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Physiological responding in a two-dimensional Social Interaction Simulation

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Physiological Responding in a Two-Dimensional Social Interaction Simulation

by

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Each person whose signature appears below certifies that this dissertation in his opinion is adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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CONTENTS

Approval Page ii

Acknowledgements iii

List of Tables vi

List of Figures vii

Abstract viii

Chapter Page

1. Introduction 1

2. Method 14

    Subjects 14
    Materials 14
    Apparatus 15
    Procedure 16
        Preparation 16
        Experimental Conditions 17
            Condition A: Aggressor 18
            Condition B: Defender 20
        Data Scoring and Analysis 21
        Hypotheses 22

3. Results 23

    Demographic Analysis 23
    Video Game Exposure Analysis 24
    Subjective Impressions of the Experience 26
    Primary Hypothesis Testing 30
        Hypothesis 1A: Heart Rate Analysis 30
        Hypothesis 1B: Skin Conductance Level Analysis 35
        Hypothesis 2: Discrete vs. Independent Measures 40
        Hypothesis 3: Learning Effects 48

4. Discussion 52

    Hypothesis 1 54
    Hypothesis 2 58
    Hypothesis 3 61

Conclusions 61

References 67

Appendix A: Consent Forms 70

Appendix B: Lab Protocol and Script 73

Appendix C: ANOVA Tables 76

Appendix D: Electronic Screening Questionnaire 89

TABLES

Table Page

1. Measurement Phases by Condition 18

2. Comparison of Phase one and Phase two 20

3. One-Way ANOVA of Self-report and Self-assessment Measures 29

4. Tests of Within-Subjects Effects for HR Across Phases 76

5. Within Subjects Contrasts for HR Across Conditions 78

6. Tests of Within-Subjects Effects for SCL by Phase of Measure 82

7. Within Subjects Contrasts for SCL Across Conditions 84

8. Effects for Independent vs. Sequential Measures for Heart Rate 41

9. Contrasts of Independent vs. Sequential Measures for Heart Rate 43

10. Effects for Independent Measures vs. Sequential Measures for SCL 45

11. Contrasts of Independent Measures vs. Sequential Measures for SCL 47

12. Hypothesis Testing for Repeated Kills with Intertrial Recovery 51

FIGURES

Figure Page

1. Controlled Virtual Interaction Arena.......19

2. Demographic Composition of the Sample.......23

3. Game Preference of Participants Who Regularly Play.......25

4. Subjective Impressions of Experience.......26

5. Aggress vs. Defend for HR Across Measurement Phase.......31

6. Maximal vs. Minimal Level of Gore for HR Across Phases of Measure.......33

7. Audio Complexity for HR Across Measurement Phase.......35

8. Comparison of Aggress vs. Defend by SCL Across Measurement Phase.......36

9. Comparison of Gore Levels by SCL Across Measurement Phase.......38

10. Comparison of Audio Complexity by SCL Across Phases.......39

11. Comparison of Sequential vs. Independent Measures Across Phases (HR).......44

12. Comparison of Sequential vs. Independent Measures Across Phases (SCL).......48

13. HR of Repeated Kills Over Five Trials.......49

14. SCL of Repeated Kills Over Repeated Trials.......50

Introduction

With the increasing usage of computers in the conduct of research, diagnosis and treatment, it is necessary to examine the factors which may allow us to adapt computers to better aid the field. Many professionals are already using virtual environments (VE) to simulate fearful stimuli for desensitization techniques (Carlin, Hoffman & Weghorst, 1996, Rothbaum & associates 2001, 2002 and others). Although these researchers are yielding promising results, we do not know exactly which factors of computer environments are more or less important to the effectiveness of these treatments.

One question which has risen to the forefront, is whether a full VE is required to achieve reliable, meaningful changes in participants emotions and physiology. In other words; can a two-dimensional computer simulation elicit meaningful and reliable physiological changes in normal participants? Or is a 3-d virtual environment required?

