic. Hypotheses two and three were rejected because positive and negative affect scores could not be predicted from condition. Hypothesis four was also rejected as self-reported frustration was also not statistically different between conditions. Hypotheses five and six were rejected because different conditions did not result in different skin conductance peaks per minute, and HRV percentage change. This reinforces the non-significance of self-reported affect results (H2, 3, 4, 8, 9) by indicating that arousal and stress are not necessarily influenced by atmosphere. Hypothesis seven was rejected because most EMG measures of brow and cheek activity did not vary significantly between conditions. However, normalized EMG amplitude average of the brow muscle did vary with condition, indicating more intense negative valence emotional events [65] or increased mental workload [37] during the dissonant music condition. Hypotheses eight and nine were rejected because none of the SAM measures varied between conditions. The rejection of hypotheses two, three, four, eight, and nine, all of which concern aspects of player affect, indicates a surprising lack of effect of atmosphere on player affect given the success of the treatment at creating different levels of atmosphere as measured by questions of thematic fit. Hypotheses ten and eleven were also rejected because neither PXI aesthetic experience nor IEQ immersion varied by condition. A surprising result given that immersion was rated highly as an important factor to the experience of atmosphere.

DIFFICULTY DISSONANCE

This work defines difficulty dissonance as a mismatch between the skills a player possesses at a game and the skills required to overcome some challenge in the game. Difficulty dissonance can cause players to eventually give up and cut their play sessions short. It is therefore instrumental that difficulty dissonance be studied, so that negative player reactions like rage-quits do not occur. We know from previous work that frustration has a complex relationship with player experiences. Although we can tie quitting behaviours to negative player affect we cannot tie it to frustration, motivating further research on the relationship between frustration and difficulty dissonance in the future. In the study of rage-quits, I controlled the practice time participants were allowed to have in a low-threat environment in order to differentiate the relative skills players in different conditions had at the game. This allowed me to compare various measures of player experience as well as more accurately predict how long it takes players to quit when they encounter an unbeatable obstacle. Time persevering against a significant challenge can now be predicted using a death count per minute against that challenge, SAM valence, and SC increase above baseline. It has been demonstrated in this study that participants quit at roughly the same SC increase above their baseline, and that participants who enjoy challenge more have much more patience to persevere against an obstacle. Enjoyment derived from challenge is a significant aspect of player experiences. Studying difficulty dissonance and its related components, and predicting negative reactions to it, is therefore important to both game designers and GUR practitioners.

Only participants that quit within less than one hour of playing the game were used in the analysis. Out of 39 participants who took part in this experiment, all but one quit within less than one hour of the start of their test phase. This, responses to the open-question of why they quit, and partial support for H2, is evidence that the treatment of providing insufficient game-specific practice was enough to cause a rage quitting level of activation in the vast majority of players. Because deaths per minute and SAM valence scores can be used to predict time to quit, and the majority of participants reported something like frustration in the open-ended responses, I believe negative at-game frustration is the culprit, although I cannot be sure. As pointed out by a recent study, player's attributions of cause to in-game events are important and must be accounted for [23]. It is possible that some players in the long practice conditions thought themselves to have enough specific-game experience and instead attributed the failures to themselves instead of the game. Future work should take attributions of failure into account to better understand what kind of negative frustration was at play.

Skin Conductance Quitting Threshold

Participants in the low-practice condition were not expected to quit the testing level at a statistically significant higher or lower percentage SC activation above their baseline than participants in the high, or medium practice conditions (H1), and indeed they did not. The follow up t-tests conducted confirmed that there is no difference between the means of normalized SC increase. This outcome should help to establish a common SC magnitude of increase related to quitting at $(SC_{Last10secavg} - SCL_{min}) / (SCL_{max} - SCL_{min}) = 0.77$. However, given the failure of the measure of frustration to correlate with skin conductance or heart-rate variability, I have no evidence to link magnitude of increase in physiological measures to feelings of frustration. There is however a significant negative correlation between positive affect score and magnitude of SC increase at the time of quitting which suggests that a link between frustration and increased physiological measures of arousal could be teased out in future work with different measures of frustration. Re-running this experiment with a two dimensional game and finding a similar threshold should help to establish that such a threshold can also be applied to two-dimensional games. Future work should seek to recreate this outcome in games of different genres to establish the average acceptable level of frustration a game can cause through repeated avatar death before players quit. Such a number could be used in the assessment of future games and could even be explored in the realm of interface design. Papers which focus on physiological measurements of game user experience can cite this study as a step toward a physiological profile of fun and flow in games, as finding out what they are not is the first step towards finding out what they are.

Practice Makes Persistent

This experiment hypothesized that four different measurable factors affect the amount of time it takes players to reach the level of frustration necessary to quit the game: practice condition, time spent 3d gaming per week, preference for challenge in games, and frustration level during the test level. Differences between the three practice conditions followed the hypothesized relationships. Participants with high practice time did quit later than participants with medium practice which themselves quit later than participants with low practice time (H2). Even though no main effect was discovered in the ANOVA conducted, the result was so close to significance (p=0.051) that further analyses were required. The independent samples t-tests conducted showed that although no significant differences are observed between the short and medium practice conditions or between the medium and long practice conditions, a significant difference does exist between the time it takes participants to quit in the short and long practice conditions. This evidence suggests that a 20-minute difference in game-specific practice time may be enough to change participant quitting behaviour. However, it is unknown whether the effect of this 20-minute difference is specific to this game, genre, or perspective, so this should be the topic of future inquiries. GUR researchers and practitioners investigating the effects of game-specific practice on discontinuation should keep track of player time spent in game and have a minimum difference of 20 minutes between conditions. I suggest 5 minutes, 25 minutes, and 45 minutes. Designers can use this method to develop systems which dynamically increase or decrease difficulty from the previously chosen difficulty level based on time spent playing.

Global Experience & Specific Persistence

Hypothesis 3 theorized that participants who 3D game more often would take longer to reach the level of frustration necessary to quit than participants who 3D game less often (H3). Given that participants self-reported the number of hours they spend 3D gaming per week it is possible that natural fluctuations in the length of their play sessions every week may have yielded a non-representative result. Perhaps participants reported how much time they spent gaming that particular week, or recently, instead of how much they play per week on average. Future work should measure time spent gaming per week with a take-home diary method or through the collection of player usernames to ensure greater measure validity. To the extent that self-report data is valuable, the findings suggest that previous unspecific gaming experience in the same modality does not increase the amount of time it takes for them to reach rage quit levels of frustration. That is, unspecific gaming time every week does not protect players from frustration. This, combined with the evidence discussed above, suggests that specific game experience is a much more important factor when it comes to predicting player quitting times than unspecific experience. Until more quantitative work on a possible link between gaming time per week and time taken to quit a difficult level can be done, I suggest for GUR practitioners to collect data on time spent gaming per week to explore this possible link. If such a link is found, one could envision systems which use Future work should explore whether genre-specific experience results in the protective effects hypothesized here.

Hard People Like Hard Mode

It was expected that those participants who are high in challenge-liking will quit significantly later than participants who are low in challenge-liking (H4). Participants self-reported how much they enjoyed challenge in their games, threatening the validity of this source of data. To address this, future studies interested in the link between a preference for challenge and persistence at a difficult level should collect a more objective measure of challenge preference, like times repeating a difficult level after player death, or number of games generally considered hard played in the last year. The results of the ANOVA suggest that individual differences in finding pleasure in challenges protects against difficulty-based frustration and keeps players persevering against obstacles longer. Such a finding implicates the enjoyment of challenge as one of the biggest contributors to gaming perseverance and should be considered by any study of difficulty or game discontinuation. Furthermore, companies balancing the difficulty curves of their games through player tests should reflect individual differences in their own and their intended audience's challenge preferences.

