Causing Fear and Anxiety Through Sound Design in Video Games

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By Ahmed Abdel-Meguid

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Causing Fear and Anxiety Through Sound Design in Video Games

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This project researched and tested how to cause fear and anxiety through sound design in video games. The project made the distinction between fear and anxiety and explored how the two emotions are linked while explaining how to effectively evoke those emotions using sound design. By selecting and designing sounds using Freud's Id, Ego, and Superego theory as a baseline for human psyche, this project tested the use of volume, timing, and source in causing fear and anxiety in players.

This study used a Survival-Horror style level designed and constructed by the author. The player must find his or her way through an old and aging mansion during a nighttime thunderstorm while being ambushed by enemies from various hiding spots.

Twenty-seven Guildhall students were used as testers ranging from ages 22 to 40, predominantly male, from all backgrounds of video gaming. Results, based on quantitative and qualitative analysis of the data, suggested that the best method for causing fear is high-volume, well-timed, and sourced sound effects. For anxiety, data suggested the best method is medium-volume, untimed, and unsourced sound effects.

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Nomenclature

Avatar- An avatar is a video game player's in-game character.

Anxiety- Anxiety is a physiological and psychological state characterized by uneasiness and worry, typically brought about by something a person feels feel is out of his control.

Dialogue- Pieces of dialogue are the spoken words of video game characters.

Fear- Fear is a physiological and psychological state brought on by unpleasant subjective experiences. It is noticed by physiological changes such as increased heart rate and sweating, and behavioural changes such as avoidance of fear-producing objects or situations.

High-Volume Sound Effect- A sound effect played at a level of volume that is higher than the ambient soundscape of a level.

Id, Ego, and Superego Theory- Freud's theory of the human psyche that can be used to create fear and anxiety in the player. According to this theory, Level designers can teach the player how to fear a sound, as well as leverage old learned fears and innate fears that all humans have.

James-Lange Theory- The James-Lange theory states that emotions are purely a response to physical stimuli.

Low-Volume Sound Effect- A sound effect played at a level of volume that is lower than the ambient soundscape of a level.

Medium-Volume Sound Effect- A sound effect played at a level of volume that is the same as the ambient soundscape of a level.

Psychoevolutionary Theory- Plutchik's theory states that emotional responses are a product of evolution.

Sound Effects- For the purposes of this study, this all-encompassing term covers any sound that is not music, stingers, or dialogue.

Sourced Sound Effect- A sound effect that has a visible source.

Stingers- A stinger is a short music clip used to punctuate a scene or draw attention to an object or event.

Timed Sound Effect- A sound effect that coincides with a specific visual or gameplay element.

Unsourced Sound Effect- A sound effect that does not have a visible source.

Untimed Sound Effect- A sound effect that does not coincide with a specific visual or gameplay element.

Chapter 1: Introduction

Video games are digital entertainment media that utilize both audio and visual channels to capture the audience's attention and immerse them in the developers' vision. In many cases, this involves putting the player in the role of an avatar that interacts with the in-game world. In essence, the player is the star of an interactive movie; he sees his avatar's actions portrayed on screen for his entertainment. It logically follows that the aesthetics for a video game should attain similar standards to those of a movie; the quality of both visuals and sound should be high. The industry currently has a clear guideline for visuals, but not particularly, where it relates to audio. To achieve a high quality of audio, an established guideline for quality needs to exist.

Level designers can use sound to enhance the player's anxiety and fear. This relatively inexpensive process of creating and implementing sound yields very effective results and therefore, should be researched and refined. Using clearly defined sound design principles, Level designers can add a high level of polish to their levels. The purpose of this project is to determine the best use of volume, timing, and source of in-game sound effects to cause fear and anxiety in the player.

Volume is the most basic property of sound. Level designers can use variations in volume to scare the player with suddenly loud sounds, or slowly ease in certain sounds using incremental volume changes.

Timing is the point in a game at which a sound plays. Level designers can determine exactly when the player hears a sound and have it coincide with a visual or gameplay event, or they can simply set that sound to play randomly while a player is in a certain area. Modern games frequently use both techniques.

For the purposes of this study, a source is a visible instigator of a sound effect. For example, the source light bulb flickering sound effect would be the light bulb itself. A sound effect with a source

typically communicates something specific to the player. Sounds effects without sources typically convey a general mood or feel.

The goal of this project was to experiment with the volume, timing, and source of in-game sound effects to find the best possible combinations of those properties for creating fear and anxiety in the player. This work examines how a Level designer can manipulate and test three basic attributes of sound, volume, timing, and source, through level design to evoke fear and anxiety.

Chapter 2: Field Review

Developers utilize sound effects in all current-generation video games. Sounds can enhance current emotions felt by the listener, or they can evoke entirely new emotions. Video games are digital entertainment media that utilize both audio and visual channels to capture the audience's attention and immerse them in the developers' vision. Oftentimes, this involves evoking a specific emotion in a player through the use of those channels. Knowing how the human mind processes emotions is a crucial part of the theory behind evoking emotions. Also, knowing how previous games have utilized the audio channel and how effectively their efforts were is useful for this study. The following section covers theories behind human emotion as well as a practical review of how certain games utilized sound in scaring the player.

Anxiety, Fear, and Human Emotion Theory

Two common emotions that players feel while playing video games are anxiety and fear. Anxiety is "a diffuse, unpleasant, vague sense of apprehension…" (Kaplan and Sadock, 1998). Anxiety is a physiological and psychological state characterized by uneasiness and worry, typically brought about by something a person feels feel is out of his control. Players feel anxiety because they cannot always predict the future outcome of their actions. Level designers can use sound to enhance anxiety, which causes an elevated sense of worry in the player and possibly make challenges feel more dangerous than they actually are. With anxiety, a player can be made to feel as though they have overcome an extremely difficult obstacle when in reality, the actual scenario may have been much more forgiving.

Fear is also a prevalent emotion for players while gaming. "Fear is an emotional state evoked by threat of danger. It is usually characterized by unpleasant subjective experiences; physiological changes, such as increased heart rate and sweating; and behavioural changes, such as avoidance of fear-producing

objects or situations." (Martin and McFerran, 2008). Since video games are littered with threats and danger, learning to fear those threats are crucial to a player's in-game performance. The important takeaway from this is that that fear and anxiety are inherently linked with video games. Developers can take advantage of this concept and elevate the player's fear using many methods including sound effects.

At first, fear may sound similar to anxiety, but this is not the case. According to many researchers, they are closely related but not the same. "…anxiety is not the result of a known or specific threat. Rather it comes from your mind's vision of the possible dangers that may result in the situation." (Ankrom, 2009). "Fear is an emotional response to a known or definite threat." (Ankrom, 2009). The two emotions are very closely linked; fear feeds off of anxiety and anxiety feeds off of fear, but they are two separate mental processes. To expand on this, a player's fear may be magnified by anxiety if they are already anxious and a fear inducing stimulus is introduced. The player is already in a state in which he is nervous and tense therefore he may perceive a threat to be more dangerous than it actually is, causing an elevated fear response. Conversely, a Level designer may introduce a fear stimulus with an unrelated stimulus, such as a sound or a visual object. If this is repeated often enough, the player may have an elevated anxiety response whenever the Level designer introduces the unrelated stimulus within his level.

Because Level designers control all that the player sees and hears throughout a video game experience, they should be aware that they can control the level of fear and anxiety that a player feels throughout. To help in understanding how human emotions and how Level designers may use that knowledge to their advantage, this field review explains several theories behind fear and anxiety.

Ego, Super-Ego, and Id

The Ego, Super-Ego, and Id are Freud's terms for the major parts of the human psyche. In relation to fear and anxiety, the Id plays a crucial role in regulating emotions and determining human actions. "The Id comprises the unorganized part of the personality structure that contains the basic drives. The id acts as a pleasure principle: if not compelled by reality it seeks immediate enjoyment. It is focused

on selfishness and instant self-gratification. Personality as Freud saw it, was produced by the conflict between biological impulses and social restrains that were internalized. The Id is unconscious by definition." (Wikipedia, 2009). According to Freud, the Id's main drive is immediate satisfaction and continued survival. This means that in order for Level designers to effectively cause fear, one must leverage the player's id, or subconscious.

The id contains a person's most basic and subconscious fears and desires. The id strives to avoid the things it fears, and to pursue things it finds attractive. Certain psychologists theorize that humanity shares a number of innate fears they have from birth. To most effectively and efficiently evoke fear using the id, the Level designer should identify those basic fears that humans share. "Infants have three basic innate fears: of sudden motion, of loud or abrupt noises, and of sudden approach." (Gebeke, 1993). While Gebeke describes fears shared by infants, humans as a whole share these fears within their subconscious mind. The human id is naturally afraid of these events, which happen to be readily available principles for Level designers. Using this theory, Level designers can attempt to cause fear in their players via the id. A person's id strives to please and preserve that person. Leveraging the id typically involves finding things that everybody innately fears, such as loud and abrupt noises, and utilizing them within sound design.

While the id attempts to obtain whatever pleases it at the time, the Ego is the cognitive and decision making portion of Freud's human psyche model. "The Ego comprises that organized part of the personality structure which includes defensive, perceptual, intellectual-cognitive, and executive functions. Conscious awareness resides in the ego, although not all of the operations of the ego are conscious. The ego separates what is real. It helps us to organize our thoughts and make sense of them and the world around us." (Wikipedia, 2009). The ego takes into account the concepts a person learns and attempts to reconcile the needs of the id with reality. The ego tends to steer a person away from anything that they are taught to fear. This includes the fear of failure, fear of pain, fear of heights, or fear of drowning. According to Gebeke, even the fear of death is a learned fear and is therefore governed by the ego. For Level designers, this means that anything that the player has been taught to fear can be leveraged to evoke

fear, including death and failure, which are risks (to the player's avatar) in most video games. Level designers can use sound effects that represent a learned danger to evoke fear in a player via the ego. For example, if a player gets close to an electrical hazard, the Level designer can add a loud sparking noise to scare the player. The Level designer can also add a loud choking sound effect when the player has been in water for a long time, or a loud whistling of wind at the top of a cliff to evoke the fear of falling.

Interestingly, the ego can also be leveraged to create anxiety in a player. According to Freud, the ego is rational; it represents reason and logic. The ego may be leveraged to cause anxiety in the player when it reasons that a threat is present. "it (anxiety) comes from your mind's vision of the possible dangers that may result in the situation." (Ankrom,2009) The player can be made to feel anxiety when brought close to a seemingly unavoidable threat that they have been taught to fear. Assuming a player fears death for example, the Level designer can place sounds in their level to simulate uncontrollable death-causing entities such as artillery shells raining down from an enemy encampment; random gunfire; and unknown, hidden monster sounds. Utilizing the ego correctly allows Level designers to make the player feel close to death without actually putting them in danger, thus causing anxiety.

The super-ego is the third of Freud's three parts of the human psyche. It governs morality and ideals and typically conflicts with the id's desires. The ego attempts to reconcile the id and the super-ego in a way that caters to both. Since the super-ego mainly governs morality, it is considerably less effective at causing fear and anxiety compared to the ego and id.

Freud's theory of the id, ego, and super-ego can be used to create fear and anxiety in the player. According to this theory, Level designers can teach the player how to fear a sound, as well as leverage old learned fears and innate fears that all humans have. Thus, Freud's theory is used in designing and creating the sound effects to be tested in this study.

James-Lange Theory

The James-Lange theory states that emotions are purely a response to physical stimuli. If the player jumps, he rationalizes that he is scared. If he is sweating, he rationalizes that he is anxious. "…the

bodily changes follow directly the perception of the exciting fact, and that our feeling of the same changes as they occur is the emotion. Common sense says, we lose our fortune, are sorry and weep; we meet a bear, are frightened and run;" (Straker, 2008). The James-Lange theory maintains that any emotion is the direct cause of a physical change.

This theory suggests that in order to create an effective sound for scaring players with, Level designers should create ones that elicit the most desirable physical responses from the players. In order to test a theory like this, Level designers would have to use observational analysis to record how a player physically reacts to any given sound effect.

Major criticisms of this theory include the lack of emotional change when injecting adrenaline into a subject, and that cutting the nerves from an organ has no effect on emotions that that organ regulates such as the hypothalamus and the adrenal glands (Wikipedia 2009).

Conversely, physical responses can be more accurate gauges of human emotion than asking a person how they feel and listening to their response. According to the James-Lange theory, if a player is fearful or anxious, he exhibits physical indicators of that emotion. Thus, this theory is incorporated by observing the player and recording their physical reactions to each sound effect.

Plutchik's Psychoevolutionary Theory

Plutchik's theory states that emotional responses are a product of evolution. "According to Plutchik, the concept of emotion ought to apply to all animal life… Emotions, he says, should be most generally thought of as useful adaptations to life's contingencies." (Plutchik, 1984). This theory essentially states that the triggers for emotions are engraved deep within the human psyche from birth. This also states that the triggers for these emotions are shared by all humans. According to Plutchik's theory, Level designers can reliably evoke fear and anxiety in different people using the same stimulus for everybody.

Plutchik also states that emotions vary in terms of intensity and their similarity to one another (Cornelius, 1996). For Level designers, this theory supports the idea that they may gauge the

effectiveness of their sound effects in evoking a specific emotion by finding how close the player's emotion is to the Level designer's desired emotion. This theory also supports that Level designers have control over how intensely they make a player feel a given emotion. Pictured on the following page is Plutchik's emotion wheel that many psychologists and researchers use when testing emotional responses.

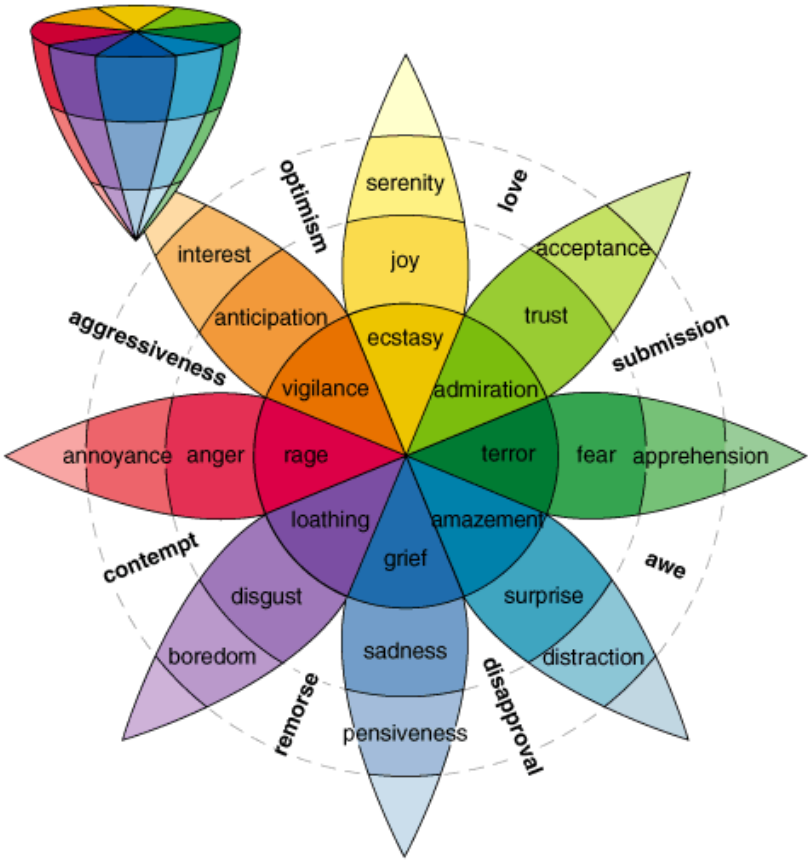

Figure 1: Plutchik's Emotion Wheel (http://www.fractal.org/Bewustzijns-Besturings-Model/Plutchikfig6.gif)

Plutchik's theory essentially states that humans share a common set of emotional triggers, and that those emotions can be reliably measured. This theory may be difficult to test since humans often communicate their feelings differently from one another. For instance, one person may have a different definition for fear than someone else. Humans may also become accustomed to a certain emotion and therefore require more intense stimulation than another human. This causes inconsistencies with data analysis, and

therefore the test must be limited to analyzing self-reported responses rather than the true emotion a person feels.

Plutchik's psychoevolutionary theory suggests that emotions have different intensities. For the purposes of this study, Plutchik's theory is integrated by asking the player how intensely they felt a given emotion while listening to a set of sounds within a level.

Three different theories of human emotion are integrated into this project. Freud's theory of the id, ego, and super-ego serves as a guideline for creating sounds that cause fear and anxiety in the player. The James-Lange theory requires a qualitative observation method to gauge player reaction. Lastly, Plutchik's psychoevolutionary theory provides a quantitative analysis method to gauge the effectiveness of sound effects. Using these three theories, a sound methodology can be created to test different properties of sound design.

Sound Design in Video Games

Sound design is used in almost all video games. Unfortunately, it is typically rushed and only implemented near the end of the development cycle. To create high quality sounds, Level designers should plan in advance, and study the principles used in other games to create the most effective sounds for their particular use. Because this study pertains specifically to the use of sound in creating fear and anxiety, one should study games that cater to those emotions.

In order understand industry standard sound design pertaining to fear and anxiety, this study examines a specific genre known as Survival-Horror games. Survival-Horror games are designed to keep the player in a state of fear and anxiety throughout the game using potentially disturbing visuals and sounds. Dissecting the sound design of these games can serve to greatly enhance a Level designer's knowledge of how to cause fear and anxiety in video games.

This section of the field review goes into detail about five different Survival-Horror games and the sound design behind them. The games chosen for this field review are:

***Alone in the Dark* (Atari 2008)-** Alone in the Dark uses high quality visuals and an epic musical score coupled with interspersed moments of surprise and terror to cause player fear and anxiety.

***Dead Space* (Electronic Arts 2008)-** Dead Space has an abundance of ambient sound effects and clutter to add to the realism and increase the player's anxiety level. Dead Space uses a combination of well timed and high volume sound effects to elicit strong fear responses from the player. The game is known for the praising reviews of its sound design.

***Eternal Darkness* (Nintendo 2002)-** Eternal Darkness takes a minimalistic approach to sound design and only uses sounds very sparingly. This approach allows the player to hear what few sounds are in the game with little difficulty, which increases the overall effect of each sound.

***Doom 3* (Activision 2004)-** The sound design of Doom 3 focused on voice acting and ambient sound effects. The ambience succeeded in creating a mood of anxiety and tension, while the encounters and monsters focused on creating fear.

***Silent Hill 2* (Konami 2001)-** Silent Hill 2 is an older games that also uses an a minimalist approach to sound design. There are more sounds present in this game than in Eternal Darkness, with more of an emphasis on ambient sounds to create anxiety.