It would seem that at least in some limited circumstances it should be possible to elicit these emotional and physiological changes using 2-dimensional presentation methods (i.e. a computer screen). Some support for this idea may be found in observing people who play video games. In a two-dimensional game, players react emotionally in many ways expressing anger, sadness, happiness and a host of other emotions. Likewise, television evokes at least partial emotional responses from normal humans, making us cry, laugh, etc. For many years, professionals in the biofeedback field have used two-dimensional computer graphics to provide feedback for patients, particularly children. By use of different animations, clinicians can affect modest changes in physiology via this interface.

As can be seen from these examples, there is ample evidence to suggest that some emotional or physiological responses may be reliably measured using two-dimensional computer simulations. It is likely that some stimuli, or combinations of stimuli are better presented in different modes. Some types of primarily visual stimuli such as the Wechsler picture arrangement sub-test might be presented only in two dimensions. However, complex situations of multiple sensing modalities with multilayered stimuli are perhaps only adequately reproduced by using a three-dimensional simulation employing VE equipment.

To begin an examination of these conditions, it was decided that a simulation comparing virtual aggression and fear might produce the best physiological differentiation in responses. A pilot study was recently conducted in this laboratory which sought to record differences in Heart rate (HR) and Skin Conductance (SC) responses to a provocative computer simulation. A violent video game (Quake 3 ®) was edited and altered to create a virtual laboratory where the environment, presentation of stimuli and other factors would be controlled. The participants were asked to interact in two conditions; one where the participant would be the aggressor attempting to shoot and kill a virtual character and in the other, the participant would become the virtual victim being shot and killed by a character in the game.

It was predicted in accordance with previous aggression literature that when the participant was in the role of aggressor that autonomic nervous system (ANS) responses would decrease as a function of concentration or cognitive load (i.e., concentrating on the target) (see Lacey, 1959, 1967). It was also predicted that when the participant was in the role of virtual victim, a significant increase in ANS function would be observed

(Klorman & Ryan 1972, Schwartz 1981 and others) as a manifestation of the so termed "flight" response.

Physiological measurements were made during five discrete phases (see Table 1.) Of Baseline, Track, Shoot, Kill and Recover. Although statistically significant differences were observed between the measurement phases verifying that the phases are likely to be meaningful, there were no significant differences between the Aggressor and Victim conditions except during the "kill" phase of measure (see Figure 1).

From this result, it would appear that given an aggressor and a victim role, the two-dimensional representation was not "real" enough to elicit the physiological differences which should have been observed. This concept of "realness" has been termed by computer scientists as "presence". In the computer science field, presence is as difficult to define as intelligence is for psychologists to define. However, the widely accepted "general" definition is that feeling of reality or "realness" and the extent to which a person feels physically and psychologically immersed in a simulation. Since there were distinct changes in physiological reactivity to the different phases of measure, but only marginal differences between the two conditions (aggressor vs. victim) it was proposed that the manipulation of some critical areas of presence might elicit greater measurable differences between the two conditions.

The basis for these predicted physiological responses will be illustrated, beginning with a review of the physiological literature as it relates to cognition and aggression . The specific elements of presence and their proposed manipulations will then be presented followed by the specific hypotheses to be examined in the project.

Throughout the physiological arousal literature, heart rate (HR) and skin conductance (SC) are typically used to examine autonomic nervous system responses to stimuli. Heart Rate is measured using electrodes attached to the skin to record electrical impulses from the heart and is expressed as either beats per minute (BPM) or interbeat interval (IBI) which is an index of heart acceleration or deceleration. Skin Conductance Level (SCL) or galvanic skin response (GSR) is the measure of sweat production which is measured by passing a small current between two electrodes attached to the epidermis and calculating the electrical resistance across the skin. As SC is controlled only by sympathetic pathways, increases in SC indicate increased sympathetic activation, however decreases in SCL do not necessarily indicate parasympathetic activation.