The Curious Case of Frustration and Persistence

Finally, it was also expected that those participants who experienced the most frustration during the test level would quit significantly earlier than participants who did not experience much frustration (H5). However, the results indicate that a participant's self-reported level of frustration at the time of quitting has no effect on the time it takes them to quit. This result is surprising given the significant positive relationship between frustration level and negative affect score, and significant negative correlations between frustration level and challenge preference as well as the valence and dominance scales of the SAM. Given these expected significant correlations with all collected measures of affect this is a surprising result and therefore warrants further investigation. It is possible that the wording of the single-question self-reported measure of frustration primed participants to under-report their frustration, as participants were asked how frustrated they felt "while playing the last level

[they] played" instead of how frustrated they felt at the time that they quit. It is also possible that when they read this question, participants realized that frustration reactions were the subject of the study and therefore did not feel comfortable reporting accurate frustration levels. It is also possible that the relief of no longer playing the offending game positively influenced participant's recall of their frustration levels during the game. Equally likely is the possibility that failing repeatedly so quickly caused participants to not to attribute their failure to themselves, stemming frustration. Future studies concerned with the effects of frustration on quitting time should use previously validated measures of negative affect such as the PANAS and the SAM or develop more robust measures of frustration specifically. The SAM could be used repeatedly over the game play at regularly scheduled pauses to collect affect data while avoiding the priming of participants.

Predicting Time to Quit

To assess the relationships between the time it takes participants to quit and the various measures collected in this experiment a multiple regression analysis was conducted. Results indicate that the model significantly predicts the time it takes participants to quit. The best predictors in descending order are the number of deaths per minute suffered in the test level, level of normalized SC above baseline, and SAM valence score. A regression model using only these variables was explored and resulted in an unstandardized predicted value for quitting time which is significantly correlated to observed quitting time (see figure four). This result, coupled with the fact that time to quit was the only significant predictor of SC levels before quitting, lends further evidence to the assertion that the human nervous system has a ceiling on the level of arousal it is exposed to before quitting and that ceiling can be used to predict when players will discontinue play. HRV on the other hand could not be predicted by the available variables nor could it predict time to quit. Those working on affective games can make use of these results by setting their games to reduce difficulty (thereby reducing avatar deaths per minute) if player's normalized SC levels averaged over ten seconds reaches 0.77. Game companies, especially those who make use of micro-transactions and are therefore perennially concerned with increasing participant engagement, can make use of these results by taking account of SC levels, the number of avatar death events per minute, and the player's level of valence when running play tests. Other variables which may be related to time taken to quit and could be included in game tests include amount of time previously spent playing the specific game, deaths per minute when practicing, points per practice level, and participant biological sex. Although these variables were not significant predictors they were close enough that they merit further investigation using larger data sets. Until methods can be developed to assess player SC levels and valence during play, game designers can make immediate use of these results by creating systems which keep track of time previously spent playing the game, deaths/failures per minute, and point's collected per previous play session and dynamically changes difficulty from the previously selected difficulty level.

Exploring Correlations – HRV and Practice Time

Bivariate Spearman correlations were carried out between all collected variables. Although one cannot conclude direction and causation from this data, it can help one further explore the relationships between collected variables. HRV change between baseline and test was negatively correlated with practice time, indicating a domain specific protection from stress. This is what one would expect because HRV is known to have a negative relationship with stress levels [53, 54]. As practice time increases HRV changes decrease, indicating that practice time may inoculate users from stress felt during difficult parts of the game. This result may be due to directional fractionation, as arousal is not based on a unidimensional continuum and therefore HRV does not necessarily increase as SC increases [99]. This lends further evidence to the results indicating that time spent practicing has a stress protecting effect on participants, which may lead to more time spent persevering against a difficult obstacle. I therefore suggest the use of HRV measures in user tests as a potential measure of stress along with skin conductance and SAM valence scores. However, this conclusion is based on a significant correlation. Practice time could not predict HRV changes, so this relationship should be further explored in future studies.

Exploring Correlations – Age and Challenge Preference

Age was also found to be negatively correlated with preferring challenge in games, showing that older adults prefer easier games. This could be because of a fundamental different conception of gaming as a leisure activity with fewer cognitive demands by older demographics borne from being introduced to video games in a time when they were simpler. Such a result indicates further research is needed. Game developers working on titles meant for older adults should take their challenge preferences into account by supplying multiple difficulty options or scaling difficulty based on player age.

Participants who played 3D games more often collected more stars and died less often. Their average normalized skin conductance over the last ten seconds of play was lower, indicating a potential arousal decreasing aspect of global practice. This lends further evidence to the earlier call for more work on the effects of global practice on specific player experiences.

Challenge preference was positively correlated with positive affect score, points per practice level, and SAM valence score. It is negatively correlated with negative affect score, deaths per minute in practice and deaths per minute in the test level. The positive correlation with positive affect score and negative correlation with negative affect score is likely because of those enjoying challenge being positively impacted by the test experience while those who do not enjoy challenge were negatively impacted. Those who enjoy challenge collected more points to give themselves that added task, increasing the challenge of their playthroughs. This indicates that participants' self-reported preference for challenge was observable in their in-game behaviours. Game designers can take advantage of this finding by providing additional in-game challenges that players need not complete to progress but can if they wish to challenge themselves. Participants who enjoy challenge were also better at avoiding death, while those who gamed more often per week were not, indicating that performance in video games might be more effected by the difficulty of the practice than its regular repetition. Professional e-sports players can act on these findings by increasing the difficulty of their practice conditions when regular practicing is interrupted by external factors such as travel.

Exploring Correlations – Player Affect

Frustration level is negatively correlated with challenge preference, SAM valence, and SAM dominance, and very significantly positively correlated with negative affect score. This indicates that this item does a decent job of measuring frustration, as well as categorizing frustration as an emotion permeated by decreased dominance and valence and increased negative affect. Negative correlation with challenge preference indicates that enjoying challenging games protects against frustration when challenged by games. Frustration level however is not correlated with deaths per minute in the test level, a surprising result given that this is the single best predictor of time to quit. Perhaps the feeling which caused participants to quit was more akin to annoyance then frustration, resulting in the observed correlations. Deaths per minute in the test level was expectedly negatively correlated with SAM valence score. Developers play-testing hard games should keep track of participant frustration using SAM questionnaire at regularly scheduled pauses in gameplay until a more reliable measure of frustration can be developed.

Positive affect score was positively correlated with SAM valence and arousal, and negatively correlated with deaths per minute in the test level and normalized SC increase in the last 10 seconds of play. Correlation with the SAM valence score is to be expected while with the arousal score it is a curiosity. Perhaps, participants interpreted the SAM arousal as excitement, thereby positively categorizing higher arousal. On the other hand, perhaps those who had a positive overall experience found the experiment energizing while those who did not were drained by it. Negative correlation with deaths per minute in the test level is to be expected as more deaths could result in poor affect. This makes the negative correlation between positive affect score and SC increase in the last ten seconds of play especially curious as no correlation exists between SAM arousal and SC increase. It is possible that those who enjoyed positive affect after the test level did so because they were somewhat protected from SNS activation, or perhaps both the positive affect and lower SC increases were caused by a third variable that is neither challenge preference (as that variable does not correlate with SC increase) nor hours per week spent gaming (as that variable does not correlate with positive affect score). The curious negative correlation between SAM valence and SC increase at the time of quitting calls for further study.