The following section of the field review discusses the sound design in these games at length. Sound design has three major properties: volume, timing, and source. Volume is the decibel level at which a sound is heard. Timing is when a sound is heard. Source is the origin of a sound. There are three different types of sounds: stingers and music, sound effects, and dialogue. Stingers and music are a type of mood-setting device that typically coincide with the theme of a game. Sound effects cover a sounds

not covered by stingers/music and dialogue such as ambient noise, weapon sounds, and environmental effects. Lastly, dialogue is the spoken word of a character in a game. The following review studies the use of three the properties of sound design (volume, timing, and source) in the implementation of the three different types of sounds (stingers/music, sound effects, and dialogue).

Volume

Level designers choose at what volume to play their sounds. Since the player may change the overall game volume at will, the only important aspect of volume is its magnitude in relation to other sounds. A "loud" sound has a higher volume than the average sounds currently playing. A "soft" sound has a lower volume than the average. The player hears louder sounds over softer ones, which makes loud sounds more effective at evoking sudden and shocking emotions in the player such as fear. Softer sounds however, serve as a good atmospheric tool that can create an indefinable aura of lingering anxiety.

Use of volume with Stingers/Music

Survival-Horror games frequently utilize sounds called "stingers" to accentuate major gameplay events and to transition between music. A stinger is a short music clip used to punctuate a scene or draw attention to an object or event. Stingers used in video games typically transition between low-tension and high-tension moments. The stingers are characterized by having a higher pitched and higher volume than the rest of the sounds currently playing. The higher volume contrasts the high-tension gameplay from the low-tension gameplay, and causes the player to associate high volume music with anxiety and fear such as found in the burning building level in *Alone in the Dark*.

The use of volume with stingers has usually followed a set pattern: high-volume stingers are more effective. Level designers should know that stingers are typically best played at high volumes because the stinger is meant to draw attention to something. Because a stinger draws attention to a specific object or event, stingers are generally used when attempting to cause fear in the player. Since people innately fear loud and sudden noises, high volume stingers lend themselves well to evoking fear in a player.

Use of volume with Sound Effects

Most games employ the use of sound effects. For the purposes of this field review, this all-encompassing term covers any sound that is not music or dialogue. Ambient noises such as rustling leaves and the steady drip of rain, player avatar sounds such as pained grunts or battle cries, and weapon noises such as the crack of a rifle or the swing of a club are all sound effects.

In *Alone in the Dark*, the ambient sounds such as electrical sparks and raging fires are louder than the music, typically abrupt, but soft enough that they do not drown out the important sounds like dialogue and combat sound effects. The ambience of *Alone in the Dark* helped to add to the anxiety level of the player because the ambient sounds conveyed a feeling of unknown danger.

The ambient sounds of *Dead Space* consist of steam vents leaking, garbage rustling, and lights sparking. The ambient sounds are all medium to low volume. This volume decision causes the ambience to remain completely atmospheric. The Level designers did not use ambient sound as a fear or anxiety evoking tool. Rather, the ambient sound is simply for immersing the player in the setting.

The player avatar's and monsters' actions are the loudest part of *Dead Space*. The player's interaction with the monsters is the most important part of the game, and thus those sounds take precedence over all other sounds. Focusing on the important aspects of the game through sound can help evoke emotion in the player.

For instance, any the time the player engages in combat, the monsters screech loudly and fiercely until they die. The scream is very shrill and very recognizable. This technique instantly tells the player they are in danger, and also makes them want to finish the combat extremely quickly. Because the monsters can kill the player's avatar, these sound effects cause fear in the player.

Another example is when during gameplay moments where the player's avatar has a limited air supply, the avatar makes loud choking sounds well before it would be reasonable for him to actually be choking. For example, after only 20 seconds of holding his breath, the avatar begins making loud gasping

noises. While embellished, it clearly communicates to the player that they are in danger and must leave the airless atmosphere as soon as possible. Because the player's avatar is in danger of dying in this scenario, these sound effects also cause fear.

Although *Dead Space* gets extremely loud during dangerous portions, the Level designers also add a few quiet, low-clutter moments mixed in with the typically cluttered sound design of the rest of the game. This technique creates a contrast between high-action and low-action moments, which keeps the player from being desensitized to sound effects. This takes into account the theory behind Eternal Darkness and Silent Hill 2 where "less is more" and a few high-volume sound effects scattered throughout evoke more fear than many high-volume sound effects that the player may eventually become used to.

Ambient sounds in *Eternal Darkness* are high-volume, but scarce. There are short and long stretches of silence all throughout the game. This contrast made all the rest of the sounds feel more intense and more meaningful. *Eternal Darkness* shows that the use of silence in sound design can be a valuable tool. Character sounds effects are high volume, but also sparse. The ambient noises randomly become more frequent and high-pitched. This technique could cause more anxiety if used periodically during high-tension moments.

All of the ambient sounds and music in *Doom 3* are loud; they drown out almost everything else. The enemy sounds are quieter than the ambient noise, which causes the enemies to seem less menacing. The only thing louder than the music and the ambient noise is the player avatar's gun, and it is overly loud. *Doom 3* seems to focus more on visual quality than sound quality. The volume of the sounds in *Doom 3* do not seem to add to anxiety or fear in the player.

However, one section in *Doom 3* that stands out among the rest is a part where a screaming, flying skull circles around the player's avatar, and its volume rises and falls based on its distance from the player's avatar. This part of the game adds much needed quality and causes a great deal of fear and anxiety for a short time due to the perceived danger from the sudden and loud sounds, and mysterious nature of the flying skulls.

Doom 3 has an enemy ambush almost every time the player's avatar picks up an item. The developers use the same sound and the same enemy for many of these ambushes. This eventually becomes boring and repetitive, and players begin to expect the ambushes. During many enemy attacks, the enemy sounds starts soft and ramp up to loud. For example, a zombie's labored breathing may start off low, but then it gradually increases in volume as the fight becomes more intense. This technique seems to lessen the fear during the fights because the player has time to become acclimated to the new sound effect.

Silent Hill 2 uses low-volume ambient noise with high volume sound effects. The enemies of *Silent Hill 2* are extremely loud and their sounds are instantly recognizable. Like E*ternal Darkness, Silent Hill 2* also uses a minimalist approach to sound design. However, unlike *Eternal Darkness, Silent Hill 2* uses many low-volume ambient effects such as wind whistling in the distance and light bulbs flickering to create a feeling of immersion in a run-down town where danger lies around every corner. This creates a strong feeling of anxiety in the player.

The use of volume with sound effects varies depending on whether the Level designer is attempting to evoke fear or anxiety. Sound effects can evoke both emotions. Overall, high volume, abrupt sound effects have been more effective at causing fear while low to medium volume ambient sound effects have been effective at creating anxiety by convincing the player that they are in a dangerous atmosphere.

Use of volume with Dialogue

In most of these games and most notably, *Alone in the Dark*, the supporting characters speak with each other. The dialogue is always louder than everything else so that the player can hear it through the clutter of other sounds.

Dialogue is typically used to sell a dangerous atmosphere to a player. Thus increasing his anxiety. During a part of *Dead Space*, the player's avatar receives garbled communications from one of his squad mates as they attempt to converse with the player's avatar. The purpose of the dialogue is to

sell the dangerous atmosphere to the player by conveying storyline information. One time, as that squad mate is speaking, they is killed by an unknown entity. This causes the player to become more anxious as he does not know what killed his squad mate, but he knows that it is somewhere potentially close by.

Overall, dialogue is louder than most other sounds in games. This holds true not only for Survival-Horror, but also for most other games as well. This is because dialogue needs to be heard clearly and articulately in order for it to have any effect on the player. Dialogue should always be heard as loudly as possible so that the player may understand the words.

In summary of stingers, loud volume is typically the best choice for evoking fear. For sound effects, using loud ones can help evoke fear while softer, intermittent and ambient sound effects can help evoke anxiety. Finally, in the case of dialogue, loud is always the best so that the player can understand the words.

Timing

Level designers can determine where and when the player hears any sound in their levels. Level designers can set the sound to play randomly within the level, or they may pre-script the sound to play coincided with a specific visual or gameplay element. Well-timed sounds can cause a great amount of shock in the right spot, but randomly timed sounds can be very effective at creating a tense atmospheric effect.

Use of timing with Stingers/Music

Level designers use stingers in *Alone in the Dark* during moments of surprise such as an enemy suddenly lunging at the player's avatar from a dark closet. The orchestra becomes louder and transitions to high tempo music during high-tension sections. The timing of the musical changes coincides with the timing of these surprise moments and causes the player to become anxious when he first hears the stinger, which enhances the reaction of fear that the actual surprise brings.

The timing of most stingers and musical changes in *Dead Space* coincides perfectly with an enemy attack, causing anxiety and fear as with *Alone in the Dark*. However, some stingers play randomly to artificially escalate player anxiety during downtime and evoke the feeling of danger when in reality, there is none.

Eternal Darkness also uses a mix of random and purposeful stinger timing. Stingers sometimes play completely randomly, but they also always play before a surprise moment such as an ambush. This design philosophy teaches the player to expect an ambush and become anxious after each stinger.

Silent Hill 2 also uses stingers during high-tension moments, like many other Survival-Horror games. However, the use of stingers is limited to in-game story sequences where the player has no control over his avatar. *Silent Hill 2* rarely uses stingers during actual gameplay, but this does not detract from the fear or anxiety caused by the stinger.

Overall, stingers are excellent devices for causing anxiety and fear when timed properly. However, Level designers may also choose to use stingers as an anxiety inducing tool by teaching the player that a stinger may or may not foreshadow a dangerous situation. If the Level designer precedes most dangerous situations with a stinger, it causes the player's anxiety to increase every time they hear a stinger regardless of the following event.

Use of timing with Sound Effects

Level designers either time sound effects to coincide with a specific event, or they may have them playing randomly throughout the level.

In most games, whenever an enemy ambushes the player's avatar, an appropriate sound effect accompanies the ambush such as a door swinging open or glass shattering. This effect is mainly for startling the player and causing fear rather than anxiety, but the sudden jolt causes tension that lasts after the player overcomes the ambush. If the player remembers that sound, he can learn to be afraid of environmental effects rather than enemy sounds, thus increasing the amount of anxiety-inducing sound effects at the Level designer's disposal.

While many Survival-Horror games use ambushes regularly, such as the majority of encounters *Dead Space* and *Doom 3*, *Silent Hill 2* seldom uses ambushes to scare the player. Instead, this game does the complete opposite and instead warns the player when there are nearby enemies by playing a radio static sound loop. This effect, coupled with the extremely limited visibility in the game, causes the player to search frantically for the source of the static whenever he hears it. This is an excellent tactic for creating anxiety in the player; the player knows that a dangerous situation is nearby, but its location and nature are unknown.

Randomly timed sound effects, such as the environmental ambience are present in *Alone in the Dark* and *Silent Hill 2*. The Level designers in these instances simply set a sound such as crackling fire, whistling wind, or shaking earth to play at a random interval so that the player hears it throughout the level. This helps to immerse the player in the game and sell the idea that their atmosphere is dangerous and filled with peril beyond their control, thus increasing player anxiety.

Timing sound effects to coincide with dangerous situations can greatly enhance fear. Alternatively, Level designers can also teach the player to feel anxiety when specific sound effect is played, as with *Silent Hill 2.* The use of randomly timed ambient sound effects however, can increase anxiety in the player by immersing the player in a dangerous environment. It is also important to note that teaching a player to expect a dangerous situation after a certain sound effect can teach the player to feel anxiety whenever that sound is played, thus making timed sounds useful for creating anxiety.

Use of timing with Dialogue

As with all sounds, the Level designer chooses when to play dialogue within their level. Since dialogue typically carries important information, the Level designer usually sets it to play at a predetermined time. A few notable exceptions exist, such as when the player hears a line of dialogue set to loop for the purpose of ambience.

The timing of dialogue can help to cause anxiety, especially when used in conjunction with other sound effects. For example a squad mate in *Dead Space* says “Did you hear that!?” when an ambient

monster sound is played. This draws extra attention to the ambient sound, enhancing the anxiety it causes in the player.

Level designers can use well timed dialogue to coincide with other sounds in their level to enhance the emotions felt from those other sounds. Level designers may also use dialogue as an ambient sound to enhance anxiety and sell the atmosphere to the player.

In summary, the timing of sounds can enhance both fear and anxiety in a player. Using a sound to coincide with a clear danger may enhance the fear a player feels, while using a sound to loop and create ambience can immerse the player in the dangerous atmosphere and cause anxiety. Both cases may be easily implemented by Level designers. Sound effects are especially useful in the aforementioned case.

Source

Some sounds play from a source, such as a radio, or a sparking wire. Other sounds play with no apparent source, such as music, or a muffled scream whose origin the player cannot pinpoint. The presence or absence of source is an important factor in the psychology of sound.

Use of source with Stingers/Music

Stingers and music rarely ever have a source in video games.

Use of source with Sound Effects

When designing sound effects, a Level designer must decide if the player hears that sound from a visible source, or if the player simply hears the sound with no visible source.

With the notable exception of *Silent Hill 2,* almost all games have clearly visible sources for their sound effects. Ventilation shafts leaking from *Alone in the Dark*, sparking electrical wires from *Dead Space*, and rustling leaves in *Eternal Darkness* are all visible to the player when their sound effects play. This technique helps to immerse the player, but does not appear to add to fear or anxiety.

Most ambient noise in *Silent Hill 2* has no visible source. There are such things as babies crying, discordant wind chimes clanging together, and tricycle bells ringing, but the player cannot find the source of any of those in the game. This adds a strong air of mystery, which can cause anxiety.

Because fear is a reaction to a known and defined entity, having a sourced sound is more apt to cause fear in a player. Conversely, anxiety is a reaction to an unknown and undefined outcome, so having an unsourced sound is more likely to cause anxiety in a player.

Use of source with Dialogue

As with other sounds, the Level designer can decide whether or not dialogue comes from a clearly defined source. Both methods have been used in creating fear and anxiety.

At certain times in *Alone in the Dark*, the player has a companion that fights alongside him. He can hear his companion scream for help during combat, giving the player a sense of urgency to kill the monsters as quickly as possible. This also creates a feeling of anxiety since the player does not know whether his companion will live or die. Other times, the player can hear supporting characters' echoing screams through the walls, adding to the scary atmosphere and selling the threat of danger to the player's avatar. In both cases, they communicate danger clearly to the player.

During a section in *Doom 3* when the player walks his avatar through a hallway, a disembodied voice on the announcement system laughs maniacally, seemingly directed at the player's avatar. *Doom 3* repeats this technique many times throughout the game, using the announcement system to repeatedly taunt the player's avatar from an unknown location. This technique serves to create a strong feeling of anxiety.

The use of source with dialogue is used for creating anxiety in these cases. Since fear is a direct response to a clear threat, Level designers may have a hard time evoking fear using dialogue.

In summary, source and its role in creating anxiety and fear through sound design has been clear. If a Level designer wants to evoke fear, he should use a sourced sound because fear is a response to a clear and present threat. If the Level designer wants to evoke anxiety, an unsourced sound is the better

option because anxiety is a response to an unknown. Overall, both methods have been effective at evoking their respective emotion.

Conclusion

This field review suggests that the three sound design principles can be best used in the following manner for sound effects:

Hypothesis for Causing Fear

Volume	Timing	Source
High-Volume	Timed	Sourced

This study experiments with the different attributes of sound effects to find which ones are the most successful at causing fear and anxiety in the player. In relation to sound effects fear, high volume is associated with a sudden jolt and noise which, research suggests, humans innately fear. Since fear is the result of a specific stimulus, research suggests that a well timed sound effect with a specific source to coincide with that stimulus would be the most effective at creating fear.

Hypothesis for Causing Anxiety

Volume	Timing	Source
Low-Volume	Untimed	Unsourced

In relation to anxiety, medium to low volume sound effects tend to be processed as background noise. This helps to sell a nonspecific feeling of a dangerous atmosphere to the player, which is conducive to anxiety. The timing of sound effects can be either timed or untimed. If a Level designer teaches the player that a certain sound effect can foreshadow danger, this can increase anxiety. Alternatively, the sound effect can be randomly timed to add a greater sense of immersion in a dangerous atmosphere. Finally, because anxiety is triggered by a nonspecific threat, research suggests that having a sourced sound would not be as effective as having a non-sourced sound.

Referring to human emotion theory and a theory of sound design in Survival-Horror games, one has a basis of understanding for the following experiment. Using the sound design and psychology principles learned in this field review, one can create a sound methodology that tests three sound design principles (volume, timing, and source), with the use of sound effects to find how a Level designer can use each to evoke fear and anxiety in the player.

Chapter 3: Methodology

This study provides developers an idea of what combinations of volume, timing, and sources create fear and anxiety in the player. This study also helps others to more easily research advanced topics on sound design so that it can become a better-documented aspect of level design. The following project tests different sound design techniques in relation to player fear and anxiety.

This project explored the use of volume, timing, and source sound to create fear and anxiety in a player. Based on the data the field review, the hypothesis is as follows: high volume sound effects with predetermined timing and a clear source are the most effective at creating fear, and low volume sound effects with a random timing and undefined source are more effective at creating anxiety.

This study tested the hypothesis using a Survival-Horror style level in *Gears of War*, created in the Unreal Editor 3. The level contained a set selection of sound effects placed throughout the level in order to test each defined property of sound design.

This project measured player anxiety and fear reaction to each sound effect. To do this, each subject was given a clear definition as per the field review of the difference between fear and anxiety. Eeach subject's play-through was recorded using FRAPS, a computer video recording program. During the test subject's play-through, his physical reactions to each sound were observed and written down for qualitative analysis. After the player finished the level, the player saw his recorded play session as he answered a series of questions pertaining to his emotional response to each sound effect for quantitative analysis.

The Product

The final product of this project was a Survival-Horror style *Gears of War* level which contained three tests to gauge the effectiveness of customized sound effects with different properties. Each test gauged the effectiveness of a specific property of sound: volume, timing, or source. During each play-through, each test randomly played one of three possible alternative sound effects to ensure that the data collected was not due to the quality of a specific sound effect.

During each tester's play-through, he heard one alternative from the volume test, one alternative from timing test, and one alternative from source test. As shown in the chart below, the player could have heard the wolf howl from the volume test, the lightning from the timing test, and the footsteps from the source test. In this example case, the player heard the wolf howl at high-volume, medium-volume, and low volume; he heard the lightning at timed and untimed intervals; and he heard the footsteps with a source and without a source.