Examining moment to moment ANS changes reflecting emotional states has proven difficult. One reason that these states are so difficult to measure is because emotional expression is brief and only last a few seconds on average (Ekman, 1984). Some researchers however have made significant strides in our understanding of emotional states and the ANS. Among those states which have thus far been differentiated, are HR accelerations during anger. Anger is thought to be close to a "fight" response and therefore we observe HR increases. HR increases metabolism to provide energy for action (Frijda, 1986) This finding has been replicated in studies which initiated anger in numerous ways. This is true when provoked (Ax 1953 and Schacter 1957), under criticism (Funkenstein et.al, 1954), and while using angry imagery, (Schwartz, Weinberger & Singer, 1981). This HR increase has even been reliably observed using only angry facial expressions (Cohen, Izard & Simmons, 1986) and when watching a video of an angry speech (McHugo, Lanzetta, Sullivan, Masters & Englis, 1985).

The fear response and it's arousal of the ANS has also been studied in various forms. Consistent HR increases significantly higher than baseline or controls have been observed when participants were shocked (Ax, 1953), criticized on arithmetic performance (Funkenstien et.al, 1954), used fearful imagery (Schwartz, 1981), Facial expressions of fear (McCaul, Holmes & Solomon, 1982), slides of mutilation (Klorman & Ryan, 1972) and fear of snakes (Hare, 1973). HR acceleration during sadness is thought to create anxiety which is in turn alleviated by if comfort from others which makes association more rewarding during grief (Levenson, 1992) HR increases were noted when participants used sad imagery (Schwartz et.al, 1981), and posed sad facial expressions, (Cohen et.al., 1986).

In a simulation where a participant is challenged by an opponent, we may expect changes in physiology as well. However, studies show that competition has little effect on HR or SC contrary to what would be expected. Rule and Hewitt (1971) investigated the effects of insults given by a partner during a traditional shock-learning paradigm where the "teacher" administers electric shocks to the "learner" as punishment for incorrect answers. Participants who were insulted more had a significant increase in HR as compared to the other groups during learning. When the roles were reversed the highly insulted group also had a marked increase in HR in anticipation of shocking the partner.

Thus the opportunity for revenge for insults resulted in increases in HR both when receiving the insult and when administering shocks to the instigator. Lanzetta and Englis (1989) examined SC in relation to cooperation and competition expectancies. No significant differences were found between those who expected cooperation versus those who expected competition. From these results it appears that some types of expectation effects are not manifested in physiological responses.

From the review thus far, we can observe that a "fight" situation where a "victim" can turn on their perceived aggressor does not result in decreases in HR but increases. Therefore, it is likely that we have not truly differentiated, through laboratory control, between a "fight" or "flight" response by measuring HR or SC.

Measures of HR in response to attention and cognitive processing can be traced back to Wundt's experiments in the early 1900's and the linking of emotions with physiological changes were discussed by James in the late 1800s (James, 1884 as reported by Levenson, 1992).

However, analyses conducted more recently have found that increased attention results in HR deceleration whereas increased cognitive load results in HR acceleration (Lacey, 1959, 1967). Jennings and Matthews (1984) hypothesized that decreases in HR in response to electronic stimuli could be indicative of increased attention and deliberate cognitive processing. They found that decreased HR was related to focused attention. HR was measured as boys were focusing on an electronic game of pong (target acquisition). HR decreased from baseline when anticipating release of the game ball. Therefore this supports previous findings that when acquiring a target, a participant will exhibit a decrease in HR if focusing attention on the task.

Zahn-Waxler et al. (1995) also provided support for the hypothesis that focusing of attention results in lowering HR. Zahn-Waxler and associates studied boys and girls measuring HR and SC (skin conductance) while listening to emotion provoking stories.