As one would expect negative affect score was negatively correlated with SAM valence score. Deaths per minute in the practice phase was also expectedly positively correlated with deaths per minute in the testing phase and negatively correlated with points per practice level, as dying results in lost points. Points per practice level was positively correlated with stars per practice level and negatively correlated with deaths per minute in the test level. The first correlation is to be expected as stars make up part of the points participants collect. The second correlation is also not surprising as those who show greater engagement with the game's rewards could also be more likely to be skilled players who can better avoid death in the hard testing level. The significant negative correlation between stars per practice level and deaths per minute in the test level also indicates this interpretation. Practitioners can use this as evidence of logically assumed relationships between various measures of player experiences and negative affect.

Limitations

The biggest threat to the validity of this study is selection bias, as participants were students and friends of students at the University of Waterloo. I therefore have no way of knowing if the present sample is representative of the larger population of video game players. Furthermore, I have no evidence to suggest that conclusions drawn based on this test with this specific game can be applied to other games. However, I do outline with detail the method, which can be used with other games to ascertain their own SC increase ceilings, and to test whether the conclusions drawn here are as generalizable as the method used.

THEMATIC DISSONANCE

This work defines thematic dissonance as a mismatch between the audio and visual elements of a game. Thematic dissonance is a player experience which is the consequence of disrupting atmosphere, the thematic cohesion between visual and audio elements of a game.

Audio is a powerful driver of atmosphere because it makes up one of the three modalities of interaction between players and games and it is easy to control in the lab; the other two being visual and tactile. We know from previous work that sound effects and music are important for creating immersion, and now we know that all three of these factors are important to the experience of atmosphere. In this study of atmosphere, I controlled the type and presence of sound and music in order to differentiate the atmospheric experiences of players in different groups. This allowed me to compare various measures of player experience as well as define atmosphere empirically. I have found evidence has been found that some disruptions to atmosphere, specifically those with music instead of unrelated voiceover, are associated with significantly higher intensity negative valence facial events. This study demonstrates that atmosphere is a significant consideration in game quality assessments and buying decisions, and its disruption can negatively impact player experiences. Defining atmosphere and understanding its related components is important to GUR practitioners and game designers alike.

We expected that the treatment would create four rungs of thematic fit, or atmosphere, however, the results indicate that the conditions where Bloodborne’s own soundtrack was present and the condition with music disabled but sound effects enabled (silent condition) were similarly rated, as were the two conditions with happy music and unrelated voiceover in the background. The two conditions expected to be high in thematic fit indeed were. The two conditions expected to be low in thematic fit also were. The fact that so much agreement exists between the online and in-lab studies’ ordering of the different conditions in terms of thematic fit and atmosphere lends evidence to the proposed definition of atmosphere as the emergent experience that occurs when visual and auditory components of a video game have strong thematic cohesion. As does the strong correlations between ratings of atmosphere and ratings of thematic fit. HCI practitioners and game developers who are interested in the topic of video game atmosphere can now make recourse to an academic definition of it validated by data. Atmosphere is the emergent experience that occurs when visual and auditory components have strong thematic cohesion.

Atmosphere and the PX

Hypotheses 2, 3, 4, 8, and 9 deal with measures of participant affect including the PANAS, self-reported frustration, and SAM measures. All measures of affect were not statistically significantly affected by the condition. These results are surprising given that thematic fit and atmosphere did differ between conditions, indicating that the level of atmosphere experienced does not have a significant effect on player affect. This, is corroborated by the non-significant results of analyses of physiological measured (hypotheses 5, 6, and 7). Combined with the non-significant effect on all collected measures of PX (see table ten) including PXI aesthetic experience and IEQ immersion (H10 and 11) this would indicate that the player experience of games is not significantly affected by atmosphere. However, normalized EMG amplitude average at the brow muscle did vary significantly with condition. HCI practitioners and game developers interested in atmosphere can take from these results the fact that influencing atmosphere may not necessarily have a large effect on PX when measured with questionnaires alone.

Adding Insult to Injury

Although H7 could be rejected because dissonant conditions did not cause an increase in negative valence events, it is partly supported as it appears that dissonance between background music and setting can increase the intensity of negative valence muscle activity events [65]. The intensity of activity in the Corrugator muscle region as measured by the average amplitude of EMG signals coming from the brow muscle was significantly different between the happy (dissonant music) condition and the unrelated voiceover (dissonant no-music) condition. One possible reason for this would be because the game being hard, participants may have interpreted the happy music as mocking their failure, contributing to the intensity of negative valence responses. The same would not have occurred during the dissonant no-music condition where the unrelated voiceover may have been thematically at odds with the setting but could not reasonably be perceived as mocking. Another possible interpretation is that happy music increased intensity because it was dissonant enough to intensify negative valence responses. In other words, it was annoying. This finding is interesting as joyful music could reasonably be expected to intensify activity in muscle groups associated with smiling instead of frowning. Such a result then supports the hypothesis that significant disruption of atmosphere can cause unwanted effects on participant affect and should therefore be avoided. It is also possible that the dissonant music condition added additional mental workload that registered in brow activity [37]. This would indicate that the dissonant music condition interferes with the processing of information. Both explanations are consistent with the statistically significant difference which implies that the unrelated voiceover could have directed participant attention elsewhere, removing player attention from negative reactions to in-game events, preventing players from fully processing negative valence events, thereby decreasing the intensity of activity in the corrugator muscle region. This result calls for further study on the effect of atmosphere on the player experience.

Atmosphere and Game Elements

The third study in this project constitutes an exploration of the factors in games which may be linked to atmosphere. I asked participants what components of music and games were most important to the experience of atmosphere. These results are of note to game developers because they provide a list of attributes which could be treated if influencing atmosphere is the desired effect. Developers interested in effecting atmosphere should concentrate primarily on music, setting design, and immersion. Story/Narrative, sound effects, environmental noise, colour palate, enemy design, level design, sense of presence, flow, and graphical style are all also worth looking into. Multiplayer is the least likely to affect atmosphere. If the goal is to influence the atmosphere through music, those factors which are most likely to affect atmosphere are tempo, rhythm, genre, melody, instrumentation, and most importantly mood. Lyrics are the least likely component of music to affect atmosphere and therefore should be considered last. Generalization of these data may be limited to its representativeness of the population of game players. However, it provides a list of factors with potential influence over the experience of atmosphere which necessitates their further study.

Player Audio Preferences

We also asked participants about their audio preferences while playing games, finding that 44.9% of participants do not listen to the game's audio in default mode. This finding indicates that players have diverse audio preferences and therefore developers should strive to include the option to change audio settings in their games. The results indicate that 27.1% of respondents use those settings to change their experience of the game's audio without listening to any sounds extra to the game. 11.2% of players listened to non-game music while playing, indicating that some developers should include options for importing outside audio into the game. Furthermore, given the effect of non-thematically-related music on the experience of atmosphere developers can make use of these results by building systems which import extraneous music into the game engine and modifies its tempo to strengthen the atmosphere. 6.6% of participants indicated that they listen to YouTube videos, TV shows, or podcasts either in addition to or instead of game audio. This would indicate an interest by some players to participate in parallel activities while gaming, which this project has shown to potentially negatively affect the experience of atmosphere. However, this is still a potentially large population of underserved players who prefer to take in various forms of entertainment at once. Operating system and game engine developers can take advantage of this finding by including picture-in-picture capabilities for their software which would allow players to load a YouTube video, podcast, or video chat in the case of a computer, somewhere on-screen, and could even move UI elements to accommodate multiple entertainment forms. This preferred way of experiencing videogames has, to my knowledge, never been studied before, and merits further investigation.