	Volume Test
Tests High-Volume, Medium-Volume, and Low-Volume	
Alternative 1	Wolf Howl
Alternative 2	Gunfire
Alternative 3	Wretch Growl
	Timing Test
Tests Timed and Untimed	
Alternative 1	Lightning
Alternative 2	Boomer Growl
Alternative 3	Creaking Door
	Source Test
Tests Sourced and Unsourced	
Alternative 1	Locust Growl
Alternative 2	Glass Shattering
Alternative 3	Footsteps

Figure 2: Sound Requirements Illustrated

Volume Test

Volume Test	
Tests High-Volume, Medium-Volume, and Low-Volume	
Alternative 1	Wolf Howl
Alternative 2	Gunfire
Alternative 3	Wretch Growl

Figure 3: Volume Test Sound Effects

Wolf Howl

This is an ambient atmospheric sound of a generic wolf howl. The high, medium, and low-volume versions of this sound all play at low-action points of the level. The sound effect is untimed and unsourced.

Gunfire

This is an ambient atmospheric sound of an assault rifle firing. The high, medium, and low-volume versions of this sound all play at low-action points of the level. The sound effect is untimed and unsourced.

Wretch Growl

This is a gameplay sound of an in-game enemy called the wretch. The high, medium, and low-volume versions of this sound all play right before a wretch ambushes the player. The sound effect is timed and sourced.

Timing Test

	Timing Test
Tests Timed and Untimed	
Alternative 1	Lightning
Alternative 2	Boomer Growl
Alternative 3	Creaking Door

Figure 4: Timing Test Sound Effects

Lightning

This is an ambient atmospheric sound of a lightning strike. The timed version plays just as a wretch ambushes the player. The untimed version plays at a random point in a hallway. The sound effect is medium-volume and unsourced.

Boomer Growl

This is a gameplay sound that signals an imminent boomer ambush. The timed version plays just as the player sees a rocket explosion from the boomer's gun. The untimed version plays at a random point as the player is descending a staircase. The sound effect is medium-volume and unsourced.

Creaking door

This is an ambient sound of a creaking door, accompanied with a visibly moving door. The timed version plays just as the player gets ambushed by a locust. The untimed version plays at a random point in a hallway. The sound effect is medium-volume and sourced.

Source Test

	Source Test
Tests Sourced and Unsourced	
Alternative 1	Locust Growl
Alternative 2	Glass Shattering
Alternative 3	Footsteps

Figure 5: Source Test Sound Effects

Locust Growl

This is a gameplay sound of an enemy called the locust. The sourced version plays just as a locust ambushes the player. The unsourced version plays with no enemies present. The sound effect is medium-volume and timed.

Glass Shattering

This is an ambient atmospheric sound of a pane of glass shattering. The sourced version plays just as a pane of glass shatters in front of the player. The unsourced version plays without a visible pane of glass shattering. The sound effect is medium-volume and timed.

Footsteps

This is an ambient atmospheric sound of footsteps moving across wooden floorboards. The sourced version plays along with dust particles falling from the ceiling, in sync with the footstep sounds. The unsourced version plays without dust particles falling. The sound effect is medium-volume and timed.

To ensure fair comparison, the project parameters require that only the volume, timing, or source of each sound change for each test. For example, all three wolf howls (one for each low, medium, and high-volume) are unsourced and untimed, but varying in volume. The project tested each property once with each test subject, (high-volume, medium-volume, low-volume, timed, untimed, sourced, and unsourced) which totaled to seven tested sounds per subject. The project used some custom sound effects using The Guildhall sound library, edited with the Audacity sound editing program and the UnrealEd3 Sound Editor.

SP-Ambushed

Gears of War Level Abstract

Revision Notes

02/03/09 - Initial version of document

Quick Summary

The focus of this level is to use a disturbing, scary, and tense atmosphere to scaring the player into thinking they are always in danger. The player starts at the front of the mansion and has to make his way to the bottom to rescue Dominic and escape. The level is mostly devoid of adversaries but throughout the level, numerous scripted sequences trick the player into thinking the mansion is crawling with danger at every turn. This is a single player level for Gears of War.

Gameplay Overview

General Game Flow

1. Begin at entrance of mansion
2. Move down hallway and kill first wretch
3. Continue down second hallway and kill locust to obtain assault rifle
4. Fight last wretch and obtain shotgun
5. Descend stairwell and rescue Dom
6. Boomer boss fight
7. Exit mansion

Major Elements

- Combat: Three wretches and a soldier surprise the player from different ambush points in the map. At the end of the level, the player, along with Dom, has to fight a boomer in a destructible library.
- Stealth: None.
- Puzzles: None
- Boss Battles: Boomer fight in a destructible library

Major Objectives

- Primary: Escape with Dom
- Secondary: Procure suitable weaponry
- Bonus: None
- Hidden: None

Technical Overview

Campaign/Act

- SP-Ambushed: An abandoned mansion holds danger at every turn
- Level Position in Campaign: This is a stand-alone level

Mission Location

- Setting- Indoors, Ruined Mansion
- Time- Nighttime
- Season- Fall
- Weather- Stormy

Mission Difficulty (1-10)

- Starting: 1/10
- Middle: 4/10
- Ending: 7/10

Mission Metrics

- Play Time: 6 minutes
- Physical Length: 4096uu
- Physical Area: 8192uu x 4096uu x 2048uu
- Max New Characters: 0
- Max Visual Themes: 2

Details

Theme/Mood

The visual aesthetics of this level draw heavily from the Adams House level in the original Gears of War. The lighting is much dimmer and means to scare the player into feeling alone in an unexplored and dangerous place. Many scripted sounds and physics effects keep the player on edge as they anticipate an ambush around every corner.

Major Characters/Vehicles

- Player –
    - Model: Marcus Fenix
    - Inventory: Revolver
    - Start Location: Mansion Entrance
    - Motives/Objectives: Survival and Escape

- Dominic Santiago –
    - Model: Dominic Santiago
    - Inventory: Lancer Assault Rifle, Shotgun, Grenades
    - Motives/Objectives: Assist the player when the Boomer ambushes them
    - Starting Location: Bottom floor of the mansion, in Area 2

Gameplay Mechanics

- Prerequisite Skills:
    - Taking cover
    - Shooting
    - Reloading
    - Roadie Run
    - Fighting Locust soldiers
    - Fighting Wretches
    - Fighting Boomers
- Skills Learned
    - Watching your back

Story

- Introduction: Upon waking up, you realize you are all alone, and unarmed. The explosion has blocked off the entrance, and the only way back home is to find a way out. Your immediate concern is to survive until you can find a weapon. Your overall mission is to rescue Dom, and find an alternate exit for extraction.
- In-Game:
    - Player starts wounded and down on one knee
    - Objective Indicator reads:
        - Rescue Dom
        - Escape the mansion
- Extro: None

Visual References

Terrain/Vegetation

Figure 6: Level Terrain Reference 1

Figure 7: Level Terrain Reference 2

Models/Architecture

Figure 8: Level Model and Architecture Reference 1

Figure 9: Level Model and Architecture Reference 2

Figure 10: Level Model and Architecture Reference 3

Figure 11: Level Model and Architecture Reference 4

Textures/Lighting

Figure 12: Level Texture and Lighting Reference 1

Figure 13: Level Texture and Lighting Reference 2

Figure 14: Level Texture and Lighting Reference 3

Figure 15: Level Texture and Lighting Reference 4

Characters/Vehicles

Figure 16: Marcus Fenix (Player)

Figure 17: Dominic Santiago

Rough Map

Figure 18: Level Key

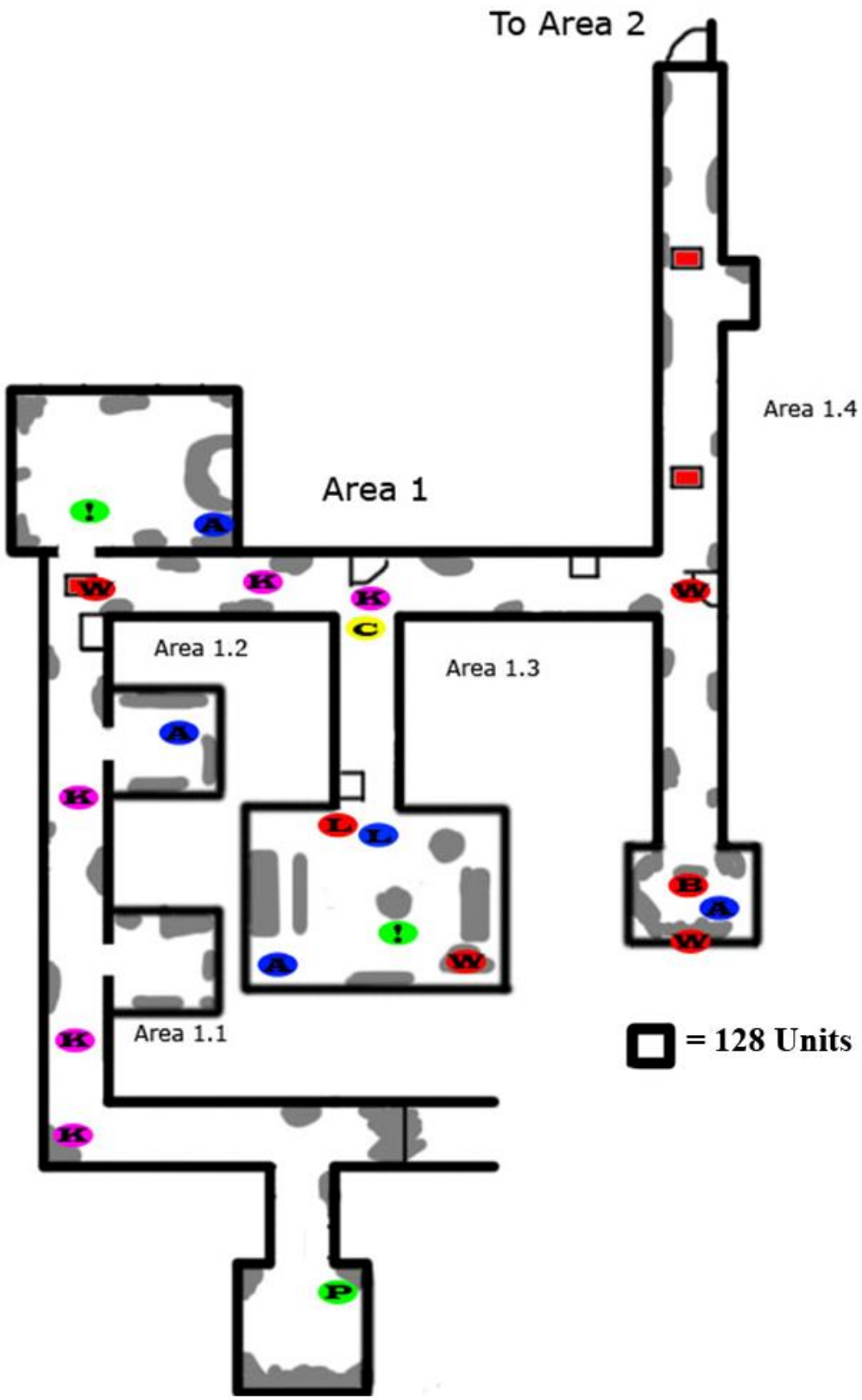

Figure 19: Ambushed- Area 1

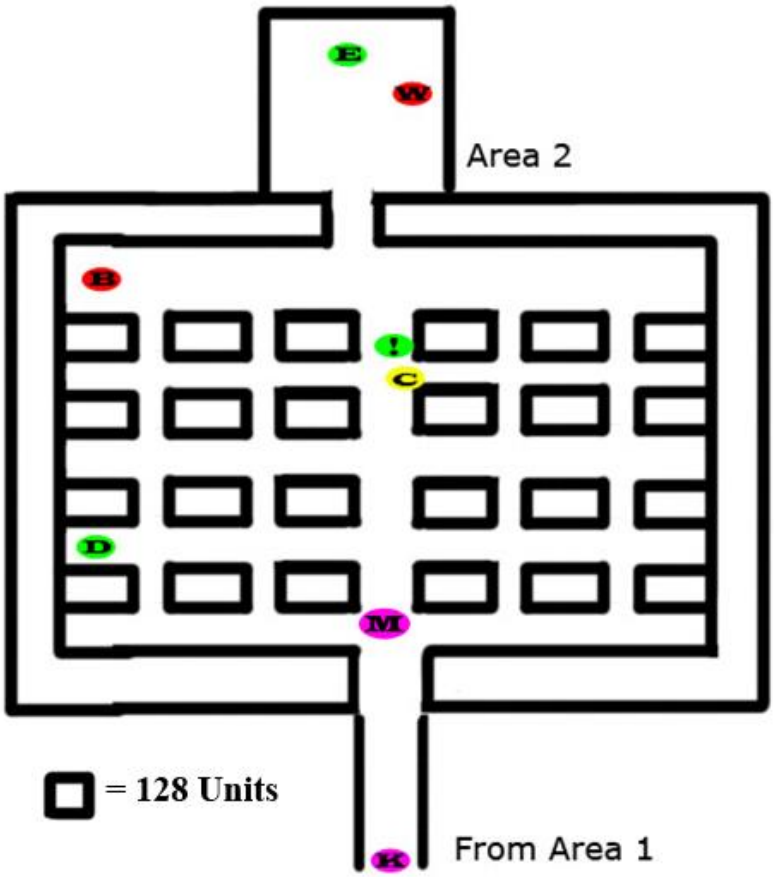

Figure 20: Ambushed- Area 2

Sound Placement

As stated in the product description, this level utilized different sound effects to test volume, timing, and source. As shown in the figure below, the level contained three tests; one for testing volume, one for timing, and one for source. During each play-through, the tester heard each test play one of three possible alternative sound effects at different points throughout the level. Refer to the product description for an in-depth analysis of each sound effect. The following maps indicate where the sound effects for each possible alternative played within the level.

	Volume Test
Tests High-Volume, Medium-Volume, and Low-Volume	
Alternative 1	Wolf Howl
Alternative 2	Gunfire
Alternative 3	Wretch Growl
	Timing Test
Tests Timed and Untimed	
Alternative 1	Lightning
Alternative 2	Boomer Growl
Alternative 3	Creaking Door
	Source Test
Tests Sourced and Unsourced	
Alternative 1	Locust Growl
Alternative 2	Glass Shattering
Alternative 3	Footsteps

Figure 21: Sound Requirements Illustrated

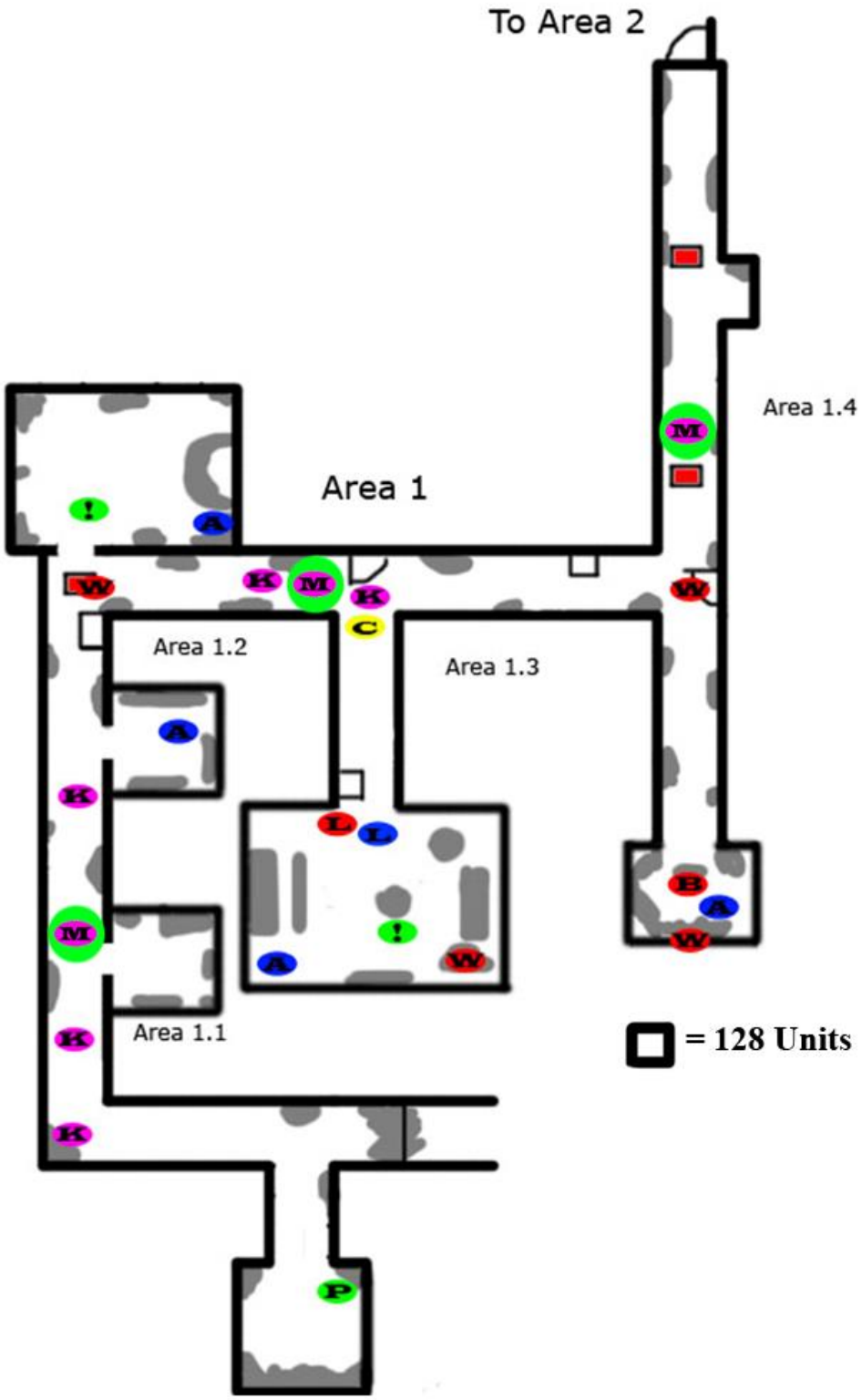

Figure 22: Volume Test, Alternative 1 (Wolf Howl)

Figure 23: Volume Test, Alternative 2 (Gunfire)