They found that HR decreased when the children were paying attention to a novel stimulus. They also found that higher HR and HR deceleration (presumably from the focusing of attention), predicted empathic concern and prosocial behavior. Lower HR was also associated with aggression and avoidance ratings by their teachers and the experimenters (see Scarpa & Raine, 1997 for a complete review). In a related report Perry, et.al.(1997) examined a "predatory" sub-set of boys which "bullied" and commonly aggressed against others in a residential treatment center. These boys exhibited marked decreases in HR when they discussed violent events they had participated in. They also described a "soothing, calming feeling when they began stalking a potential victim." This finding is key to the present study in that these boys were evidently not in fear and thus not exhibiting a fight or defensive response. But rather they appeared to be exhibiting a predatory response belonging more to the category of instrumental aggression.

Heart Rate decreases in chronically aggressive individuals and antisocial individuals particularly have recently been investigated by several research groups. Fear response in psychopathic and non-psychopathic individuals was investigated by Patrick, Cuthbert and Lang (1994). They found that psychopathic individuals exhibited less autonomic activation than controls when processing fearful images. This effect was evident from HR and SC measures.

In a previous study, Patrick, Bradley and Lang, (1993) found that participants who were more antisocial displayed a decreased startle potentiation response when viewing pictures which were aversive. These studies indicate that antisocial participants appear to have a decreased responsivity to anxiety-producing stimuli. However, in a related study, the investigators found that antisocial participants may exhibit an autonomic "pressor" effect when faced with conflict-producing stimuli.

In this study, Gottman, et.al. (1995) investigated physiological differences between Type I and Type II domestic batterers. Type 1 batterers are thought to have antisocial personality disorder-like traits and are globally more violent in their interactions with others. Type 2 batterers are thought to have less antisocial personality traits and typically are violent only to family members. They placed the batterers in emotion-provoking sessions with their spouses (where they discussed problem areas of their marriages). They found that the Type 1 (antisocial) batterers exhibited a marked increase in IBI (lowering of HR) in comparison with Type 2 domestic batterers. During the experimental task the Type 1 batterers appeared to have stopped their excitation response after only a few minutes and increased their IBI when they began focusing on their mate. The investigators theorized that this subset of batterers may be "vagal reactors". Therefore in the preparation to perhaps commit acts of aggression, a person may exhibit a decrease in HR either as an emotional response or as an act of cognitive focus and concentration. When examining human aggression, two general forms have been identified in the literature: instrumental or predatory aggression which is controlled, focused aggression, for the purpose of gaining something (i.e. robbery, hunting, etc.) and defensive, fight or flight (defensive, or affective) aggression (fleeing a predator or fighting when cornered) which is more excitatory and less controlled.

When considering the investigation of a "flight" response versus an instrumental or purposeful approach to a conflict situation, one might presume that both responses would be excitatory and thus heart rate (HR) would increase. Contrary to intuition, it appears that in humans, a flight response increases arousal for reasons of preparing the organism for action, whereas a predatory or instrumental response may lower autonomic activity in preparation to focus cognitive skills on the target of intended aggression.

It would appear from the research to date that we should expect a participant's HR to decrease when concentrating, tracking a target and committing aggression. In a conflict situation where the participant is in the role of victim, we would expect ANS functions to increase as a manifestation of the "flight response" We now turn to the issue of presence and how it could influence the outcome of computer simulations presenting aggressive conflict.

Many elements of presence in the computer simulation which were presented but not controlled or manipulated in the pilot study were carefully examined. In the study, one area of presence which was employed, but not controlled was the level of blood and gore. The levels of blood and gore in this simulation can range from simple bullet holes, to the character literally exploding into bloody vapor and body parts. This was not held constant during the pilot resulting in inconsistent presentation of the two death sequences.