Atmospheric Genres

However, atmosphere is more important in some genres as compared to others. Given participant's ratings of horror, survival horror, action, adventure, and RPGs as the genres of games most likely to include atmospheric games, I believe that the choice of Bloodborne [G3] as the stimuli for this study was validated. The results in this vein could be used by developers once they have decided on a genre. If a game in one of the five genre's listed above is being made, consider spending extra time on atmosphere, as that is what players expect. If a game in in the racing, sports, strategy, fighting, mobile, or family games genres, you are relatively more safe ignoring atmosphere. Designers of these types of games are encouraged to provide a large variety of customization sound options to cater to the 17.8% of players who listen to extraneous audio while playing. These genres rated as less atmospheric are also the genres most likely to include multiplayer. On the contrary, the genres rated as highly atmospheric concentrate mostly on single-player games. This supports the finding above that multiplayer is not considered to be an important factor in the experience of atmosphere. One can, therefore, conclude that there is something about multiplayer experiences which is either resistant or antithetical to atmosphere. This relationship between player number and atmosphere merits further study.

Atmosphere, Quality, and Purchasing Decisions

A statistically significant difference from the hypothesized median Likert-value of three (moderate) indicates a considerable effect of atmosphere on quality judgements and buying decisions. This indicates to game developers working on the genres described above as atmospheric that thematic cohesion should be considered early and throughout design to ensure an atmospheric game. Because quality can be expected to influence buying decisions, and atmosphere was rated as an influence on quality and buying decisions, game developers and publishers should consider atmosphere an important aspect to invest in for their single player games.

Limitations

This paper suffers from a lack of significant results when it comes to the effects of atmosphere on the various measures of player affect. It is not likely that this is because of a failure of the atmosphere treatment as participants in different conditions did rate them differently in terms of thematic fit and level of atmosphere. Perhaps the effect of thematic fit on brow muscle activity, opinions of quality, and buying decisions, but lack of effect on qualitative measures of PX indicates that atmosphere is a subtle, but important experience. It is also possible that the size of the sample, intended to explore physiological differences, was unable to display the qualitative effects of atmosphere. Furthermore, it is possible that a lack of control of the third pillar of video game experience, the interaction, the missing piece from the definition of atmosphere, is imperative to cause the hypothesized effects of atmosphere on qualitative measures of PX. Future studies exploring atmosphere should manipulate elements of gameplay as well as visual and auditory elements in relation to their thematic fit with one another to more deeply explore the effects of atmosphere on PX. This would provide a more generalizable definition of atmosphere as the emergent experience that occurs when visual, auditory, and gameplay components of a video game have strong thematic cohesion. This third pillar of atmosphere was not included in this study because of its wide breadth and due to the need to first establish the preliminary relationship between auditory and visual thematic fit, and atmosphere. The present study is a solid first step in the quest to under-stand atmosphere.

UNDERSTANDING DISSONANT PLAYER EXPERIENCE

This thesis is a step towards understanding the effects of dissonance on player experiences. The first contribution is in the direction of establishing a ceiling of frustration that the average player is willing to tolerate, and it shines light on the relationship between various factors and time until play discontinuation. Game designers already use dynamic difficulty systems and difficulty level choices to better accommodate players with differing levels of expertise. Now game designers have more information on how much difficulty-based frustration for how long, applied to which players, causes players to quit games. This can help them avoid difficulty dissonance by moderating the difficulty level, leading to longer and more enjoyable playing experiences. Recently, large game companies like Ubisoft and Valve have begun using similar physiological measures in testing. It is unrealistic to have moderators observe rage-quitting phenomena first hand given that the number of playtesters in a session can be much greater than the number of moderators. This makes the development of a system for automatically detecting emotions associated with unwanted quitting behaviours cost saving in the long run. The first study is of use to the HCI community because it further validates the use of physiological measures in the assessment of intended game user experience and player frustration and establishes a common threshold for negative arousal as measured by SC and HRV with their entertainment software. At the same time, it demonstrates that the amount of time it takes to reach this activation can be predicted by player valence, deaths per minute, and normalized SC increase.

Our second experiment formalizes an empirically validated definition of atmosphere as the emergent experience that occurs when visual and auditory components of a video game have strong thematic cohesion. This, combined with average ratings of various game and music components tied to atmosphere should facilitate conversations about the topic which are often fraught with subjective statements. Results regarding the effect of thematic cohesion, or atmosphere on questionnaire measures of PX indicate that further work is required. However, future papers on this topic can cite this work as having found a significant effect of dissonant music on brow event intensity. Future studies could also focus on treating the other modalities of atmosphere, visual setting and interaction. This study indicates the importance of atmosphere to different genres as well as the sonic preferences of players, providing developers information on whether to concentrate on atmosphere depending on the genre of game they are developing. I provide evidence that atmosphere has a considerable effect on perceptions of game quality and a moderate influence on purchasing decisions.

CONCLUSION

This work draws on years of related PX research to design and report experiments which shed light on the effects of difficulty and thematic dissonance on the player experience. Although both studies of dissonant PX have their drawbacks and illustrate the areas where further research is required, they illuminate areas of negative player experience previously unexplored. The first study examined the mechanisms involved in difficulty-based discontinuation of play. The second study illuminates the concept of game atmosphere, the factors which have an effect on it, and its effect on PX.

Drawing on SC increase above baseline, deaths per minute, SAM valence score, practice time, and preference for challenge we can now take further steps to predict with greater certainty how fast and at what level of SNS activation repeated failure will lead to discontinuation. I provide a model which could be used to predict player quitting time based on three of the above factors. Game designers and games user researchers alike can make use of these results by collecting measures like those just mentioned when balancing games and studying game difficulty and quitting reactions. Specifically, areas of the game where normalized SC levels of players rise above 77% should be monitored for undue difficulty. Future work should focus on those aspects of player experience which show promise at possibly affecting time to quit, such as specific game practice time and performance during that practice.

Drawing on the definition of atmosphere and the factors affecting it provided in this work we can now take further steps to study its effects on the PX. I provide an empirically validated definition of atmosphere and a comprehensive study of its associated factors, allowing for more objective conversations about this topic in the future. Game designers can make use of these results when prioritizing aspects of their games when atmosphere building is the goal. Music tempo, mood, and instrumentation being a good place to start. Games user researchers can make use of these results by furthering the study of atmosphere in the direction of visual setting, and collecting further data on the effect of atmosphere variation on PX. The study of dissonant player experiences is important because identifying the factors which influence negative mismatches between player expectation and game actuality allows us to avoid these pitfalls in the games we design. This can aid in the creation, for example, of more enjoyable PX through greater perseverance resulting in more pleasure derived from the completion of challenges, and more atmospheric exploration of crafted worlds.

With virtual reality rising in prominence in research and applications, some of the contribution of this work could be generalized to virtual reality (VR) experiences as well, where previous work has suggested the prominence of visual material in influencing PX [89]. Those seeking to create atmosphere in VR are therefore suggested to concentrate on setting design, story, colour palate, enemy design, level design, and graphical style. Difficulty dissonance would also be especially important to track in VR games. Their suitability to short play sessions would presumably require games to have easier challenges to complete in order to allow for short practice times which are sufficient to affect the propensity to persevere at a challenge. Virtual learning and training environments can also employ this work by collecting error rates, previous time spent in the learning environment, and asking users about their preferences for challenge. This could allow them to more efficiently pace the lesson schedule to one which will keep the learner engaged. This work contributes the concepts of difficulty and thematic dissonant player experiences along with empirical investigations of each. It has implications for the improvement of user experiences in both training and entertainment software.