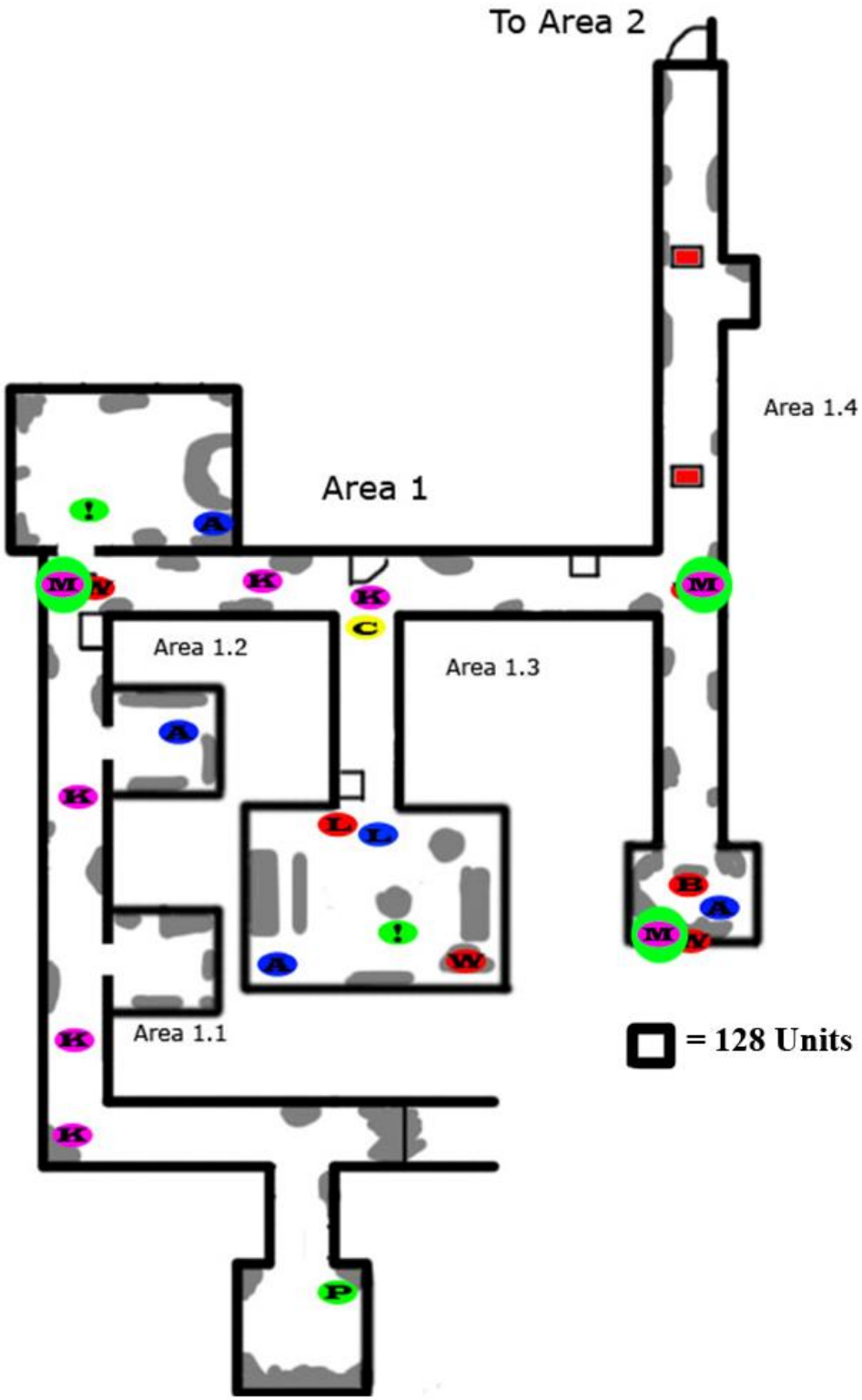

Figure 24: Volume Test, Alternative 3 (Wretch Growl)

Figure 25: Timing Test, Alternative 1 (Lightning)

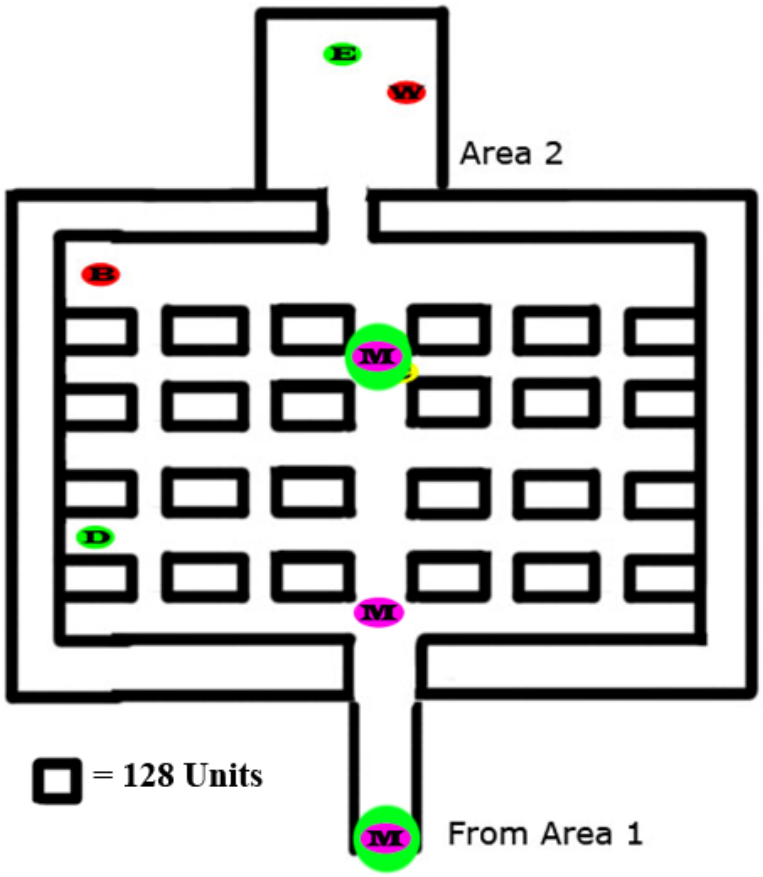

Figure 26: Timing Test, Alternative 2 (Boomer Growl)

Figure 27: Timing Test, Alternative 3 (Creaking Door)

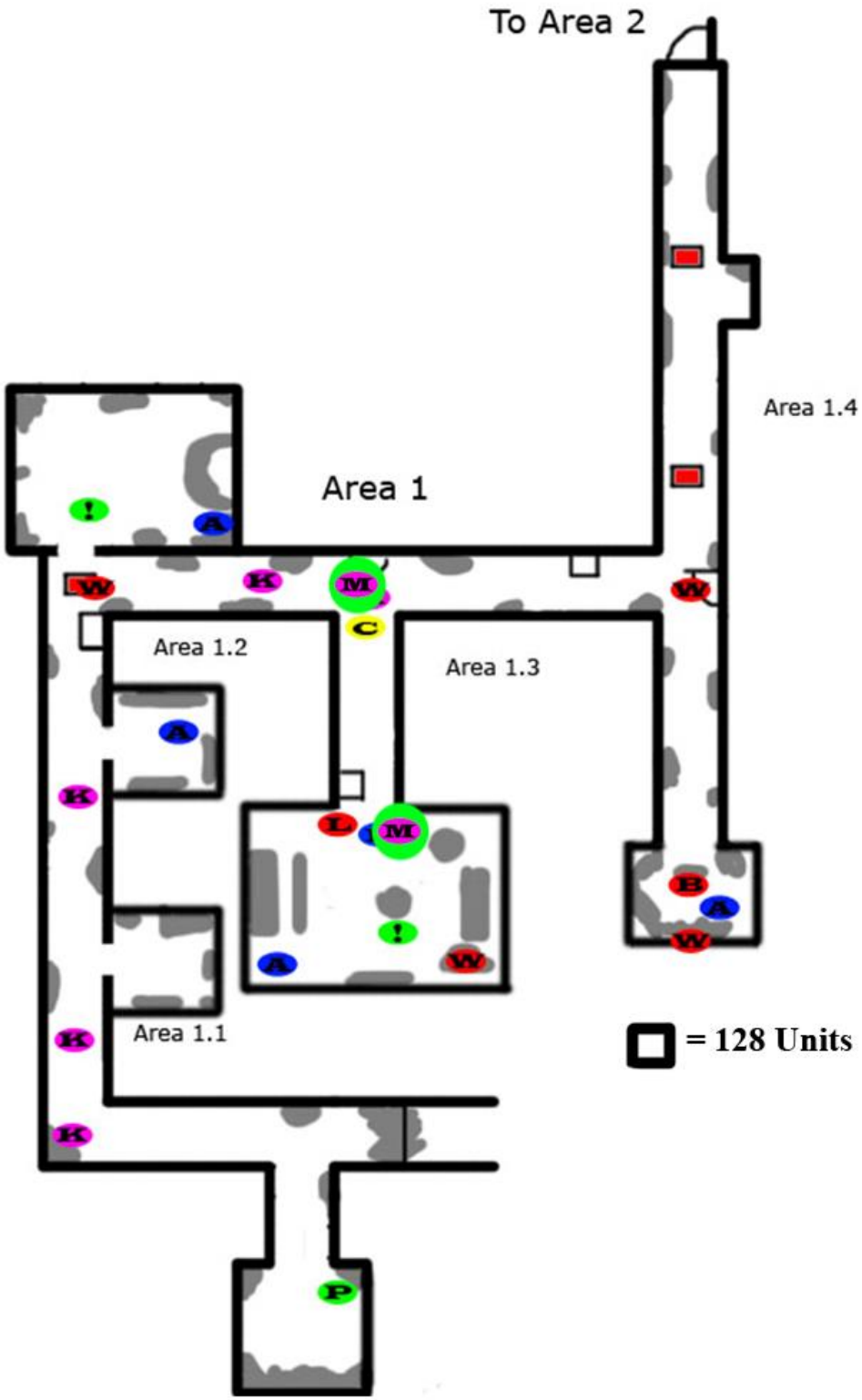

Figure 28: Source Test, Selection 1 (Locust Growl)

Figure 29: Source Test, Alternative 2 (Glass Shattering)

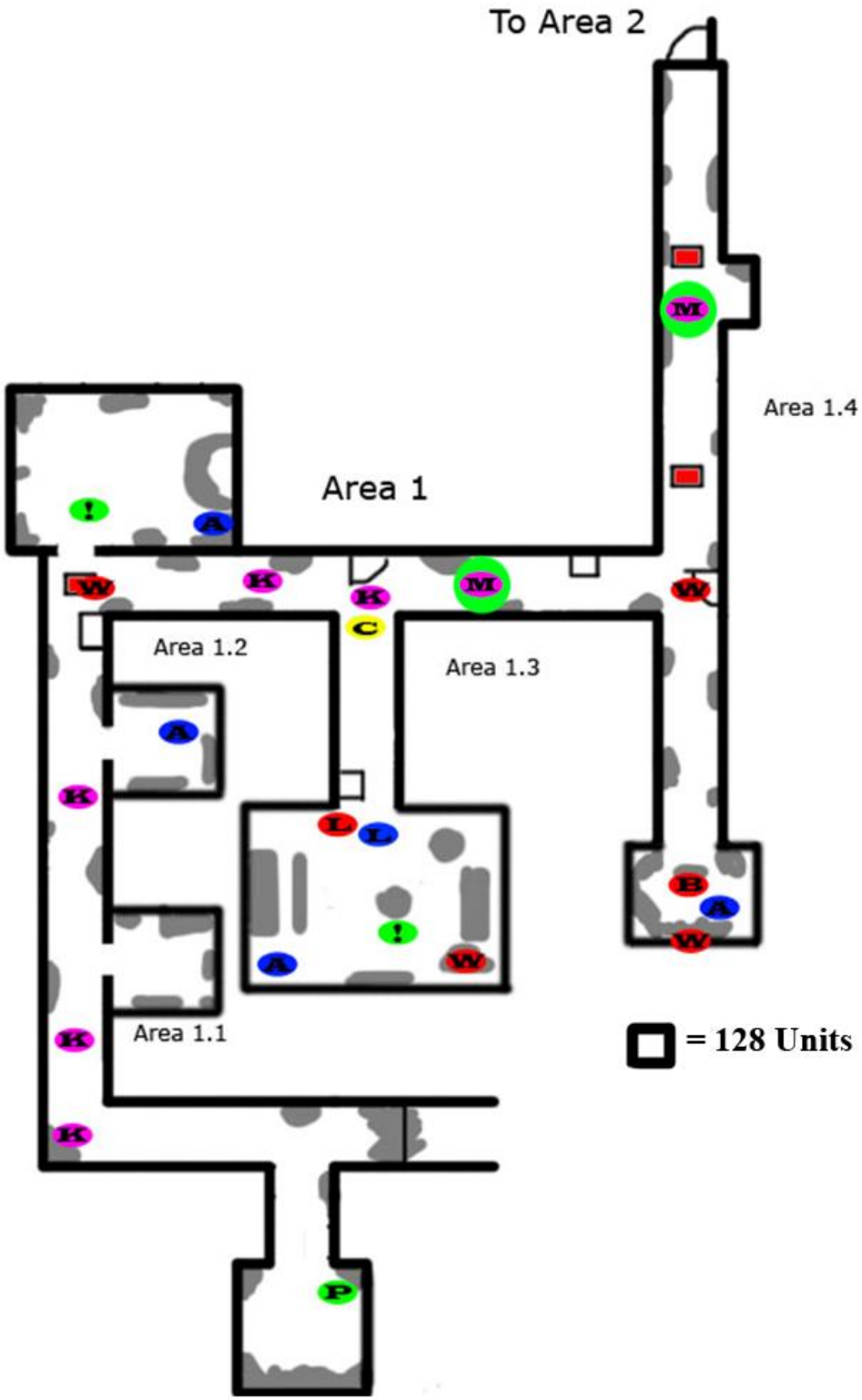

Figure 30: Source Test, Selection 3 (Footsteps)

Testing

Data Collection

In order to collect data for this study, 27 testers, all over the age of 18, were used to play Survival-Horror style level with three tests in it to test volume, timing, and source. The tester's play-through of the level was recorded using FRAPS, a computer video recording application. While the tester played through the level, his physical reactions were recorded for qualitative analysis. After the tester completed the level with no interruptions, the player watched their recorded play-through so that they may answer if they were fearful or anxious from each sound effect and if so, how intense that emotion was. The tester then answers if they felt any other emotions at that point in the level.

During a testing session, the tester was given a standard SMU consent sheet to sign. Then the tester was given a printed definition of fear and anxiety. They then played through the level with no interruptions. During this time, the tester's physical reactions to each sound were recorded. At the end of the play through, the player was asked what they felt from each sound effect and why. A data collection sheet measured the testers' reactions both qualitatively and quantitatively. The data collection sheet also measured demographics such as gender, age, how often the subject plays video games, and his or her favorite types of video games. Testing was conducted at the SMU Guildhall. Testers were chosen from the pool of students at the SMU Guildhall.

Figure 31: Sample Data Collection Sheet

Demographics

Tester #_____

Gender: Male Female

Age: _____

How many hours on average do you play video games per week?

1-3 4-6 7-10 10-15 15-25 25+

What is your favorite game genre (if any)?

Survival-Horror	First/Third Person Shooter	Musical	Role-Playing
Puzzle	Strategy	Platformers	Simulation

Test Data

Sound effect 1:

How intense was your fear level at this point in the game?

(Lowest) 1 2 3 4 5 6 7 (Highest)

How intense was your anxiety level at this point in the game?

(Lowest) 1 2 3 4 5 6 7 (Highest)

Sound effect 2:

How intense was your fear level at this point in the game?

(Lowest) 1 2 3 4 5 6 7 (Highest)

How intense was your anxiety level at this point in the game?

(Lowest) 1 2 3 4 5 6 7 (Highest)

Sound effect 3:

How intense was your fear level at this point in the game?

(Lowest) 1 2 3 4 5 6 7 (Highest)

How intense was your anxiety level at this point in the game?

(Lowest) 1 2 3 4 5 6 7 (Highest)

Sound effect 4:

How intense was your fear level at this point in the game?

(Lowest) 1 2 3 4 5 6 7 (Highest)

How intense was your anxiety level at this point in the game?

(Lowest) 1 2 3 4 5 6 7 (Highest)

Sound effect 5:

How intense was your fear level at this point in the game?

(Lowest) 1 2 3 4 5 6 7 (Highest)

How intense was your anxiety level at this point in the game?

(Lowest) 1 2 3 4 5 6 7 (Highest)

Sound effect 6:

How intense was your fear level at this point in the game?

(Lowest) 1 2 3 4 5 6 7 (Highest)

How intense was your anxiety level at this point in the game?

(Lowest) 1 2 3 4 5 6 7 (Highest)

Sound effect 7:

How intense was your fear level at this point in the game?

(Lowest) 1 2 3 4 5 6 7 (Highest)

How intense was your anxiety level at this point in the game?

(Lowest) 1 2 3 4 5 6 7 (Highest)

Data Analysis

This study analyzed the data using quantitative and qualitative analysis and comparison of mean Likert Scale (1-7) values of fear and anxiety evoked from each sound effect. The study compared the effectiveness of variations in each property of sound and how effective each variation was at creating the desired emotion (fear or anxiety). Example data sheets for quantitative analysis are shown below.

Tester 1	Volume Test			Timing Test		Source Test	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	6	7	2	1	6	2	1

Tester 2	Volume Test			Timing Test		Source Test	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	2	3	4	2	1	4	3

Tester 3	Volume Test			Timing Test		Source Test	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	4	5	3	4	7	1	2

	Results for Volume			Results for Timing		Results for Source	
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Fear Average	4	5	3	2.5	4.5	2.5	2

Figure 32: Example Data Tabulation Sheet for Fear

	Results for Volume			Results for Timing		Results for Source	
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Fear Average	4	5	3	2.5	4.5	2.5	2
Tester 1	Volume Test			Timing Test		Source Test	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Anxious? 1-7	4	7	1	1	6	4	1
Tester 2	Volume Test			Timing Test		Source Test	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Anxious? 1-7	1	3	2	7	1	4	2
Tester 3	Volume Test			Timing Test		Source Test	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Anxious? 1-7	1	7	4	1	2	3	5
	Results for Volume			Results for Timing		Results for Source	
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Anxiety Average	2	5.5	2.5	3	3	3.5	2.5

Figure 33: Example Data Tabulation Sheet for Anxiety

This study then quantitatively determined how these three basic properties of sound can be used to create fear and anxiety in the player by comparing the differences of means between each test subject. For example, if the mean intensity of fear during a timed sound effect between all test subjects is 6, and the mean during an untimed sound effect is 4, then timed sound effects can be considered to be more effective at causing fear than untimed sound effects.