Some studies show that HR deceleration occurs when participants experience disgust if exposed to mutilation and butchery images (Hare, Wood, Britain & Shadman, 1971, Hare 1972, and Klorman et.al. 1975). Hare and associates (1970, 1971) found however that participants can have differential reactions to images of gore. To some individuals a picture of a slaughter house elicited pupil dilation and HR acceleration as the stimulus was interpreted as unpleasant and arousing. However other individuals shown the same picture responded with "morbid fascination" and exhibited subsequent

HR deceleration and pupil constriction. With a rapid visual sequence of blood and gore we would expect to see an acceleration of HR and increase in SC measures.

In the computer science field, and particularly in regards to VE, the concept of "presence" has received much attention (see Lombard & Ditton, 1997, for a review). "Presence" is the measure of how close to "real" a virtual environment is subjectively interpreted and experienced by a participant. In this area computer scientists are currently examining which variables appear to be most important to convey this sense of reality and which variables are not. When examining such variables ranging from dynamic lighting and shadows, to collateral noise these researchers quantify and measure the system variables but from our perspective, do not necessarily conceptualize the cognitive or sensory variables in the same way. Although many have included physiological variables in their measurements of VEs, according to their training, they tend to examine computer variables such as frame rate, brightness and other factors. Psychologists may contribute to this area of research if we examine these factors in light of cognitive processes which may moderate or mediate those physiological responses.

One element of presence which was not manipulated was the sound quality and complexity. In the pilot, only primary sound effects were used and the participant did not wear headphones to isolate stray sound sources. Other sounds in the laboratory which may have contributed to a lack of presence were keystrokes, mouse movements, chair wheels and other sounds.

Surprisingly few researchers have examined the effects of sound and sound complexity on the quality of presence and physiological reactivity to computer simulations. Gelkey and Weisenberger (1995) predicted that auditory information was necessary for an adequate sense of presence even when all other sensory modalities were experienced in a VE.

Stereoscopic displays like those employed in the present study were used by Hendrix and Barfield (1996) to subjectively measure a participants' sense of presence. They found that participants reported a greater sense of presence when auditory stimuli was present even though the environment was stereoscopic as contrasted with using a full VE helmet.

Murray, Arnold and Thornton (2000) induced moderate hearing loss using wax ear plugs. Had small N and used only subjective reporting. The actual hearing loss was not measured. Pre and post hearing tests were not given to measure the true amount of loss. Found that participants had a wide range of negative experiences which led to a feeling of lack of presence and general detachment.

Level of complexity was not controlled during the pilot as well. Although several researchers have proposed different classifications for sounds, Ramsdell proposed 3 levels: Social hearing which includes linguistic and musical hearing, the second is warning hearing which signals an event or what psychologists would call a sign-stimulus. And lastly was called primitive hearing. This category refers to background, ambient or environmental sounds.

One way that game designers have been able to compensate for this lack of auditory information is to provide thematic background music which plays during the game action. This effectively camouflages the absence of the ambient sound which should be present adding to the games realism. The music also adds a cinematic feel to the game.

Murray, Arnold and Thornton (2000) proposed five auditory dimensions of presence which can be measured during a VE: Self presence occurs where participants attended more closely to their bodily functions such as breathing and heart beat while their hearing was impaired by the earplugs. Environmentally Anchored presence is feeling as part of the environment and not simply an observer. Accentuated presence is a heightened sense of environmental presence. Social presence is experienced in communication with others in that environment. And lastly, Intellectual presence is "logically knowing" where one exists in reality. These areas appear to have face validity, but have yet to be verified through careful analysis.

Although these may be valid interpretations of their survey data, a cognitively oriented conceptualization may be more amenable to research methods than these global components. It was proposed that varying levels of auditory complexity be employed in this study to measure the graded effects of audio complexity on HR and SC levels.

Another problem with presence was that the virtual characters had a "fantasy" space trooper appearance rather than a more realistic, 21st century appearance. It was decided to manipulate this appearance, creating a male character which was dressed in present day apparel. Although it is understood that game designers work with a particular theme, for research purposes it may be necessary to portray the characters in a more reality-grounded fashion.