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Appendix 1: Physiological Profile of Rage-Quitting Pre-Test Questionnaire

1. What is your age?
____
- -
2. What is your biological sex?
male female
- -
3. Have you ever played Super Mario 3D Land?
yes no
- -
4. Have you ever played Super Mario 3D World?
yes no
- -
5. Do you have normal or corrected to normal vision?
yes no

Appendix 2: Physiological Profile of Rage-Quitting Post-Test Questionnaire

1. How many hours per week do you spend playing 3D video games?						
	1	3	5	7	9+	
- -						
2. To what degree do you agree with the statement: "I like it when video games are really hard to beat"						
Strongly Disagree			Neutral			Strongly Agree
1	2	3	4	5	6	7
- -						
3. To what degree do you agree with the statement: "I was frustrated while playing the last level I played"						
Strongly Disagree			Neutral			Strongly Agree
1	2	3	4	5	6	7
- -						
4. Explain in one sentence why you stopped playing the game.						
______________________________						
______________________________						
______________________________						

Appendix 3: Online Atmosphere Study Questionnaire

Game User Experience Survey

Start of Block: Introduction

QA Title of Project: A Study of Subjective Experience of Video Games You are invited to participate in a research study conducted by *Giovanni Ribeiro*, under the supervision of *Dr. Lennart Nacke (Systems Design Engineering and DAC)* of the University of Waterloo, Canada. The objectives of the research study are *to study the user experiences of video-game players.* The study is for a Master's Thesis. If you decide to volunteer, you will be asked to complete a **30-minute online survey** that is completed anonymously in that researchers will not ask for your name. Survey questions focus on demographic information asked to describe the study population, and responses to a short video of gameplay, followed by a questionnaire about your own opinions in relation to a specific facet of video game experience. Participants will need earphones or headphones in order to participate in the study. Participation in this study is voluntary. You may decline to answer any questions that you do not wish to answer and you can withdraw your participation at any time by not submitting your responses. There are no known or anticipated risks from participating in this study. The benefits of participation in this study include learning about research in player experience in general and the topic of this study in particular. You will receive additional background information about the study. There are no other personal benefits to participation, but it will potentially help video game developers by providing data related to specific subjective play experiences. In appreciation of the time you have given to this study, you can enter your name into a draw for 1 of 2 prizes. The prizes include two **$50 Amazon gift cards**. Your odds of winning one of the prizes is based on the number of individuals who participate in the study. We expect that approximately 100 individuals will take part in the study. Information collected to draw for the prizes will not be linked to the study data in any way, and this identifying information will be stored separately, then destroyed after the prizes have been provided. The amount received is taxable. It is your responsibility to report this amount for income tax purposes. It is important for you to know that any information that you provide will be confidential. All of the data will be summarized and no individual could be identified from these summarized results. Furthermore, the web site is programmed to collect responses alone and will not collect any information that could potentially identify you (such as machine identifiers). When information is transmitted over the internet confidentiality cannot be guaranteed. University of Waterloo practices are to turn off functions that collect machine identifiers such as IP addresses. The host of the system collecting the data such as Qualtrics™ may collect this information without our knowledge and make this accessible to us. We will not use or save this information without your consent. If you prefer not to submit your survey responses through this host, please contact one of the researchers so you can participate using an alternative method such as through an e-mail or paper-based questionnaire. The alternate method may decrease anonymity but confidentiality will be maintained. The data, with no personal identifiers, collected from this study will be maintained on a password-protected computer database in a restricted access area of the university. As well, the data will be electronically archived after completion of the study and maintained for a minimum of 7 years and then erased. By agreeing to participate in the study, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities. This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#22329). If you have questions for the Committee contact the Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca. For all other questions about the study, please contact Giovanni Ribeiro *at ggsribei@uwaterloo.ca* or *Dr. Lennart Nacke at len@uwaterloo.ca*. Further, if you would like to receive a copy of the results of this study, please contact either investigator. Thank you for considering participation in this study.

QB Consent to Participate With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

- ○ I agree to participate
- ○ I do not wish to participate (please close your web browser now)

QC ***Please read all question carefully!***
Please keep a pair of headphones or earphones on hand!

End of Block: Introduction

Start of Block: Game User Experience Survey

Q1a What is your age?

____

Q2a What is your biological sex?

○ Male

○ Female

Q3a On average, how many hours per week do you spend playing video games?

○ 1 Hour

○ 3 Hours

○ 5 Hours

○ 7 Hours

○ 9+ Hours

Q5a Please find a quiet spot and watch the full video in full-screen with headphones and then respond to the questionnaire on the next page.

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Q6a How well did the audio element of the video fit the theme of the visual environment and setting depicted?

- (1) No Thematic Fit
- (2) Low Thematic Fit
- (3) Moderate Thematic Fit
- (4) Considerable Thematic Fit
- (5) High Thematic Fit

Q7a Please indicate to what extent you feel this way right now, reflecting upon the video you watched.

	(1) Very Slightly/ Not at All	(2) A little	(3) Moderately	(4) Quite a Bit	(5) Extremely
Interested	○	○	○	○	○
Distressed	○	○	○	○	○
Excited	○	○	○	○	○
Upset	○	○	○	○	○
Strong	○	○	○	○	○
Guilty	○	○	○	○	○
Scared	○	○	○	○	○
Hostile	○	○	○	○	○
Enthusiastic	○	○	○	○	○
Proud	○	○	○	○	○
Irritable	○	○	○	○	○
Alert	○	○	○	○	○
Ashamed	○	○	○	○	○
Inspired	○	○	○	○	○

Nervous	○	○	○	○	○
Determined	○	○	○	○	○
Attentive	○	○	○	○	○
Jittery	○	○	○	○	○
Active	○	○	○	○	○
Afraid	○	○	○	○	○
Frustrated	○	○	○	○	○

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Q8a To what extent would you describe the gameplay video you just watched as atmospheric?

○ (1) Not at All Atmospheric

○ (2) A Little Atmospheric

○ (3) Moderately Atmospheric

○ (4) Considerably Atmospheric

○ (5) Very Atmospheric

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Q9a To what degree do you agree with the statement: "I like it when video games are really hard to beat"?

○ (1) Strongly Disagree

○ (2) Somewhat Disagree

○ (3) Neutral

○ (4) Somewhat Agree

○ (5) Strongly Agree

Q10a
To what extent does the following factor affect your experience of the game's atmosphere?

	(1) Does Not Affect Atmosphere at All	(2) Affects Atmosphere a Little	(3) Moderately Affects Atmosphere	(4) Considerably Affects Atmosphere	(5) Strongly Affects Atmosphere
Story/Narrative	○	○	○	○	○
Music	○	○	○	○	○
Sound Effects	○	○	○	○	○
Environmental Noise (i.e. wind, birds chirping)	○	○	○	○	○
Colour Palate	○	○	○	○	○
Presence of Fog	○	○	○	○	○
Multiplayer	○	○	○	○	○
High Definition	○	○	○	○	○
Enemy Design	○	○	○	○	○
Setting Design	○	○	○	○	○
Level Design	○	○	○	○	○
Immersion (a mental state of absorption in the current experience)	○	○	○	○	○

Sense of Presence (the feeling of being there)	○	○	○	○	○
Flow (extreme focus, sense of control, distortion of the experience of time)	○	○	○	○	○
Graphical Style	○	○	○	○	○
Genre	○	○	○	○	○

Q11a To what extent would you describe the gameplay video you just watched as having atmosphere?

○ (1) Has No Atmosphere

○ (2) Has a Little Atmosphere

○ (3) Has a Moderate Amount of Atmosphere

○ (4) Has Considerable Atmosphere

○ (5) Has a Lot of Atmosphere

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Q12a Please rate the following genres in terms of how atmospheric games in that genre tend to be

	(1) Not At All Atmospheric	(2) A little Atmospheric	(3) Moderately Atmospheric	(4) Considerably Atmospheric	(5) Very Atmospheric
Sports	○	○	○	○	○
Platformer	○	○	○	○	○
MMO (Massively Multiplayer Online)	○	○	○	○	○
Horror	○	○	○	○	○
Survival Horror	○	○	○	○	○
Action	○	○	○	○	○
Adventure	○	○	○	○	○
First-Person Shooter	○	○	○	○	○
Third-Person Shooter	○	○	○	○	○
Strategy	○	○	○	○	○
Racing	○	○	○	○	○
Fighting	○	○	○	○	○
Mobile	○	○	○	○	○
Family Game	○	○	○	○	○

Flight	○	○	○	○	○
RPG (Role Playing Game)	○	○	○	○	○

Q13a
How much does a game being atmospheric influence your decision to buy it?