Qualitative analysis was used as well by asking the player what they felt at each sound effect, and recording their physical reactions to each sound. Physical reactions and player responses to each sound were then cross referenced between responses and reactions from the same sound for accuracy and consistency. Inconsistencies were noted. Using this method to supplement quantitative analysis, this study can more accurately determine which sounds are effective at creating fear and anxiety.

Chapter 4: Results and Analysis

The procedures outlined in the methodology section were used to study the fear and anxiety responses of 27 testers playing a Survival-Horror level. Using this data, this project can suggest conclusions on how to design sound effects for maximal fear and anxiety responses in players.

This project collected both Likert-scale values of fear and anxiety responses in players while listening to specifically designed sound effects as well as verbal and physical player responses to those sounds. This study collected data via an administered standard survey, verbal interviews, and physical observation of the player as they played. Overall, the project collected both quantitative and qualitative data pertaining to the effectiveness of different sound design techniques in causing fear and anxiety in players. The data analysis that follows is a commentary of the effectiveness of the testing process itself and a reflection on the data collected.

Analysis of Research Methods

The overall goal of the research methods in this test was to gauge how fearful or anxious a sound effect caused a player to become. Using both the quantitative and qualitative methods in conjunction with each other, this study determined the likely cause and intensity of fear and anxiety at each point throughout the level. The pilot testing period refined and honed the research methods to provide an effective method for testing.

Pilot Testing

Ensuring that the research methods were effective in extracting data from this test required an analysis of these methods. Pilot studies were performed on the faculty and students at SMU Guildhall. The purpose of these pilot studies was to determine what, if any changes were required for the level and data gathering methodology. Pilot testing showed that the sound effects were too close to each other.

The pilot testing period resolved this issue by moving the sound effects so that they may be heard clearly and without possible mix-up with other sounds. Once all possible combinations of sound effects were sufficiently far enough away from each other, the level received no further modifications.

In addition to showing that revising sound effect placement allowed for more accurate testing, pilot tests showed that giving the testers a written definition of fear and anxiety taken from the "Fear, Anxiety, and Human Emotion Theory" section of the Field Review ensured that they answered the questions more consistently with the definitions. After pilot testers were given the written definitions of fear and anxiety, they did not appear to have difficulty differentiating between the two emotions.

No changes to the questionnaire were necessary during the preliminary pilot tests. The questionnaire proved to be a proficient tool for gathering quantitative Likert-scale data during the pilot testing.

Once testers had no difficulty with the sound point placement and answering questions based on the definitions, the test methods were considered valid and pilot testing was ended.

Quantitative Data Collection

To obtain quantitative data, the test subjects filled out a survey detailing the intensity of their fear and anxiety when they heard each sound effect. While filling out the survey, subjects watched their recorded play-through of the level so they could better recall what they felt while playing. This method allowed subjects to observe themselves at the specific point that the test required data on and allowed them to reflect on what they were feeling. They then marked a number between one and seven on a Likert-scale signifying the intensity of their fear or anxiety at that point (Higher numbers signifying more intense fear or anxiety.) Allowing them to observe their play-through ensured that they did not have to attempt to recall what happened from memory. This method allowed the test subjects to quickly provide a large amount of quantitative data which can be found in Appendix A.

Qualitative Data Collection

To obtain qualitative data, the testers' physical responses for each sound effect were recorded, and they were asked what they felt at each sound point and why. If the testers responded physically at any sound effect, the response was recorded and described in the tester's qualitative data.

The interview portion of the test was conducted as the player was filling out the survey. While the tester filled out the intensity of their fear and anxiety for each sound effect, they were questioned about what made them feel that fear or anxiety and why. All responses pertaining to fear and anxiety were recorded in the tester's qualitative data in Appendix B.

Conclusion

This study was meant to accurately gauge how fearful or anxious a sound effect caused a player to become. Using quantitative data collection methods, the test constructed allowed for a basic understanding of the tested sound design techniques on fear and anxiety. Using qualitative methods in conjunction with the quantitative data, this study determined the specific causes of fear and anxiety that existed within the test.

Demographics

Participants of this study submitted their personal information to help determine whether any demographical factors contributed to their fear or anxiety responses. The demographics collected were age, gender, game preference, and hours of games played per week. The following is an analysis of the demographic data in relation to fear and anxiety responses.

Age

The testers' ages were recorded to determine if older or younger subjects were more susceptible to fear and anxiety. Testers' ages ranged from 22-40, with 75% of them between ages 22-30. Each of the testers' ages can be found in Appendix A.

Gender

The testers' genders were recorded to determine if it would have an affect on how fearful or anxious subjects became. The vast majority (90%) of testers were male, with only three females as shown in Appendix A.

Hours Played Per Week

Testers were asked how many hours per week of video games they played to determine whether a tester's experience with video games would affect their fear and anxiety responses. The testers all played a varying amount of hours per week of video games. There existed a wide distribution of hours per week ranging from testers who only played 1-3 hours per week, to testers who played 25+ hours per week as shown in Appendix A. The average number of hours played by testers per week was approximately 12.5.

Video Game Preference

Testers were asked if they preferred Survival-Horror games over other types of games to see if game preference would have an effect on fear and anxiety responses in a Survival Horror level. 40% of test subjects preferred Survival-Horror games, while 60% did not, as shown in Appendix A.

Demographical Data Analysis

This test determined whether the different demographics had any relationship with one another. Possible correlations between age, hours of video games per week, and video game preference were

analyzed, but the correlations were less than 10%. This meant that each of the demographics showed less than a 10% relationship with each other, which suggests that age, hours of games per week, and game preference are mostly independent of each other.

As shown in Figure 31, all testable demographical data had negligible (less than 0.1) correlations with other demographical factors. This means that any correlations found between demographical factors and emotional responses are not confounded by being correlated to another demographical factor. This allows the relationship between emotional responses and demographics to be analyzed without accounting for other demographical factors at the same time.

	Demographical Data Correlations		
Correlations	Age	Hours of Games per Day*	Likes Survival Horror?**
Age	1.00	0.04	0.09
Hours of Games Per Day	0.04	1.00	0.06
Likes Survival Horror	0.09	0.06	1.00

Figure 34: Demographical Data Correlations

Results

With the variations in data from the demographics explained, the overall results can be reviewed without accounting for multiple demographics at the same time. Results from the testing showed noticeable patterns in fear and anxiety responses across volume, timing, and source tests.

Fear

The testers' levels of fear at each "sound point" were recorded using the aforementioned process in the "Question Analysis" section. The following section discusses the results separately based on the quantitative and qualitative data in the following section.

Quantitative Results

The quantitative data pertaining to fear showed consistent patterns, as shown in Figure 35. A more detailed quantitative data compilation can be found in Appendix A.

	Fear Responses						
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Mean	2.8	2.3	2.0	3.8	2.2	3.1	2.7
Std Deviation	1.5	1.5	1.1	1.8	1.3	1.8	1.8

Figure 35: Means and Standard Deviations of Fear Responses

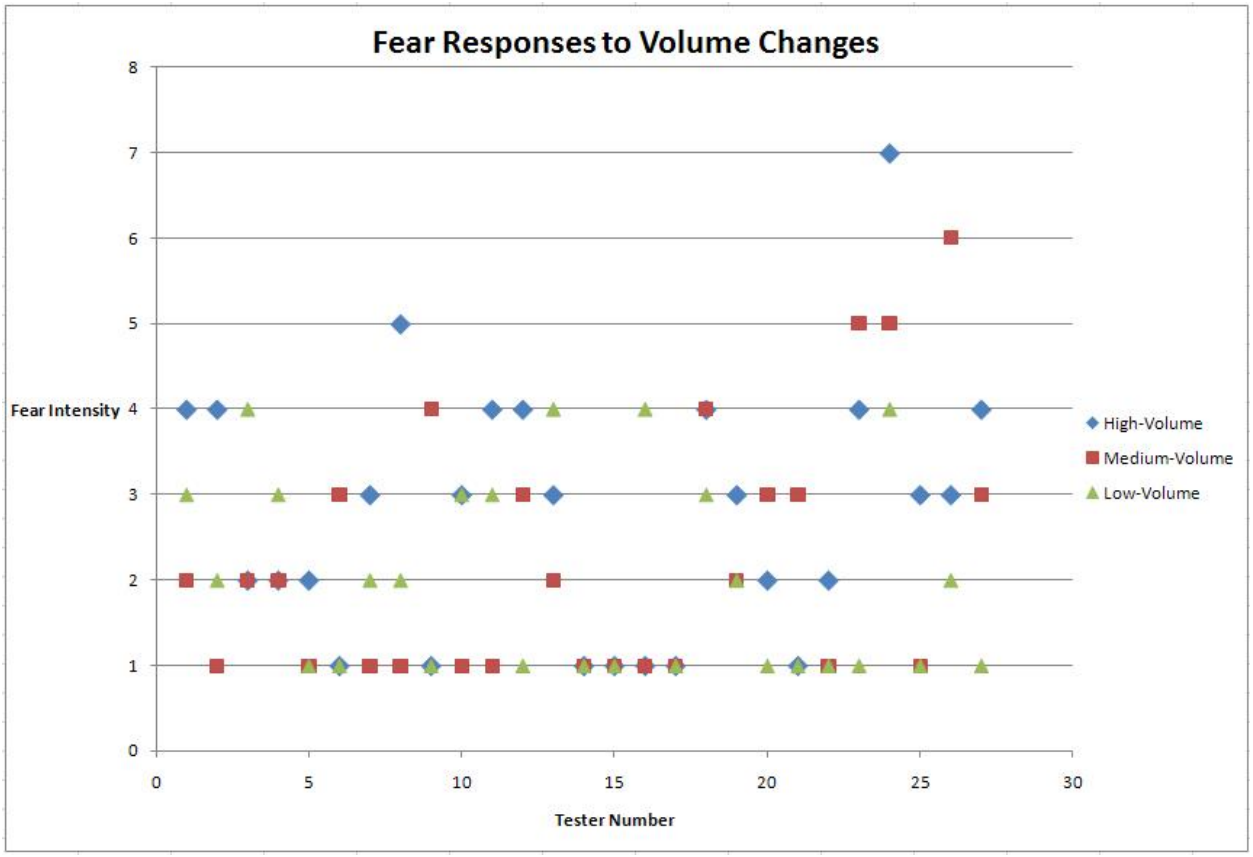

Figure 36: Scatter Diagram- Fear Response to Volume Changes

For volume, data showed a steady increase in fear response the louder the testers heard a sound effect. Low-volume sound effects had a mean of 2.0 on the Likert-scale, medium-volume effects had a mean of 2.3, and high-volume effects had a mean of 2.8.

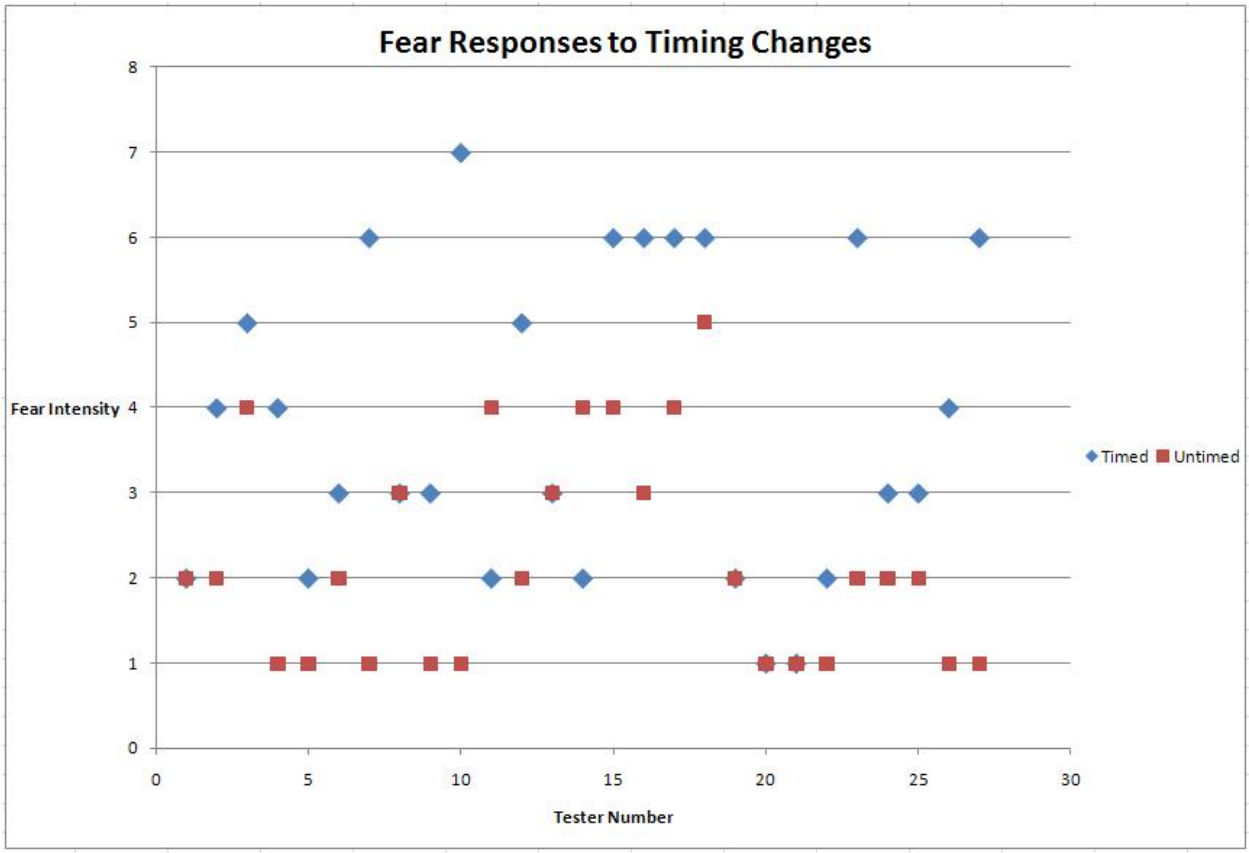

Figure 37: Scatter Diagram- Fear Response to Timing Changes

For timing, data showed an extremely high increase in fear response with timed sound effects compared to untimed sound effects. Timed sound effects showed a mean of 3.8 on the Likert-scale, while untimed sound effects showed a mean of 2.2.

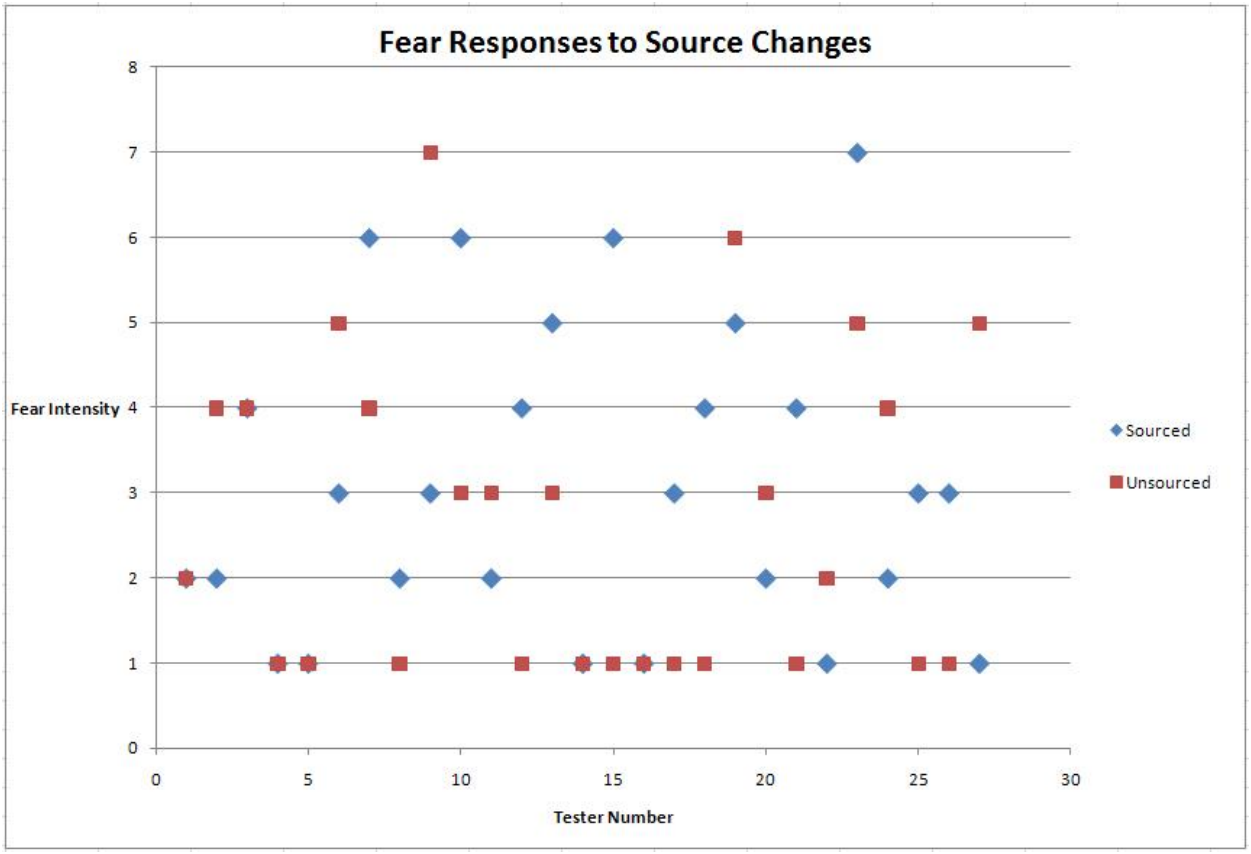

Figure 38: Scatter Diagram- Fear Response to Source Changes

For source, data showed a slight increase in fear response with sourced sound effects compared with sourced unsound effects. Sourced sound effects are at a mean of 3.1 on the Likert-scale while unsourced sound effects have a mean of 2.7.

As shown in Figure 39, age played a small part in affecting fear response. The correlations between fear response and age were all positive. Correlations between sound effects played at different volumes were within the 0.2 range. While this was a weak correlation, it was consistent and worthy of note. The correlation between the sound effects played with different timings ranged from 0.28 (Timed sound effects) to 0.07 (Untimed sound effects). The 0.28 correlation with timed sounds was a weak correlation, but it showed that older players reacted more fearfully to timed sound effects than they did to untimed sound effects. Finally, there existed a moderate (0.45) correlation to fear response due to sourced sound effects.