The project was conducted in two phases. In phase one, the differences between the aggressor and victim were measured employing the manipulations of audio complexity and level of gore to observe changes in response magnitude. Considering these changes in presence control and measure, the present study was designed to examine the physiological differences between a human aggressor and human victim as vicariously enacted through a two-dimensional computer simulation. It was predicted that during a simulation where the participant acted as an aggressor, deceleration of HR and a general decrease in SC would be observed similar to recent studies which found that exposure to images of butchery, intense concentration and instrumental aggression resulted in a deceleration of ANS functions. It was also hypothesized that when acting in the role of victim, a participant's HR and SC would increase as a physiological manifestation of the flight response. It was predicted that more complex audio levels would result in a greater magnitude of differences between the two conditions (Aggressor vs. Victim) and that higher levels of blood and gore would result in an increased magnitude of differences between the conditions.

The second section of the project was developed to measure any systematic presentation effects by comparing independent measurements to the previous aggressor condition measurements in a simple between groups' test. It was predicted that independent measures would not significantly differ from measures during the aggressor condition. Lastly, habituation effects from repeated exposure to violence when presented in an extremely controlled fashion (see methods below) were to be measured.

It was hypothesized that participants would exhibit a significant acceleration from baseline measures on the first trial, and an accompanying longer time to recovery. In subsequent trials it was predicted that this response would decrease in magnitude as trials increased and the recovery time would become increasingly shorter as trials increased.

Method

Subjects

A total of 42 college students with no prior history of pathology were recruited through campus postings and undergraduate psychology courses for the 2 hour experiment. Four students' scores were excluded because of confounding factors or equipment malfunction problems during testing which could not be repaired in an expeditious manner.

Some participants received extra course credit for their participation. All participants admitted into this study gave informed consent (see appendix A) and were be treated in accordance with the Loma Linda University Institutional Review Board, Ethical Guidelines and the American Psychological Association's Ethical Guidelines for Psychologists (APA, 1992).

Materials

Prior to testing, a general demographics questionnaire was completed by the participants to collect categorical data. In addition, the questionnaire asked general health questions to ensure that a specific disability (such as hearing problems) would not interfere with the investigation protocol. Participants were also asked questions regarding psychological treatment for any disorders, medications taken, and video game playing attitudes, feelings and participation in any computer game playing.

Apparatus

Three IBM compatible, Pentium computers were used in the laboratory. Two computers were networked and used to present the experimental conditions. The third computer was dedicated to the collection of physiological data during the experimental trials. HR, SC was measured through surface electrodes. The HR and SC measures were filtered and analyzed by a Biopac Systems, Inc., MP100 workstation. The data for these measures were analyzed using Biopac Systems, Inc., Acqknowledge v.3.3.2 software. These measures were collected at 100 samples per second and averaged for every second. All computers were time-synchronized before each session to match collected data with the stimulus presentation.

A virtual interaction complex was constructed using a Quake 3 editing program (BSP v.9.2) creating a controlled electronic environment for the Participants to interact with. The program itself was Quake 3 which is a first-person action game that ran in modified C code under a Windows XP shell. The virtual complex was created to represent a large indoor chamber (see Figure 1). A chain-link fence was created to isolate the Opponent from the Attacker. While the fence was in place, the Attacker could not shoot the Opponent character, but both remained in full view of each other. The fence was retracted into the floor at a designated time interval where the Attacker was allowed to shoot at and kill the Opponent character. The Participants could see their opponent's movements in the complex at all times.

A dias was created at one end of the chamber to contain the Attacker while tracking the Opponent during the first phase of the trials. This area was equipped with waist-high bars which prevented the character from shooting or moving left, right, forward or backwards. Participants were instructed that the interaction was to take place between the Participant and the Experimenter. In actuality the opponent was a computer controlled character which was given specific paths and actions to follow; ensuring the stimulus presentation was uniform between participants. The presentation order of the Participant tasks of Attack and Avoid, the levels of Gore and the Sound level was counterbalanced to prevent any order effects from the conditions.