○ (1) Not at All

○ (2) A Little

○ (3) A Moderate Amount

○ (4) A Lot

○ (5) A Great Deal

Q14a Most of the time, when you play video games, do you:

○ a) Listen to the game's own audio in default mode

○ b) Listen to the game's own audio but with music or sound effects options changed

○ c) Listen to your own music or stream music from the internet as well as the game's audio

○ d) Listen to your own music or stream music from the internet with the game's audio off

○ e) Listen to a youtube video, TV show, or podcast with the game's audio on

○ f) Listen to a youtube video, TV show, or podcast with the game's audio off

Q16a

How much does a game's atmosphere influence your decision to buy it?

- ○ (1) Not at All
- ○ (2) A Little
- ○ (3) A Moderate Amount
- ○ (4) A Considerable Amount
- ○ (5) A Lot

Q17a

How important to the experience of a game's atmosphere is music's:

	(1) Not at All Important	(2) A Little Important	(3) Moderately Important	(4) Very Important	(5) Extremely Important
Tempo	○	○	○	○	○
Mood	○	○	○	○	○
Rhythm	○	○	○	○	○
Genre	○	○	○	○	○
Melody	○	○	○	○	○
Instrumentation	○	○	○	○	○
Lyrics	○	○	○	○	○

Q19a
To what extent does a game being atmospheric effect your perception of its quality?

- (1) Does Not Affect it at All
- (2) Affects it a Little
- (3) Moderately Affects it
- (4) Considerably Affects it
- (5) Strongly Affects it

Q21a What makes a game atmospheric in your opinion? (150 characters or less)

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End of Block: Game User Experience Survey A

Start of Block: Game User Experience Survey B

QD Please enter your email if you would like to be considered for the amazon gift card

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QE Thank you for participating in our survey! Your feedback is extremely valuable. If you indicated on the survey that you would like a copy of the results, they will be sent to you by email at the address you provided by August of 2018. This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#22329). If you have questions for the Committee contact the Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca. For all other questions or if you have general comments or questions related to this study, please contact Giovanni Ribeiro, Systems Design Engineering at ggsribei@uwaterloo.ca.

End of Block: Thank you

Appendix 4: In-Lab Atmosphere Study Pre-Test Questionnaire

GUR Experiment Survey

Start of Block: Game User Experience Survey A

Q136 Participant Identifier

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Q1 What is your age?

____

Q2 What is your biological sex?

- ○ Male
- ○ Female

Q3 Do you have normal or corrected to normal vision?

- ○ Yes
- ○ No

Q4 Have you ever played Bloodborne before?

○ Yes

○ No

Q5 On average, how many hours per week do you spend playing video games?

○ 1 Hour

○ 3 Hours

○ 5 Hours

○ 7 Hours

○ 9+ Hours

Q6 **Please stop answering the questionnaire and take a seat on the yellow X on the couch.**

Page Break

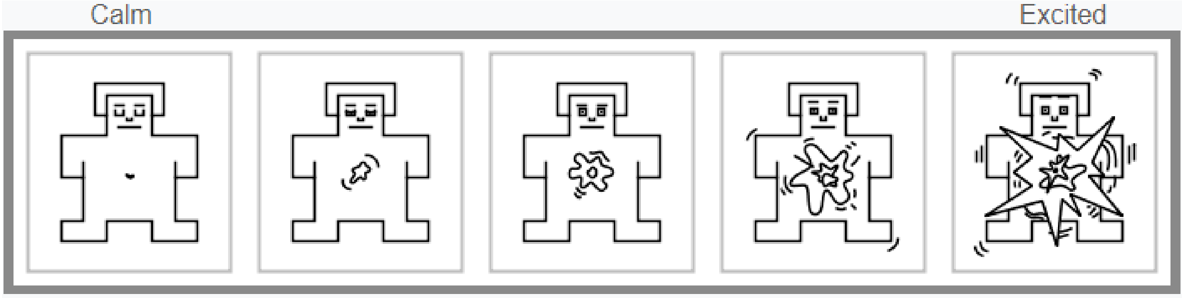
Appendix 5: In-Lab Atmosphere Study Post-Test Questionnaire

Q7 How well did the audio you heard fit the theme of the visual environment and setting depicted?

- (1) No Thematic Fit
- (2) Low Thematic Fit
- (3) Moderate Thematic Fit
- (4) Considerable Thematic Fit
- (5) High Thematic Fit

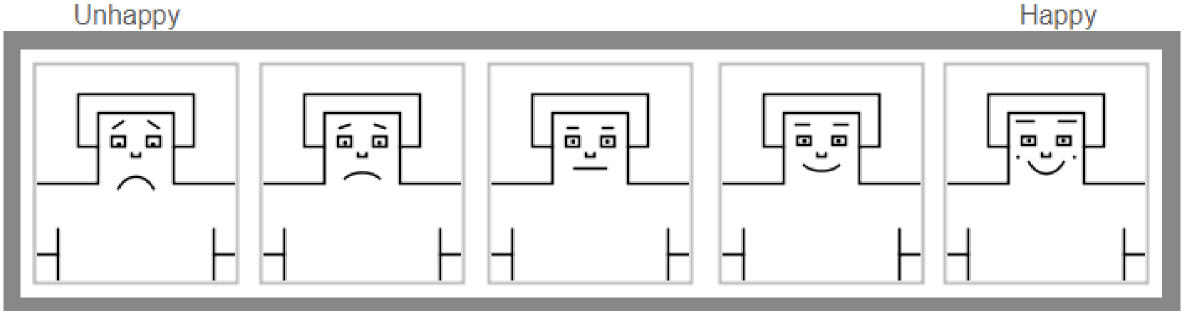
Q9 Please indicate along the following dimension how you felt while playing the game.

Calm | Excited

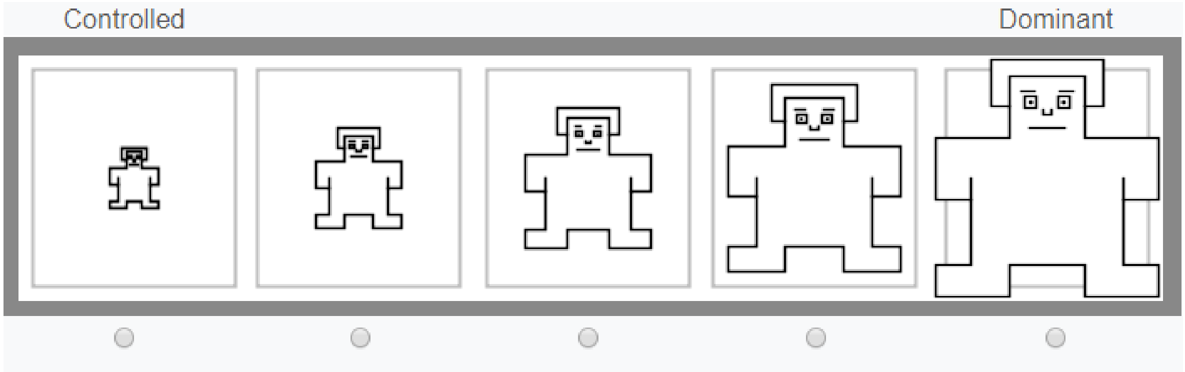


Q10 Please indicate along the following dimension how you felt while playing the game.