	Correlation of Age and Fear Response						
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Correlation	0.16	0.20	0.22	0.28	0.07	0.45	0.31

Figure 39: Correlation of Age and Fear Responses

According to Figure 40, the average amount of video games that testers played per week had a small, but consistent effect on their fear responses. The correlations between fear response and hours per week were all positive. The strongest correlation existed between hours played per week and fear response to timed sound effects (moderate correlation at 0.46). However, many negligible correlations existed pertaining to medium-volume (0.05), untimed (0.10), and unsourced sound effects (0.01). Fear response to high-volume, low-volume, and sourced sound effects had weak, but existing correlations with hours played per week, with correlations of 0.22, 0.27, and 0.29 respectively.

	Correlation of Average Hours Played Per Week and Fear Response						
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Correlation	0.22	0.05	0.27	0.46	0.10	0.29	0.01

Figure 40: Correlation of Average Hours Played Per Week and Fear Responses

As shown in Figure 41, a constant positive correlation between whether a tester preferred Survival Horror games and the intensity of his or her fear response did not exist. There were many varying correlations, both negative and positive, and all very weak. The negative correlations showed that if a tester preferred Survival Horror games, their fear response was weaker. Negative correlations existed with high-volume (-0.23), timed (-0.04), untimed (-0.15), and sourced sound effects (-0.05) in relation to game preference, while positive correlations existed with medium-volume (0.21), low-volume (0.20), and unsourced sound effects (0.07).

	Correlation of Game Preference and Fear Response						
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Correlation	-0.23	0.21	0.20	-0.04	-0.15	-0.05	0.07

Figure 41: Correlation of Game Preference and Fear Responses

Qualitative Results

Qualitative data collected supported the quantitative data results for timing and source. However, the test found no qualitative data for volume pertaining to fear. Qualitative data compilations for each tester can be found in Appendix A.

For timing, the data showed that testers reacted to timed sound effects with a higher fear response because the sound effect was accompanied by a gameplay element, such as the presence of an in-game enemy. For example, tester 17 claimed he was afraid of an enemy with a rocket launcher, but when he heard the signature "Boom!" that accompanied the enemy, he became much more afraid: "That sound the boomers make when they're around is pretty awesome. It added some fear to that room." Testers 3, 8, 10, 11, 13, 14, 15, 16, 17, 18, 21, 23, and 27 reported that the feeling of fear that came with the gameplay element was made greater by the accompanying sound effect, but the sound effect by itself did not cause fear.

For source, testers 1, 2, 9, 12, 15, 23, and 25 reported that the source of the sound effect, such as a breaking window or footsteps on the ceiling, caused them to respond with fear. However, testers 1 and 2 reported that the sound effect drew greater attention to the source of the sound and amplified their fear response. For example, tester 1 responded that if a sound did not accompany an enemy's gunshots firing down a hallway, he would not have noticed it and would therefore not have responded with fear.

Testers did not have any externally visible physical reactions to any of the sound effects.

Anxiety

The level of anxiety in testers at each sound point was recorded using the aforementioned process in the "Research Methods Analysis" section. The results were separated into quantitative and qualitative data.

Quantitative Results

The quantitative data pertaining to anxiety showed steady patterns in responses as shown in Figure 42, but required supplemental qualitative data to reach a valid conclusion.

	Anxiety Responses						
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Mean	3.4	3.6	2.8	4.2	4.0	4.0	3.7
Std Deviation	1.5	1.7	1.5	1.1	1.5	1.4	1.4

Figure 42: Means and Standard Deviations of Anxiety Responses

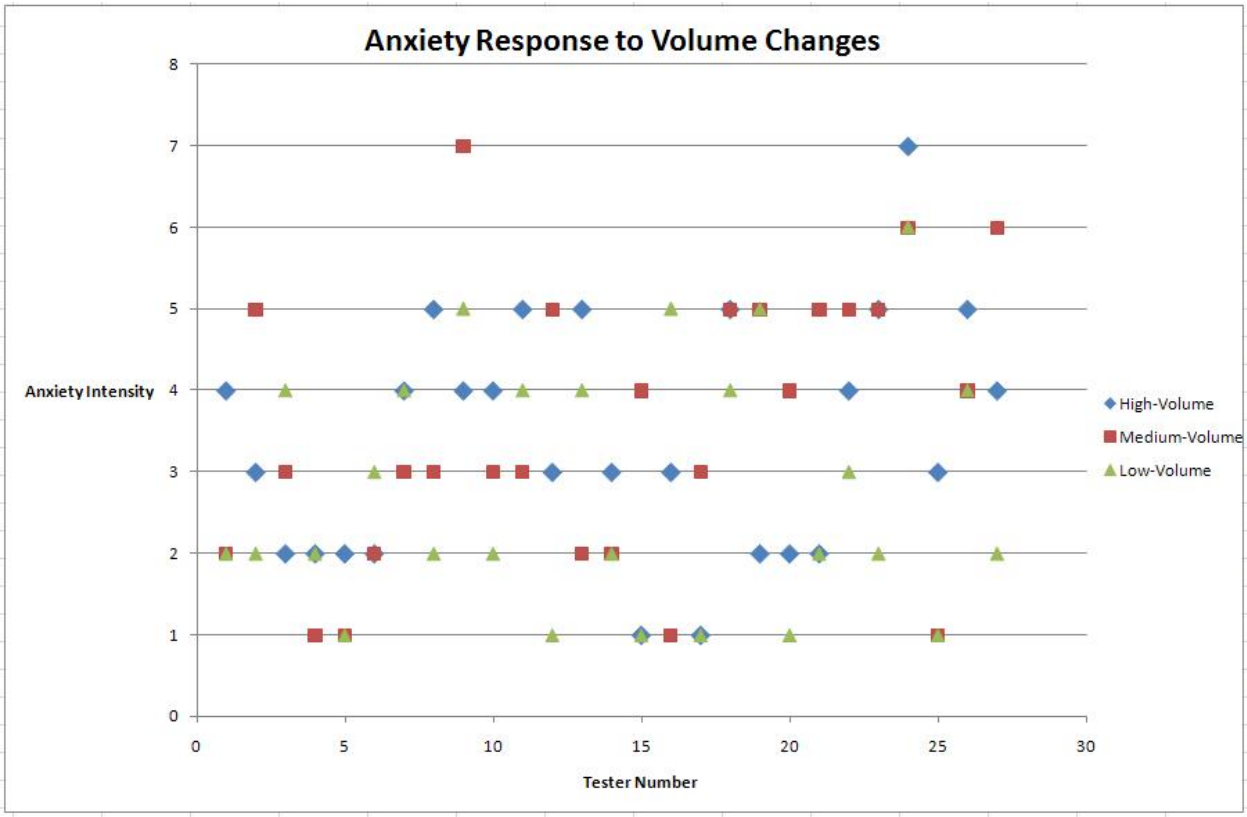

Figure 43: Scatter Diagram- Anxiety Response to Volume Changes

For volume, data showed a sharp increase in mean anxiety response between low-volume sound effects at 2.8 and medium-volume sound effects at 3.6. Data also showed an increase between low-volume sound effects at 2.8 and high-volume sound effects at 3.4. There existed an irregularity in the data between the anxiety responses of loud and medium sound effects. This irregularity showed mean anxiety response being lower on loud-volume sound effects and higher on medium-volume sound effects at 3.4 and 3.6 respectively. The variance in data was slight, less than 10%, and can therefore be

considered a negligible change in value. Thus, the effect of volume on anxiety increased from low to medium, but essentially stayed the same from medium to high.

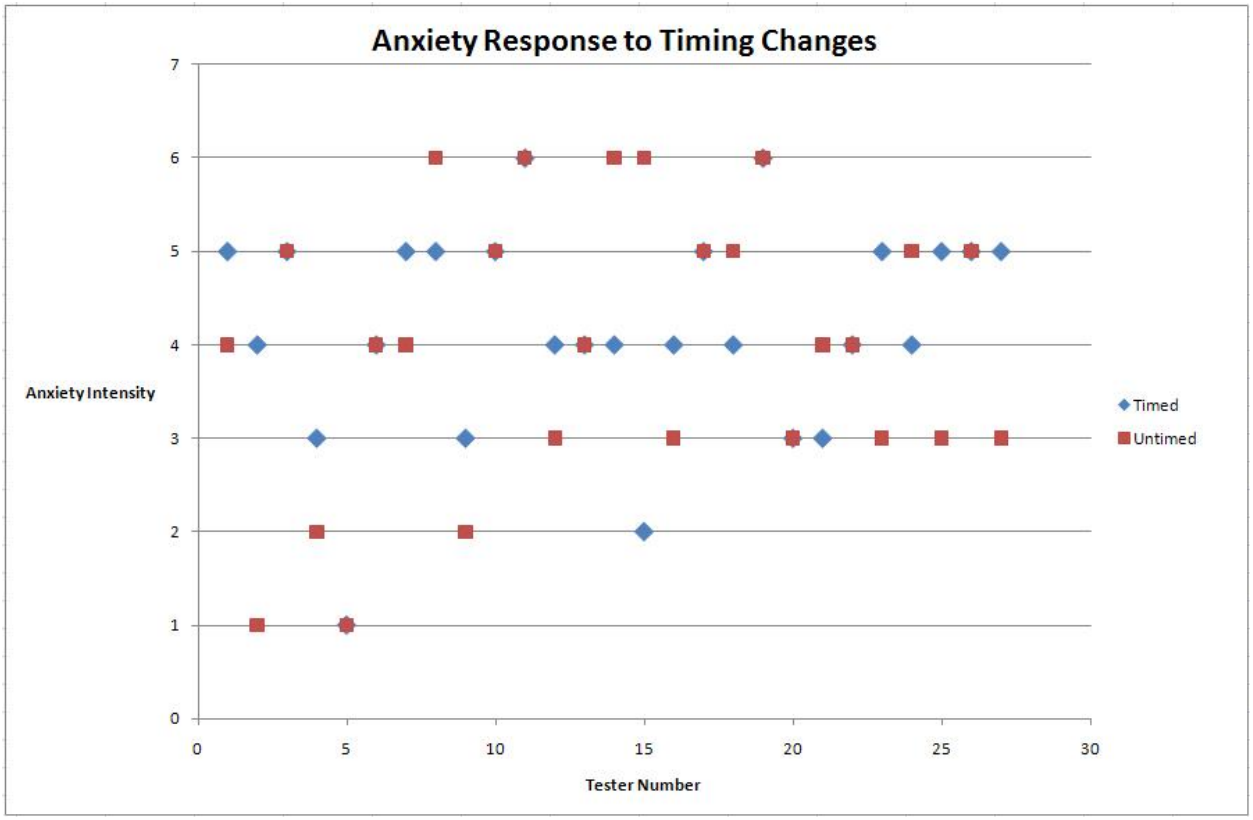

Figure 44: Scatter Diagram- Anxiety Response to Timing Changes

For timing, data showed a slight but negligible increase in anxiety response with timed sound effects compared to untimed sound effects. Timed sound effects had a mean anxiety value of 4.2 while untimed sound effects had a mean value of 4.0.

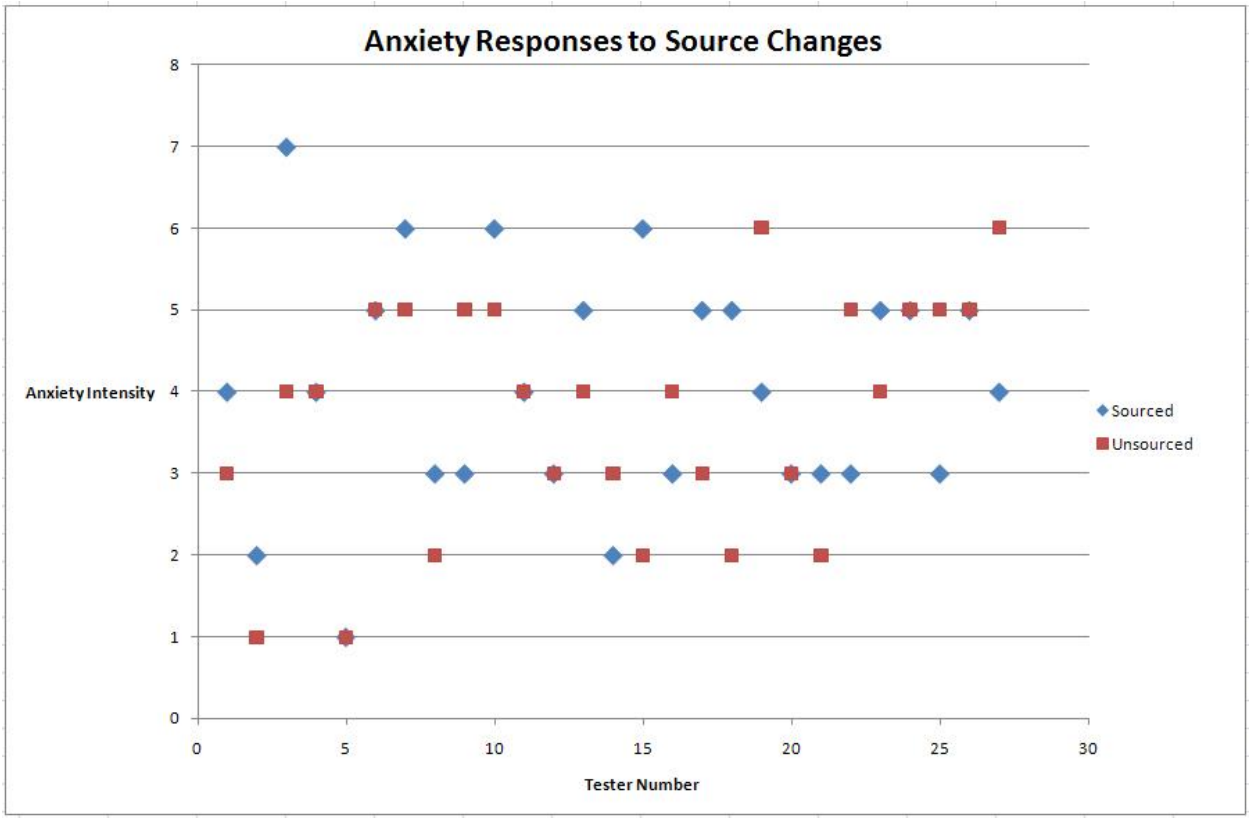

Figure 45: Scatter Diagram- Anxiety Response to Source Changes

For source, data also showed a slight but negligible increase in anxiety response with sourced sound effects compared to unsourced sound effects. Sourced sound effects showed a mean anxiety value of 4.0, while unsourced sound effects showed a mean value of 3.7.

As shown in Figure 46, a consistent positive correlation between age and the intensity of a testers' anxiety response did not exist, except for their response to volume. High-volume (0.07), medium-volume (0.18), and low-volume (0.04) correlations were all weak, but consistently positive. There were other varying correlations, both negative and positive, and all very weak. Anxiety response to timed (correlation of 0.14) and sourced (0.26) sound effects showed a slight positive correlation to age, and anxiety response to untimed (correlation of -0.07) and unsourced (-0.08) sound effects showed a negligible negative correlation. However, volume showed consistently positive correlations between anxiety response and age.

	Correlation of Age and Anxiety Response						
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Correlation	0.07	0.18	0.04	0.14	-0.07	0.26	-0.08

Figure 46: Correlation of Age and Anxiety Responses

As shown in Figure 47, a consistent positive correlation between how often a tester played video games and the intensity of his or her anxiety response existed, but most correlations were very slight. All correlations between anxiety responses and hours played per week were negligibly small (all equal to or under 0.1), except for the testers' anxiety response to sourced sound effects, which was moderately correlated at 0.45.

	Correlation of Average Hours Played Per Week and Anxiety Response						
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Correlation	0.04	0.02	0.10	0.02	0.04	0.45	0.07

Figure 47: Correlation of Average Hours Played Per Week and Anxiety Responses

As shown Figure 48, a consistent positive correlation between whether a tester preferred Survival Horror games and the intensity of a testers' anxiety response did not exist except with sourced sound effects. Sourced sound effects showed a 0.03 correlation, while unsourced sound effects showed a 0.15 correlation, both positive correlations. A moderate negative correlation exists with medium-volume sound effects and untimed sound effects, at -0.45 and -0.41 respectively. Negligible correlations existed between high-volume (-0.03), low-volume (0.13), and timed sound effects (-0.14).

	Correlation of Game Preference and Anxiety Response						
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Correlation	-0.03	-0.45	0.13	-0.14	-0.41	0.03	0.15

Figure 48: Correlation of Game Preference and Anxiety Responses

Qualitative Results

Qualitative data collected supported the quantitative data results for timing and source. However, the test found no qualitative data for volume pertaining to fear. Qualitative data compilations for each tester can be found in Appendix A.

For timing, the data showed that untimed sound effects consistently caught the player off guard and increased their anxiety. For example, tester #14 heard a randomly timed enemy attacking sound and reported that he began looking for an enemy and was unable to find it, which increased his anxiety: "I couldn't figure out where it was, I was freaked out." When questioned about how they felt when hearing untimed sound effects, testers 7, 11, 19 and 22 explained that they did not know the nature of the sound, which increased their anxiety since they could not determine whether the sound was meant to signal danger, or if it was an atmospheric sound. Because those testers did not understand the nature of the sound, they felt less in control of their situation which caused them to feel more anxious. Atmospheric sounds also helped convince players that the level is filled with danger, which also increased their anxiety. Testers 23, 26, and 27 reported that untimed sound effects added to the scary atmosphere of the level, which also increased anxiety.

For source, testers 1, 3, 4, 11, 16, 18, 19, 21, and 26 all reported that they responded with high anxiety when they could not find the source of a sound. Tester #11 said, "I played this game before and I never heard that sound. I couldn't find where it came from either, so I definitely felt some anxiety there." Testers 1, 3, 16, 18, 19, 21, and 26 stopped and looked around when an unsourced sound played, and proceeded to search for the source of the sound. Tester 18 stated that not finding a source made him worry that he had possibly missed the source, which raised his anxiety.

Testers did not have any externally visible physical reactions to any of the sound effects.

Results Conclusion

The demographics data shows that slight correlations existed between demographics and player fear and anxiety responses. After analyzing the demographics, it is apparent that a pattern also existed between the sound design principles that were tested and player fear and anxiety. With valid test results for the sound design principles available, this project can suggest guidelines for using the tested sound design principles to create fear and anxiety in players.

Data Analysis

Before testing, the projected outcome of this study was that high-volume sound effects with predetermined timing and a clear source are the most effective at causing fear, while low-volume sound effects with a random timing and undefined source are more effective at causing anxiety.

After testing, the data suggests that the hypothesis was substantiated on all counts concerning fear, but the predictions about anxiety were only valid concerning timing and source. Data suggests that medium-volume sound effects were most effective at causing anxiety. The following section contains the implications of the data that this study collected.

Causing Fear Through Sound Design

The study showed that the demographic data and fear responses were correlated, though none strongly. Demographics data showed that slight but consistent correlations existed between age and fear response. Fear response to changes in volume, timing, and source all showed a consistent but weak correlation with age. Source specifically showed a moderate correlation between fear response and age. This suggests that older players are subject to more frequent fear responses than younger players, most noticeably to sourced sound effects. This is possibly due to players becoming more sensitive to fear as they age. This is also possibly due to the idea that older players learn faster than younger players, and thus learn to fear things within a game more quickly than younger players.

Average amount of video games that testers played had a slight but consistent correlation with fear response. Many negligible correlations existed between fear response and average hours of video games played, but there also existed noticeable correlations with sourced (0.29) and timed (0.46) sound effects. This data was also consistent with overall fear responses to those sound design properties; quantitative data showed that timed and sourced sound effects were most effective at causing fear responses in players. This suggests that players who play games often are more susceptible to fear responses caused using the prescribed sound design techniques within this project than players who do

not play video games as often. This is possibly due to the fact that more experienced gamers do not have their game experience confounded by trying to learn how to play a new video game as fear-inducing events happen in front of them. This is also possibly due to more experienced players learning to fear things within the game more quickly than less experienced players.

Whether a tester preferred Survival-Horror games did not appear to affect fear response significantly; correlational values flipped between negative and positive, and all were weak correlations. One thing of significant note was that players who preferred Survival Horror games responded with less fear to the sound design techniques prescribed within this project. Quantitative data showed that high-volume, timed, and sourced sound effects were most effective at causing fear in players. Those who preferred Survival Horror games all showed negligible, but consistently negative correlations with fear response to high-volume, timed, and sourced sound effects. This suggests that players who prefer Survival Horror games are more used to fear and thus, have lower fear responses than players who do not prefer Survival Horror.

While level designers cannot always account for all possible types of players who may play their levels, they should recognize these trends when catering to these markets.

Results suggest that high-volume sound effects are most effective at causing fear in players. The quantitative data showed a clear trend in increased fear response when a sound effect is louder than the rest of the sounds in the game. This suggests to level designers that the louder they create a sound, the more effective it is at causing fear in a player.

Results suggest that sound effects timed to coincide with a gameplay element, such as an in-game enemy, are effective at causing fear. Quantitative data showed a clear trend of increased fear response in timed sound effects compared to untimed sound effects. However, it is important to note that the qualitative data showed that players did not respond with fear to the sound itself, but the fear was instead caused by the gameplay element. Further analysis also indicates that a well-timed sound effect draws attention to the gameplay element and enhances the initial fear response caused by that element. This suggests to level designers that accompanying a gameplay element with a well-timed sound effect is more

effective at causing fear in a player than playing the sound effect at a random time, or by introducing the gameplay element without a sound effect.

Finally, results suggest that sourced sounds cause more fear than unsourced sound effects. Quantitative data showed a clear trend of increased fear responses to sourced sounds compared to unsourced sound effects. As with timed sound effects, the fear response was not caused by the sound effect, but was instead caused by the source of the sound effect. Qualitative data suggested that a sourced sound effect drew attention to the source of the sound and increased the possibility of a fear response from the source. This suggests to level designers that accompanying a fear-inducing element, designed using "Freud's Id, Ego, and Superego Theory" to leverage innate and learned fears created by the ego and id, along with a sound effect is more effective at causing fear than playing that sound without a source. Seeing an enemy in a video game is a learned fear, while loud sounds are innately intimidating, which fits with Freud's theory of human emotion. Results suggest that combining the two causes a stronger fear response than using them separately.

With this analysis on fear, this study suggests that the best way to cause fear in players through volume, timing, and source is to create high volume, timed, and sourced sound effects. It is also important to note the variations in fear responses with tester demographics. Data suggests that older players, players who play video games often, and players who do not prefer Survival Horror games feel slightly more fear from the outlined sound design principles than other players.

Causing Anxiety Through Sound Design

The demographic data and anxiety responses were correlated, though none strongly. Demographics data showed that testers' ages slightly affected anxiety response. Data showed negligible correlations between high-volume (0.07), low-volume (0.04), untimed (-0.07), and unsourced (-0.08) sound effects in relation to anxiety response. Weak correlations existed between medium-volume (0.18), timed (0.14), and sourced (0.26) sound effects. This data was consistent with the correlations between fear response to volume, timing, and source settings; and age as discussed in the Quantitative Results for

Fear section. This suggests that older gamers are intrinsically more receptive to fear and anxiety responses to higher-volume, timed, and sourced sound effects. Again, this is possibly due to the idea that as gamers age, they become more sensitive to fear and anxiety, or possibly that they learn to become fearful or anxious to gameplay elements faster than younger gamers.

Demographics data showed that slight but consistent correlations existed between how often a tester played video games and their anxiety response. All data pertaining to correlations between anxiety response and average hours played per week was negligible (less than 0.1) except for with sourced sound effects, which was moderately notable (0.45). This correlation was also consistent with the correlation between fear response and hours played per week. This suggests that players who play games more often are more susceptible to fear and anxiety responses to sourced sound effects. Overall, the results suggest that players who play games often are slightly more susceptible to anxiety responses than players who do not. Again, this is possibly due to the idea that more experienced gamers can quickly learn what to be anxious about. More experienced players can also focus on the events happening within the game rather than struggling with learning the controls, which is more likely to happen to less experienced players.

Whether a tester preferred Survival-Horror games or not slightly affected anxiety response. Correlational values between game preference and anxiety response were mostly weak and negligible (less than 0.2), except for medium-volume (-0.45) and untimed (-0.41) sound effects. Results suggest that medium-volume and untimed sound effects are most effective at causing anxiety in players. Overall, this suggests that players who do not prefer Survival Horror games have higher and more frequent anxiety responses to the prescribed sound design methods in this project than players who prefer Survival Horror games. This can be attributed to the idea that players who do not prefer Survival Horror are less likely to experience anxiety while playing video games, and are thus less accustomed and more receptive to anxiety inducing techniques.

Again, while level designers cannot always account for all possible types of players who play their levels, they should take note of these trends when catering to older markets, or a market that does not play video games often.

Results suggest that medium and high-volume sound effects are most effective at causing anxiety in players. However, high-volume sound effects are not necessary; their mean anxiety responses averaged lower than medium-volume sound effects. The original hypothesis predicted that low-volume sound effects would be most effective at causing anxiety. Results suggest this is not true, and this is possibly because the effects of low-volume sounds become dissipated amidst other higher-volume sounds. It is also possible that high-volume sound effects may inadvertently elicit fear reactions from players. This suggests to level designers that the best volume to play anxiety-causing sound effects is at the same volume as the average sound effects in the game. The takeaway from the volume test is not to use low-volume sound effects to cause anxiety.

Results suggest that sound effects played at random intervals are better at causing anxiety in players than well-timed sound effects. The quantitative data did not show a substantial change in anxiety between timed and untimed sound effects. However, the qualitative data showed that timing has a significant impact on anxiety response. Qualitative data showed that untimed sound effects caught the players off-guard and caused a general feeling of unease (i.e. anxiety). Testers could not determine whether the untimed sound effects they heard were signaling danger, or if they were atmospheric sounds. Not knowing what the sound was meant to be caused them to feel uneasy and anxious. This suggests to level designers that playing sounds at random times is more effective at causing anxiety than well-timed sound effects.

Finally, results suggest that unsourced sounds cause more anxiety than sourced sounds. As with timing, the quantitative data did not support the hypothesis that unsourced sound effects cause greater anxiety than sourced sound effects. However after analyzing the qualitative data, the results showed that testers often responded with anxiety when they could not find the source of a sound. When testers heard an unsourced sound, many of them stopped and looked around in an attempt to find the source. Being unable to find the source caused players to feel anxious and worry that they may find out what caused the sound later on in the level. To better make this point, anxiety is defined by a general feeling of uneasiness or worry. Results suggest that by not revealing the source of a sound, level designers can give players a

reason to worry about what the source may have been. This suggests to Level designers that playing a sound without a source is better at causing anxiety in players than accompanying a sound with a source.

With this analysis on anxiety, this project suggests that the best way to cause anxiety in players through volume, timing, and source is to create medium volume, randomly timed, and unsourced sound effects. It is also important to note the variations in anxiety responses with tester demographics. Data suggests that as with fear, older players, players who play video games often, and players who do not prefer Survival Horror games feel slightly more anxiety from the outlined sound design principles than other players.

Conclusion

One of the caveats of this research is that all testers used were game development students. However, tester responses had sufficient variety to suggest that the sample was sufficiently diverse, and that this research is still valid for predicting fear and anxiety responses for an average video game player. Another caveat of this research is that 90% of the testers were male, with only three females. This is not enough to accurately represent female gamers.

Another caveat is that the gameplay within the level may have influenced the results of the tests. Players could possibly have ignored the sound effects and been focused on gameplay at each sound point. However since this project tests the use of sound design in video games, the test requires that the level contain gameplay for its results to be applicable in the real world.

Another caveat of this research is that players heard the same sound multiple times throughout the tests. Qualitative data gleaned from the testers suggested that this did not affect the results of the tests, but subconscious factors may have played a role in forming testers' opinions.

On the James-Lange theory of emotion, testers did not have many externally visible physical reactions to the sound effects. While this may suggest that the James-Lange theory is not applicable to this study, the test only measured gross physical responses and did not take into account more subtle

physical reactions pertaining to fear and anxiety such as heart rate, galvanic skin response, and pupil dilation. Therefore, this work is not conclusive on the applicability of the James-Lange theory of emotion pertaining to sound design in video games.

After analyzing the data, level designers can tailor their sounds to cause fear or anxiety in players. In order to effectively cause fear, data suggests that level designers should make loud, well-timed, and sourced sound effects. In order to effectively cause anxiety, data suggests that Level designers should make medium-volume, randomly timed, and unsourced sound effects.

Chapter 5: Conclusion

This project researched and tested how to cause fear and anxiety through sound design in video games. Using a field review that focused on human emotion theory and sound design principles allowed this study to create a methodology with which to test sound design principles in relation to the emotions of fear and anxiety. Finally, by following the methodology, this study used qualitative and quantitative methods to determine the best use of volume, timing and source of in-game sound effects to cause fear and anxiety in a player.

The projected outcome of this study was that high volume sound effects with predetermined timing and a clear source are the most effective at creating fear, and low volume sound effects with a random timing and undefined source are more effective at creating anxiety. After the testing was complete, data suggested that the best method for causing fear is high-volume, well-timed, and sourced sound effects. For anxiety, data suggested the best method is medium-volume, untimed, and unsourced sound effects. The most obvious trend after analyzing the data is that low-volume sound effects are not effective at evoking any emotion due to their tendency to become drowned out by other sounds.

One of the caveats and limitations of this research are that all testers used were game development students. This may impact the results of the experiment because the market for video games does not include a large number of game developers. Despite this, tester responses had sufficient variety to be considered valid for predicting fear and anxiety responses in the video game market. Another caveat of this research is that twenty four testers were male, and only three were females. This is not enough to accurately represent female gamers. With the market for video games growing, females are more likely to become a major part of the market and should therefore be considered in future studies.

A side note worthy of mention is that the lack of sound can be very effective at causing anxiety. While this was not tested, field review analysis and certain tester comments suggest that silence can cause players to become more anxious as they expect sounds and events that never come. As shown in Dead

Space, the sudden change in low to high volume is also very effective at causing sudden fear in players. Silence can be a useful tool for Level designers just as well as sound effects.

This project is valuable to level designers wishing to implement sound in their levels because it relates to basic properties of sound that all level designers have control of. Any game developers that use sound effects to create fear or anxiety can use the research from this project directly to enhance their games.

The two most important things this project accomplished were to provide an academically tested theory of sound design and emotion in video games, and to define specific techniques that level designers can use to add fear and anxiety to their level. The field review, methodology and data analysis of this project can serve as a foundation for future research as well as to provide a basic understanding of sound design theory. Possible future research opportunities that branch from this study include:

- Testing in a setting other than Survival-Horror
- Testing other properties of sound in relation to fear and anxiety
- Testing emotions other than fear and anxiety using this study's methodology
- Testing other types of sounds, such as stingers/music and dialogue
- Testing other groups of gamers, such as casual gamers
- Testing with more females
- Test the effects of absence of sound on fear and anxiety

A few suggestions on recreating this project with more favorable test conditions are:

- Testing using more than one level to account for and minimize the effect that the gameplay has on emotional responses
- Recording the subjects' interview responses on a voice recorder and/or video recording subjects during their play through the level as to gather more qualitative data per tester

- Testing using a larger level and greater number of sound effects, as to gather more quantitative data per tester

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Appendix A

Quantitative Data Compilations

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 1	Alternative 3			Alternative 1		Alternative 1	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	4	2	3	2	2	2	2
How Anxious? 1-7	4	2	2	5	4	4	3

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 2	Alternative 3			Alternative 1		Alternative 2	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	4	1	2	4	2	2	4
How Anxious? 1-7	3	5	2	4	1	2	1

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 3	Alternative 1			Alternative 2		Alternative 3	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	2	2	4	5	4	4	4
How Anxious? 1-7	2	3	4	5	5	7	4

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 4	Alternative 3			Alternative 1		Alternative 3	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	2	2	3	4	1	1	1
How Anxious? 1-7	2	1	2	3	2	4	4

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 5	Alternative 2			Alternative 3		Alternative 2	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	2	1	1	2	1	1	1
How Anxious? 1-7	2	1	1	1	1	1	1

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 6	Alternative 2			Alternative 3		Alternative 3	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	1	3	1	3	2	3	5
How Anxious? 1-7	2	2	3	4	4	5	5

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 7	Alternative 1			Alternative 2		Alternative 2	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	3	1	2	6	1	6	4
How Anxious? 1-7	4	3	4	5	4	6	5

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 8	Alternative 1			Alternative 2		Alternative 1	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	5	1	2	3	3	2	1
How Anxious? 1-7	5	3	2	5	6	3	2

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 9	Alternative 2			Alternative 3		Alternative 1	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	1	4	1	3	1	3	7
How Anxious? 1-7	4	7	5	3	2	3	5

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 10	Alternative 1			Alternative 1		Alternative 1	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	3	1	3	7	1	6	3
How Anxious? 1-7	4	3	2	5	5	6	5

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 11	Alternative 3			Alternative 2		Alternative 1	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	4	1	3	2	4	2	3
How Anxious? 1-7	5	3	4	6	6	4	4

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 12	Alternative 2			Alternative 2		Alternative 3	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	4	3	1	5	2	4	1
How Anxious? 1-7	3	5	1	4	3	3	3

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 13	Alternative 3			Alternative 2		Alternative 2	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	3	2	4	3	3	5	3
How Anxious? 1-7	5	2	4	4	4	5	4

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 14	Alternative 2			Alternative 2		Alternative 2	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	1	1	1	2	4	1	1
How Anxious? 1-7	3	2	2	4	6	2	3

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 15	Alternative 1			Alternative 1		Alternative 2	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	1	1	1	6	4	6	1
How Anxious? 1-7	1	4	1	2	6	6	2

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 16	Alternative 1			Alternative 1		Alternative 3	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	1	1	4	6	3	1	1
How Anxious? 1-7	3	1	5	4	3	3	4

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 17	Alternative 2			Alternative 2		Alternative 1	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	1	1	1	6	4	3	1
How Anxious? 1-7	1	3	1	5	5	5	3

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 18	Alternative 3			Alternative 2		Alternative 3	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	4	4	3	6	5	4	1
How Anxious? 1-7	5	5	4	4	5	5	2

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 19	Alternative 1			Alternative 3		Alternative 1	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	3	2	2	2	2	5	6
How Anxious? 1-7	2	5	5	6	6	4	6

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 20	Alternative 3			Alternative 3		Alternative 1	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	2	3	1	1	1	2	3
How Anxious? 1-7	2	4	1	3	3	3	3

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 21	Alternative 2			Alternative 1		Alternative 3	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	1	3	1	1	1	4	1
How Anxious? 1-7	2	5	2	3	4	3	2

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 22	Alternative 1			Alternative 3		Alternative 2	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	2	1	1	2	1	1	2
How Anxious? 1-7	4	5	3	4	4	3	5

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 23	Alternative 2			Alternative 1		Alternative 2	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	4	5	1	6	2	7	5
How Anxious? 1-7	5	5	2	5	3	5	4

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 24	Alternative 3			Alternative 3		Alternative 2	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	7	5	4	3	2	2	4
How Anxious? 1-7	7	6	6	4	5	5	5

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 25	Alternative 1			Alternative 3		Alternative 3	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	3	1	1	3	2	3	1
How Anxious? 1-7	3	1	1	5	3	3	5

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 26	Alternative 3			Alternative 3		Alternative 3	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	3	6	2	4	1	3	1
How Anxious? 1-7	5	4	4	5	5	5	5

	Sound Set 1 (Volume)			Sound Set 2 (Timing)		Sound Set 3 (Source)	
Tester 27	Alternative 2			Alternative 1		Alternative 1	
Property Tested	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
How Fearful? 1-7	4	3	1	6	1	1	5
How Anxious? 1-7	4	6	2	5	3	4	6

	Gender	Age	Hours of Games per Day	Likes Survival Horror?
Tester 1	M	24	15-25	Y
Tester 2	M	34	1-3	N
Tester 3	M	36	25+	Y
Tester 4	M	27	15-25	Y
Tester 5	M	27	10-15	Y
Tester 6	M	22	10-15	Y
Tester 7	M	23	25+	N
Tester 8	M	23	10-15	N
Tester 9	M	25	7-10	Y
Tester 10	M	35	10-15	N
Tester 11	M	25	7-10	N
Tester 12	M	25	25+	N
Tester 13	M	27	7-10	Y
Tester 14	F	26	1-3	N
Tester 15	F	25	15-25	N
Tester 16	M	24	10-15	Y
Tester 17	M	23	1-3	N
Tester 18	M	30	25+	N
Tester 19	M	31	10-15	N
Tester 20	M	28	1-3	N
Tester 21	M	24	7-10	N
Tester 22	M	24	7-10	N
Tester 23	M	40	10-15	Y
Tester 24	M	25	10-15	N
Tester 25	F	22	7-10	Y
Tester 26	M	27	4-6	Y
Tester 27	M	23	15-25	N

Tester Demographics

	Demographical Data Correlations			
	Gender	Age	Hours of Games per Day*	Likes Survival Horror?**
Tester 1	M	24	20	1
Tester 2	M	34	2	0
Tester 3	M	36	25	1
Tester 4	M	27	20	1
Tester 5	M	27	12.5	1
Tester 6	M	22	12.5	1
Tester 7	M	23	25	0
Tester 8	M	23	12.5	0
Tester 9	M	25	8.5	1
Tester 10	M	35	12.5	0
Tester 11	M	25	8.5	0
Tester 12	M	25	25	0
Tester 13	M	27	8.5	1
Tester 14	F	26	2	0
Tester 15	F	25	20	0
Tester 16	M	24	12.5	1
Tester 17	M	23	2	0
Tester 18	M	30	25	0
Tester 19	M	31	12.5	0
Tester 20	M	28	2	0
Tester 21	M	24	8.5	0
Tester 22	M	24	8.5	0
Tester 23	M	40	12.5	1
Tester 24	M	25	12.5	0
Tester 25	F	22	8.5	1
Tester 26	M	27	5	1
Tester 27	M	23	20	0

Correlations			
Age	1.00	0.04	0.09
Hours of Games Per Day	0.04	1.00	0.06
Likes Survival Horror	0.09	0.06	1.00

*Hours of Games per Day have been converted to average hours per day.