Unhappy | Happy



Q11 Please indicate along the following dimension how you felt while playing the game.



Q12 To what extent would you describe your game experience today as atmospheric or as having atmosphere?

- (1) Not at All Atmospheric/ No Atmosphere
- (2) A Little Atmospheric/ A Little Atmosphere
- (3) Moderately Atmospheric/ Moderate Amount of Atmosphere
- (4) Considerably Atmospheric/ Considerable Atmosphere
- (5) Very Atmospheric/ A Lot of Atmosphere

Q13 This scale consists of a number of words that describe different feelings and emotions. Please indicate to the right of each of these feelings and emotions how much you felt them while playing the game.

	(1) Very Slightly/ Not at All	(2) A little	(3) Moderately	(4) Quite a Bit	(5) Extremely
Interested	○	○	○	○	○
Distressed	○	○	○	○	○
Excited	○	○	○	○	○
Upset	○	○	○	○	○
Strong	○	○	○	○	○
Guilty	○	○	○	○	○
Scared	○	○	○	○	○
Hostile	○	○	○	○	○
Enthusiastic	○	○	○	○	○
Proud	○	○	○	○	○
Irritable	○	○	○	○	○
Alert	○	○	○	○	○
Ashamed	○	○	○	○	○
Inspired	○	○	○	○	○
Nervous	○	○	○	○	○

Determined	○	○	○	○	○
Attentive	○	○	○	○	○
Jittery	○	○	○	○	○
Active	○	○	○	○	○
Afraid	○	○	○	○	○
Frustrated	○	○	○	○	○

Q14 For the game you played today to what extent does the following factor affect your experience of the game's atmosphere?/ To what extent does the following factor affect your experience of the game as atmospheric?

	(1) Does Not Affect Atmosphere at All	(2) Affects Atmosphere a Little	(3) Moderately Affects Atmosphere	(4) Considerably Affects Atmosphere	(5) Strongly Affects Atmosphere
Story/Narrative	○	○	○	○	○
Music	○	○	○	○	○
Sound Effects	○	○	○	○	○
Environmental Noise (i.e. wind, birds chirping)	○	○	○	○	○
Colour Palate	○	○	○	○	○
Presence of Fog	○	○	○	○	○
Multiplayer	○	○	○	○	○
High Definition	○	○	○	○	○
Enemy Design	○	○	○	○	○
Setting Design	○	○	○	○	○
Level Design	○	○	○	○	○
Immersion (a mental state of absorption in the current experience)	○	○	○	○	○

Sense of Presence (the feeling of being there)	○	○	○	○	○
Flow (extreme focus, sense of control, distortion of the experience of time)	○	○	○	○	○
Graphical Style	○	○	○	○	○
Genre	○	○	○	○	○

Page Break

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Q17 Please answer the following questions by choosing the relevant number (1-5). In particular, remember that these questions are asking you about how you felt at the end of the play time.

Q102 To what extent did the game hold your attention?

○ (1) Not at All

○ (2)

○ (3)

○ (4)

○ (5) A Lot

Q103 To what extent did you feel you were focused on the game?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) A Lot

Q104 How much effort did you put into playing the game?

- (1) Very Little
- (2)
- (3)
- (4)
- (5) A Lot

Q105 Did you feel that you were trying you best?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) Very Much So

Q106 To what extent did you lose track of time, e.g. did the game absorb your attention so that you were not bored?

◯ (1) Not at All

◯ (2)

◯ (3)

◯ (4)

◯ (5) A Lot

Q107 To what extent did you feel consciously aware of being in the real world whilst playing?

◯ (1) Not at All

◯ (2)

◯ (3)

◯ (4)

◯ (5) Very Much So

Q108 To what extent did you forget about your everyday concerns?

◯ (1) Not at All

◯ (2)

◯ (3)

◯ (4)

◯ (5) A Lot

Q109 To what extent were you aware of yourself in your surroundings?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) Very Aware

Q110 To what extent did you notice events taking place around you?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) A Lot

Q111 Did you feel the urge at any point to stop playing and see what was happening around you?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) Very Much So

Q112 To what extent did you feel that you were interacting with the game environment?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) Very Much So

Q113 To what extent did you feel as though you were separated from your real-world environment?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) Very Much So

Q114 To what extent did you feel that the game was something fun you were experiencing, rather than a task you were just doing?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) Very Much So

Q115 To what extent was your sense of being in the game environment stronger than your sense of being in the real world?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) Very Much So

Q116 At any point did you find yourself become so involved that you were unaware you were even using controls, e.g. it was effortless?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) Very Much So

Q117 To what extent did you feel as though you were moving through the game according to your own will?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) Very Much So

Q118 To what extent did you find the game challenging?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) Very Difficult

Q119 Were there any times during the game in which you just wanted to give up?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) A Lot

Q120 To what extent did you feel motivated while playing?

- ○ (1) Not at All
- ○ (2)
- ○ (3)
- ○ (4)
- ○ (5) A Lot

Q121 To what extent did you find the game easy?

- ○ (1) Not at All
- ○ (2)
- ○ (3)
- ○ (4)
- ○ (5) Very Much So

Q122 To what extent did you feel like you were making progress towards the end of the game?

- ○ (1) Not at All
- ○ (2)
- ○ (3)
- ○ (4)
- ○ (5) A Lot

Q123 How well do you think you performed in the game?

- ○ (1) Very Poor
- ○ (2)
- ○ (3)
- ○ (4)
- ○ (5) Very Well

Q124 To what extent did you feel emotionally attached to the game?

- ○ (1) Not at All
- ○ (2)
- ○ (3)
- ○ (4)
- ○ (5) Very Much So

Q125 To what extent were you interested in seeing how the game's events would progress?

- ○ (1) Not at All
- ○ (2)
- ○ (3)
- ○ (4)
- ○ (5) A Lot

Q126 How much did you want to “win” the game?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) Very Much So

Q127 Were you in suspense about whether or not you would do well in the game?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) Very Much So

Q128 At any point did you find yourself become so involved that you wanted to speak to the game directly?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) Very Much So

Q129 To what extent did you enjoy the graphics and the imagery?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) A Lot

Q130 How much would you say you enjoyed playing the game?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) A Lot

Q131 When it ended, were you disappointed that the game was over?

- (1) Not at All
- (2)
- (3)
- (4)
- (5) Very Much So

Q133 Would you like to play the game again?

- ◯ (1) Definitely No
- ◯ (2)
- ◯ (3)
- ◯ (4)
- ◯ (5) Definitely Yes

Q132 How immersed did you feel? (10 = very immersed; 1 = not at all immersed

- ◯ (1) Not at All Immersed
- ◯ (2)
- ◯ (3)
- ◯ (4)
- ◯ (5) Very Immersed

Page Break

Q18 Reflect on your play experience today and rate your agreement with the following statements:

	(1) Strongly Disagree	(2)	(3) Neutral	(4)	(5) Strongly Agree
1. I feel competent at the game.	○	○	○	○	○
2. When playing the game, I feel transported to another time and place.	○	○	○	○	○
3. The game provides me with interesting options and choices.	○	○	○	○	○
4. Exploring the game world feels like taking an actual trip to a new place.	○	○	○	○	○
5. I find the relationships I form in this game fulfilling.	○	○	○	○	○
6. When moving through the game world I feel as if I am actually there.	○	○	○	○	○
7. Learning the game controls was easy.	○	○	○	○	○
8. I am not impacted emotionally by events in the game.	○	○	○	○	○