**Survival Horror preferences have been converted to numerical values, 1 denoting Yes and 0 denoting No.

	Correlation of Age and Fear Response						
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Correlation	0.16	0.20	0.22	0.28	0.07	0.45	0.31

	Correlation of Average Hours Played Per Week and Fear Response						
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Correlation	0.22	0.05	0.27	0.46	0.10	0.29	0.01

	Correlation of Game Preference and Fear Response						
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Correlation	-0.23	0.21	0.20	-0.04	-0.15	-0.05	0.07

	Correlation of Age and Anxiety Response						
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Correlation	0.07	0.18	0.04	0.14	-0.07	0.26	-0.08

	Correlation of Age and Anxiety Response						
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Correlation	0.07	0.18	0.04	0.14	-0.07	0.26	-0.08

	Correlation of Game Preference and Anxiety Response						
	High-Volume	Medium-Volume	Low-Volume	Timed	Untimed	Sourced	Unsourced
Correlation	-0.03	-0.45	0.13	-0.14	-0.41	0.03	0.15

Randomly	Sound Set 1 (Volume)		
Selected	High-Volume	Medium-Volume	Low-Volume
Alternative 1	Wolf Howl (Loud)	Wolf Howl (Medium)	Wolf Howl (Soft)
Alternative 2	Gunfire (Loud)	Gunfire (Medium)	Gunfire (Soft)
Alternative 3	Wretch Growl (Loud)	Wretch Growl (Medium)	Wretch Growl (Soft)
Randomly	Sound Set 2 (Timing)		
Selected	Timed	Untimed	
Alternative 1	Lightning (Timed)	Lightning (Untimed)	
Alternative 2	Boomer Growl (Timed)	Boomer Growl (Untimed)	
Alternative 3	Creaking Door (Timed)	Creaking Door (Untimed)	
Randomly	Sound Set 3 (Source)		
Selected	Sourced	Unsourced	
Alternative 1	Locust Growl (Sourced)	Locust Growl (Unsourced)	
Alternative 2	Glass Shattering (Sourced)	Glass Shattering (Unsourced)	
Alternative 3	Footsteps (Sourced)	Footsteps (Unsourced)	

Sound Requirements Illustrated

Appendix B

Qualitative Data Compilations

Tester #1 Case 311

Volume (Alternative 3)
Soft: Sound announced an ambush. Player was prepared for the upcoming battle.
Medium: Sound was expected. Big windows next to sound point alerted player of possible ambush.
Loud: The player had heard this sound before and assumed that it signaled another bad guy. Assumed that the best way to deal with situation was to take cover and watch his back.
Timing (Alternative 1)
Untimed: Sound was surprising.
Timed: Visuals that accompanied the sound made the sound much more alarming.
Source (Alternative 1)
Unsourced: Couldn't tell where gunfire was coming from, so he looked around
Sourced: Player was wondering why he saw gunshots, then he realized they were from an enemy

Tester #2 Case 312

Volume (Alternative 3)
Soft: Felt like the sound announced an ambush. Player prepared for combat.
Medium: None.
Loud: Player knew an ambush was coming and he prepared for combat again.
Timing (Alternative 1)
Untimed: Sound made the player fearful of a possible enemy ambush, despite the fact that the sound was not an enemy sound.
Timed: Player was generally afraid of being ambushed throughout the map. When the sound accompanied an ambush, he was extremely afraid of the enemy that came out, but relieved after combat was over.
Source (Alternative 2)
Unsourced: Player did not hear this sound due to a fight that was in progress.
Sourced: Player heard sound but was not looking at the source. He looked around his immediate area to see where it came from.

Tester #3 Case 123

Volume (Alternative 1)
Soft: Having a new weapon made the player feel considerably less anxious.
Medium: Sound raised the player's awareness of possible dangers.
Loud: Player had been scared through the entire level by the time he heard this sound. Fear was deadened slightly because of this. Player remarked that he felt like he was "enjoying being scared."
Timing (Alternative 2)
Untimed: Player stopped to look around for a moment.
Timed: Timing the sound to coincide with the rocket made the player realize that the enemy had a very dangerous weapon.
Source (Alternative 3)
Unsourced: Player heard this sound for the second time and tried frantically to find the source.
Sourced: Player saw the source of the sound, but was extremely anxious as there was nothing he could do to explore the cause of the sound (Footsteps on ceiling).

Tester #4 Case 313

Volume (Alternative 3)
Soft: Player felt they had little time to react to the danger after they heard the sound.
Medium: Player got used to feeling fear, hearing the same sound effect, and fighting the same enemies.
Loud: Player had heard this sound many times throughout the level and knew that it meant an ambush was coming.
Timing (Alternative 1)
Untimed: None.
Timed: Sound felt like it was used as misdirection for the upcoming ambush. This caused the player to have a high fear reaction when they actually were ambushed.
Source (Alternative 3)
Unsourced: Player was anxious since he couldn't find the source of the sound.
Sourced: Player felt very anxious, but not fearful because the sound did not represent a defined threat. Player was imagining what could possibly be making that sound. Player also remarked that they felt excited to be scared.

Tester #5 Case 232

Volume (Alternative 2)
Soft: None.
Medium: None.
Loud: Player rarely felt anxious throughout level. They did feel anxious here however, as they had previous knowledge of the game and the sound effect communicated the presence of a danger.
Timing (Alternative 3)
Untimed: None.
Timed: Player felt that the architecture could hide possible ambushes.
Source (Alternative 2)
Unsourced: Player had just picked up a weapon which lowered any anxiety they may have had.
Sourced: None

Tester #6 Case 233

Volume (Alternative 2)
Soft: None.
Medium: None.
Loud: None.
Timing (Alternative 3)
Untimed: Player became anxious of possible ambushes.
Timed: Player was still anxious of possible ambushes. Sound intensified that anxiety.
Source (Alternative 3)
Unsourced: Player heard this sound and saw a closed door. They assumed the sound came from behind the door as it is the most obvious culprit in the area. Player is making up their own 'monsters'.
Sourced: Player became less anxious and fearful due to having a new weapon

Tester #7 Case 122

Volume (Alternative 1)
Soft: None.
Medium: None.
Loud: Hearing this sound made the player slow down.
Timing (Alternative 2)
Untimed: Player stopped to look around for a moment and try to determine the nature of the sound.
Timed: Player did not hear the sound due to gunfire.
Source (Alternative 2)
Unsourced: None.
Sourced: Player became fearful of a possible ambush.

Tester #8 Case 121

Volume (Alternative 1)
Soft: Player felt less anxious here as he had already fought the same enemy multiple times and felt like he could take them on at any time.
Medium: Player stopped to try and figure out if the sound foreshadowed an ambush.
Loud: Player heard the sound and became fearful of an enemy dropping down to attack. The player had been attacked many times throughout the level that he felt a break in monotony would accompany an ambush.
Timing (Alternative 2)
Untimed: Player felt as though a boss battle was coming up, and he was anxious because he did not know the capabilities of the boss.
Timed: Player heard the explosion and associated it with an enemy.
Source (Alternative 1)
Unsourced: Player heard the sound but was not afraid because he felt like he knew where all the possible enemy hiding spots were.
Sourced: Player saw the source of the sound and had time to prepare himself for a fight.

Tester #9 Case 231

Volume (Alternative 2)
Soft: Player heard the sound and felt that something would happen, which did not.
Medium: None.
Loud: None.
Timing (Alternative 3)
Untimed: None.
Timed: None.
Source (Alternative 1)
Unsourced: None.
Sourced: Player was afraid of gunshots. He was not sure if they were friendly or enemy.

Tester #10 Case 111

Volume (Alternative 1)
Soft: Player felt comfortable fighting enemies since he had a better weapon.
Medium: Sound made him anxious, despite the fact that nothing happened.
Loud: Player is still wondering at this point if the sound foreshadows an ambush.
Timing (Alternative 1)
Untimed: None.
Timed: Sound accompanied by ambush heightened fear factor for the player.
Source (Alternative 1)
Unsourced: None.
Sourced: None.

Tester #11 Case 321

Volume (Alternative 3)
Soft: Player was and continued to anticipate ambushes at this point.
Medium: Player had previous experience with the game and was comfortable with the enemy this sound foreshadowed.
Loud: None.
Timing (Alternative 2)
Untimed: Player stopped to look around for a moment and try to determine the nature of the sound.
Timed: Sound is distinctive to a major enemy in the game. It foreshadowed a gameplay element that he feared and thus, succeeded in evoking fear.
Source (Alternative 1)
Unsourced: Player heard had played the game before and did not know what the sound belonged to, which made him anxious. "I played this game before and I never heard that sound. I couldn't find where it came from either, so I definitely felt some anxiety there."
Sourced: Player knew he was being fired at and was afraid.

Tester #12 Case 223

Volume (Alternative 2)
Soft: None.
Medium: Player heard this sound and remarked that he was reminded of the threat of taking damage. This caused fear. He also did not know where the sound was coming from, which made him anxious.
Loud: Player jumped at this sound.
Timing (Alternative 2)
Untimed: Player stopped to look around for a moment. Remarked that he wasn't sure if the house was under siege, but he still felt anxious.
Timed: Player felt less fearful because he had a partner to fight alongside him, but still felt afraid of the danger that came with the sound.
Source (Alternative 3)
Unsourced: Player heard this sound and assumed it was coming from the other side of the door.
Sourced: Player saw the source of the sound and had tried to take cover. Shows he was fearful of the source of the sound.

Tester #13 Case 322

Volume (Alternative 3)
Soft: Player became aware of possible ambushes. Anxiety was less because the sound signified an obvious danger.
Medium: Player did not notice this sound due to gunfire.
Loud: Player's anxiety was lower because he knew the enemy that came with this sound was not a big threat.
Timing (Alternative 2)
Untimed: None.
Timed: Player was expecting a large enemy to come out after hearing this sound.
Source (Alternative 2)
Unsourced: Player did not notice this sound due to the fight happening.
Sourced: Player became afraid of ambushes. Sound caused anxiety and fear in equal parts.

Tester #14 Case 222

Volume (Alternative 1)
Soft: None.
Medium: Player anxiety dropped due to picking up a better weapon.
Loud: Player was not afraid at this point because the enemies encountered were not a big threat. Sound effect caused him to be aware of possible enemies, but he felt in control.
Timing (Alternative 2)
Untimed: Player anxiety went up because they knew the sound belonged to an enemy that they could not see yet. "I couldn't figure out where it was, I was freaked out."
Timed: Player was surprised when the enemy came onto the screen just as the sound played.
Source (Alternative 1)
Unsourced: None.
Sourced: None.

Tester #15 Case 112

Volume (Alternative 1)
Soft: None.
Medium: Player felt extremely anxious when this sound played due to the fact that he could not see what was around a corner.
Loud: None.
Timing (Alternative 1)
Untimed: Sound coincidentally played just as an ambush happened. This elevated the fear response of the player to the ambush.
Timed: Sound elevated the fear response of the player to the ambush.
Source (Alternative 2)
Unsourced: None.
Sourced: Player became afraid of a potential ambush. He did not know if something would attack him from the source of the sound.

Tester #16 Case 113

Volume (Alternative 1)
Soft: Player was afraid of the enemy that followed the sound.
Medium: None.
Loud: None.
Timing (Alternative 1)
Untimed: Player was afraid of a possible ambush after hearing this sound.
Timed: Player's fear reaction to the ambush was elevated by the sound.
Source (Alternative 3)
Unsourced: Player began turning around to see if they could find the source of the sound. Anxiety was elevated.
Sourced: None.

Tester #17 Case 221

Volume (Alternative 2)
Soft: Player was still figuring out what to do at this point and the sound did not register.
Medium: None.
Loud: Player felt more secure since they had just acquired a new weapon.
Timing (Alternative 2)
Untimed: None.
Timed: Player was afraid of enemy specifically, but the sound elevated the fear response. "That sound the boomers make when they're around is pretty awesome. It added some fear to that room."
Source (Alternative 1)
Unsourced: None.
Sourced: None.

Tester #18 Case 323

Volume (Alternative 3)
Soft: Player felt they did not know where the enemy was coming from, so whenever they heard this sound they became more anxious.
Medium: Player expected the ambush that came with this sound, but was still anxious about it.
Loud: Player anxiety was high because he still did not know where the enemy would attack from when this sound played.
Timing (Alternative 2)
Untimed: Player heard this sound and stopped to look around for where it came from.
Timed: Player's fear response to the enemy that came with this sound was elevated due to hearing this sound.
Source (Alternative 3)
Unsourced: Player heard this sound and began searching for its source. High anxiety.
Sourced: Player felt anxiety because he saw the source of the sound but could not do anything to affect it. Sound also communicated to the player that ambushes may come from behind.

Tester #19 Case 131

Volume (Alternative 1)
Soft: None.
Medium: Says he was not reactive to this sound, but scored it high on anxiety.
Loud: Player felt this sound was purely environmental. He thought it communicated atmosphere rather than a clear and present danger.
Timing (Alternative 3)
Untimed: Player stopped was wondering if this sound was a decoy. Anxiety was high because he was wondering if something was happening that he was not aware of.
Timed: Player stopped was wondering if this sound was a decoy. Anxiety was high because he was wondering if something was happening that he was not aware of.
Source (Alternative 1)
Unsourced: Player stopped and searched for the source of this sound. High anxiety.
Sourced: Player heard this sound and instinctively thought danger. Player remarked that any kind of metallic noise communicates weaponry to him.

Tester #20 Case 331

Volume (Alternative 3)
Soft: None.
Medium: None.
Loud: Player expected there to be an ambush after this sound played.
Timing (Alternative 3)
Untimed: None.
Timed: None.
Source (Alternative 1)
Unsourced: None.
Sourced: Player did not understand the source of this sound.

Tester #21 Case 213

Volume (Alternative 2)
Soft: None.
Medium: Hearing this sound, the player was reminded of possible ambushes and high anxiety went up.
Loud: Player felt this sound was purely environmental. He thought it communicated atmosphere rather than a clear and present danger.
Timing (Alternative 1)
Untimed: None.
Timed: Player fear reaction was elevated due to the sound playing at the same time as the ambush.
Source (Alternative 3)
Unsourced: Player stopped and searched for the source of this sound. Assumed the sound came from behind the door. High anxiety.
Sourced: Player did not hear this sound due to a gunfight.

Tester #22 Case 132

Volume (Alternative 1)
Soft: Player's anxiety lessened due to having a better weapon.
Medium: Player felt something would happen when hearing this sound. Player was afraid of possible ambush. High anxiety.
Loud: Player heard this sound and prepared himself for a fight. Upon hearing most sounds, this player seemed to prepare himself for an ambush.
Timing (Alternative 3)
Untimed: Player stopped and mentally prepared himself after hearing this sound. Player was not sure what to expect, anxiety rose.
Timed: Player became afraid of being ambushed.
Source (Alternative 2)
Unsourced: Player became more anxious hearing this sound during a fight.
Sourced: None.

Tester #23 Case 212

Volume (Alternative 2)
Soft: Sound caused the player to try and anticipate what it meant. Player became cautious of his surroundings.
Medium: Player's anxiety lessened due to having a better weapon.
Loud: Player took cover after hearing this sound to prepare himself for a potential ambush.
Timing (Alternative 1)
Untimed: Sound added anxiety by enhancing the scary atmosphere of the level.
Timed: Player fear reaction was elevated due to the sound playing at the same time as the ambush.
Source (Alternative 2)
Unsourced: None.
Sourced: Player heard this sound and became afraid of something ambushing him from the source of the sound.

Tester #24 Case 332

Volume (Alternative 3)
Soft: None.
Medium: None.
Loud: None.
Timing (Alternative 3)
Untimed: Player saw the door move with the sound cue, which elevated anxiety.
Timed: Player became afraid of a possible enemy encounter.
Source (Alternative 2)
Unsourced: Player heard sound and assumed it came from behind him. Anxiety rose.
Sourced: None.

Tester #25 Case 133

Volume (Alternative 1)
Soft: None.
Medium: None.
Loud: None.
Timing (Alternative 3)
Untimed: Player became afraid of a possible ambush coming from behind. Anxiety rose.
Timed: Player was expecting something to come out of the closet. Anxiety rose.
Source (Alternative 3)
Unsourced: None.
Sourced: Player became fearful of the source of the sound.

Tester #26 Case 333

Volume (Alternative 3)
Soft: Player became anxious of possible ambush.
Medium: Player's anxiety and fear rose due to being ambushed after this sound.
Loud: Player's anxiety lessened due to having a better weapon.
Timing (Alternative 3)
Untimed: Player felt this sound added to the scary atmosphere of the level.
Timed: Player was expecting something to come out of the closet. Anxiety rose.
Source (Alternative 3)
Unsourced: Player heard this sound and wanted to identify the source. He turned around and began looking for it. Player felt curiosity mixed with anxiety.
Sourced: Player heard this sound and became afraid of something ambushing him from the source of the sound. Player did not know what it was, but he began making assumptions in his head about what it could be.

Tester #27 Case 211

Volume (Alternative 2)
Soft: None.
Medium: Player's anxiety was high because he did not know where the next ambush would come from.
Loud: Player's fear was high because he had died previously at this point in the game.
Timing (Alternative 1)
Untimed: Player felt this sound added to the scary atmosphere of the level.
Timed: Player felt the sound was meant to be misdirection. When the ambush happened, the player was unprepared and the fear reaction was high.
Source (Alternative 1)
Unsourced: None.
Sourced: Player heard this sound and was not fearful due to prior knowledge of the game.