9. I feel very capable and effective when playing.	○	○	○	○	○
10. The game was emotionally engaging.	○	○	○	○	○
11. The game lets you do interesting things.	○	○	○	○	○
12. I experience feelings as deeply in the game as I have in real life.	○	○	○	○	○
13. I find the relationships I form in this game important.	○	○	○	○	○
14. When playing the game I feel as if I was part of the story.	○	○	○	○	○
15. The game controls are intuitive.	○	○	○	○	○
16. When I accomplished something in the game I experienced genuine pride.	○	○	○	○	○
17. My ability to play the game is well matched with the game's challenges.	○	○	○	○	○

18. I had reactions to events and characters in the game as if they were real.	○	○	○	○	○
19. I experienced a lot of freedom in the game.	○	○	○	○	○
20. I don't feel close to other players.	○	○	○	○	○
21. When I wanted to do something in the game, it was easy to remember the corresponding control.	○	○	○	○	○

Q19 Please rate your agreement with the following items on the scale from (1) strongly disagree to (5) strongly agree in the context of the game you just played

	(1) Strongly Disagree	(2)	(3) Neutral	(4)	(5) Strongly Agree
1. I enjoyed playing the game.	○	○	○	○	○
2. I liked playing the game.	○	○	○	○	○
3. Playing the game was fun.	○	○	○	○	○
4. The game was entertaining.	○	○	○	○	○
5. I had a good time playing this game.	○	○	○	○	○
6. I connected with the game.	○	○	○	○	○
7. The game resonated with what I find interesting.	○	○	○	○	○
8. Playing the game was meaningful to me.	○	○	○	○	○
9. The game felt relevant to me.	○	○	○	○	○
10. Playing this game was valuable to me.	○	○	○	○	○
11. I felt competent when playing the game.	○	○	○	○	○
12. I felt capable while playing the game.	○	○	○	○	○
13. I felt I was good at playing this game.	○	○	○	○	○

14. I felt a sense of mastery playing this game.	○	○	○	○	○
15. I felt in control when playing this game.	○	○	○	○	○
16. I felt a sense of accomplishment playing this game.	○	○	○	○	○
17. I was absorbed by the gameplay	○	○	○	○	○
18. I was not thinking about other things while playing the game.	○	○	○	○	○
19. I lost track of time while playing the game.	○	○	○	○	○
20. I was no longer aware of the surroundings while I was playing	○	○	○	○	○
21. I felt immersed in the game.	○	○	○	○	○
22. I was fully focused on the game.	○	○	○	○	○
23. I felt I could play this game according to my interests.	○	○	○	○	○

24. I felt a sense of freedom about how I wanted to play this game.

25. I felt free to play the game in my own way.

26. I felt like I had choices regarding how I wanted to play this game.

27. I felt I could play this game according to the strategies that I found most interesting.

28. I felt eager to discover how the game continued.

29. I wanted to explore how the game evolved.

30. I was driven to discover more in the game.

31. I wanted to find out how the game progressed.

32. The game roused my curiosity.

33. I thought the game was easy to control.

34. The game controls were intuitive.

35. The actions to control the game were clear to me.	○	○	○	○	○
36. It was easy to know how to perform actions in the game.	○	○	○	○	○
37. I quickly grasped how to perform in-game actions.	○	○	○	○	○
38. The challenges in the game matched my skill level.	○	○	○	○	○
39. The game was challenging but not too challenging.	○	○	○	○	○
40. The game was not too easy and not too hard to play.	○	○	○	○	○
41. The game provided new challenges at an appropriate pace.	○	○	○	○	○
42. The challenges in the game were at the right level of difficulty for me.	○	○	○	○	○
43. I had a good idea of my status in the game.	○	○	○	○	○
44. It was clear to me how I was doing in the game.	○	○	○	○	○

45. The game gave clear feedback on my progress towards the goals.	○	○	○	○	○
46. I could easily assess how I was performing in the game.	○	○	○	○	○
47. The game informed me of my progress in the game.	○	○	○	○	○
48. The audiovisual styling appealed to me.	○	○	○	○	○
49. I liked the artistic design of the game.	○	○	○	○	○
50. I enjoyed the way the game was styled.	○	○	○	○	○
51. I liked the look and feel of the game.	○	○	○	○	○
52. I appreciated the aesthetics of the game.	○	○	○	○	○
53. The goals of the game were clear to me.	○	○	○	○	○
54. I understood the rules of the game.	○	○	○	○	○
55. I grasped the overall goal of the game.	○	○	○	○	○

56. The rules of the game were clear to me.	○	○	○	○	○
57. I understood the objectives of the game.	○	○	○	○	○

Q20
How important to the experience of a game's atmosphere is music's:

	(1) Not at All Important	(2) A Little Important	(3) Moderately Important	(4) Very Important	(5) Extremely Important
Tempo	○	○	○	○	○
Mood	○	○	○	○	○
Rhythm	○	○	○	○	○
Genre	○	○	○	○	○
Melody	○	○	○	○	○
Instrumentation	○	○	○	○	○
Lyrics	○	○	○	○	○

Q21
To what degree do you agree with the statement: "I like it when video games are really hard to beat"?

- ○ (1) Strongly Disagree
- ○ (2) Somewhat Disagree
- ○ (3) Neutral
- ○ (4) Somewhat Agree
- ○ (5) Strongly Agree

Q22 Please rate the following genres in terms of how atmospheric games in that genre tend to be.

	(1) Not At All Atmospheric	(2) A little Atmospheric	(3) Moderately Atmospheric	(4) Considerably Atmospheric	(5) Very Atmospheric
Sports	○	○	○	○	○
Platformer	○	○	○	○	○
MMO (Massively Multiplayer Online)	○	○	○	○	○
Horror	○	○	○	○	○
Survival Horror	○	○	○	○	○
Action	○	○	○	○	○
Adventure	○	○	○	○	○
First-Person Shooter	○	○	○	○	○
Third-Person Shooter	○	○	○	○	○
Strategy	○	○	○	○	○
Racing	○	○	○	○	○
Fighting	○	○	○	○	○
Mobile	○	○	○	○	○

Family Game	○	○	○	○	○
Flight	○	○	○	○	○
RPG (Role Playing Game)	○	○	○	○	○

Q137 Most of the time, when you play video games, do you:

○ a) Listen to the game's own audio in default mode

○ b) Listen to the game's own audio but with music or sound effects options changed

○ c) Listen to your own music or stream music from the internet as well as the game's audio

○ d) Listen to your own music or stream music from the internet with the game's audio off

○ e) Listen to a youtube video, TV show, or podcast with the game's audio on

○ f) Listen to a youtube video, TV show, or podcast with the game's audio off

Q138 For the games in general to what extent does the following factor affect your experience of the game's atmosphere?/ To what extent does the following factor affect your experience of the game as atmospheric?

	(1) Does Not Affect Atmosphere at All	(2) Affects Atmosphere a Little	(3) Moderately Affects Atmosphere	(4) Considerably Affects Atmosphere	(5) Strongly Affects Atmosphere
Story/Narrative	○	○	○	○	○
Music	○	○	○	○	○
Sound Effects	○	○	○	○	○
Environmental Noise (i.e. wind, birds chirping)	○	○	○	○	○
Colour Palate	○	○	○	○	○
Presence of Fog	○	○	○	○	○
Multiplayer	○	○	○	○	○
High Definition	○	○	○	○	○
Enemy Design	○	○	○	○	○
Setting Design	○	○	○	○	○
Level Design	○	○	○	○	○
Immersion (a mental state of absorption in the current experience)	○	○	○	○	○

Sense of Presence (the feeling of being there)	○	○	○	○	○
Flow (extreme focus, sense of control, distortion of the experience of time)	○	○	○	○	○
Graphical Style	○	○	○	○	○
Genre	○	○	○	○	○

End of Block: Game User Experience Survey A