Procedure

Preparation

The questionnaire and scale administration took place individually in the laboratory testing chamber. The chamber measured 3m x 3m x 4m, was equipped with sound dampening walls, and light and temperature were held constant. The testing chamber contained a desk, chair, computer with monitor, keyboard and mouse on the desk.

The Participants were then fitted with ECG electrodes attached in a Lead II configuration on the left and right medial forearms and the dorsomedial surface of the left foot. The ECG electrodes measured 35 mm with a 10mm recording surface and used shielded leads. The SC electrode was attached to the palmar, second phalange of the middle and ring fingers on the non-dominant hand. All dermal surfaces were prepared by vigorous cleaning using isopropyl alcohol applied with a 4"x4" gauze pad. The electrodes for ECG and SC recording were applied using conducting gel.

After electrode fitting and testing, a set of standard instructions, delivered by a script, was read for each participant which explained the tasks to be performed. Proper responses were monitored by the Experimenter to ensure the Participants understood the instructions.

Experimental Conditions

All experimental conditions involving the participants took place in a video game virtual fighting complex created for this experiment. The procedure which follows refers to the Participant's virtual character in the game and not actual personal violence. The Participants will be allowed 10 minutes to familiarize themselves with the controls and to decrease the novelty of the video game environment.

Testing phase one was conducted using a 2x2x3x4 within-subjects design. Factor A is the Type of Situation having two levels: Attack vs. Defend. Factor B is the Level of Gore having two levels: Maximal and Minimal. Factor C is Audio Complexity having three levels: No sound (Mute), character only sound (Medium) and character plus ambient sound (Full) and lastly, Factor D is measurement phase (baseline, track, shoot & kill).

Following familiarization and baseline measurement, the two experimental conditions were presented in completely counterbalanced order with the initial task randomly assigned for a total of 12 trials (see Table 1). Condition A: Attack involved Participants playing the role of Attacker, whose task was to first track the opponent with a gunsight crosshair for either 10 or 15 seconds, and then attack the opponent, killing it with a machine gun as quickly as possible. Condition B: Defend involves the Participant playing the role of a defenseless character, where they were tracked by an Attacker for either 10 or 15 seconds and then the Attacker shot and killed the Participant's character.

Table 1. Measurement Phases by Condition

Condition	Phase of Measure				
Aggressor	Baseline	Track	Shoot	Kill Target	Recover
Defender	Baseline	Be Tracked	Shot at	Be Killed	Recover

In all experimental conditions the Attacker used a machine gun with unlimited ammunition, and the Opponent had no weapon. The Opponent had no weapon because (even though not the goal) it was anticipated that some Participants may attempt to turn and fight the Attacker thus confounding the responses to be measured. To control for reward or punishment effects on the Participants for completing the task, all Participants in all trials were allowed to complete the task successfully in all trials regardless of time taken. In between each trial while waiting for HR and SC to return to baseline, the participant was asked to watch a white "cross" computerized target on the monitor with a flat black background.

Condition A: Aggressor. The Participant received a typed message on the computer screen stating, "Prepare to track the Defender until you are released." Participants were instructed in the familiarization stage that the character would be immobile and could not fire weapons for the first few moments upon entering the complex. During this period, the Participant tracked the Prey's movements by keeping the targeting crosshair centered on the Prey until Participant's character was released into the complex.

The Participants character materialized on the dais at one end of the complex (see Figure 1-point A) and could only slew right and left in 360o . No other movements were permitted. The Opponent simultaneously materialized at either point B or C (see Figure 1) but could move side to side freely behind the chain-link barrier. After either 10 or 15 seconds the barrier was retracted into the floor and the Participant was instructed to shoot the Prey and terminate it as quickly as possible.

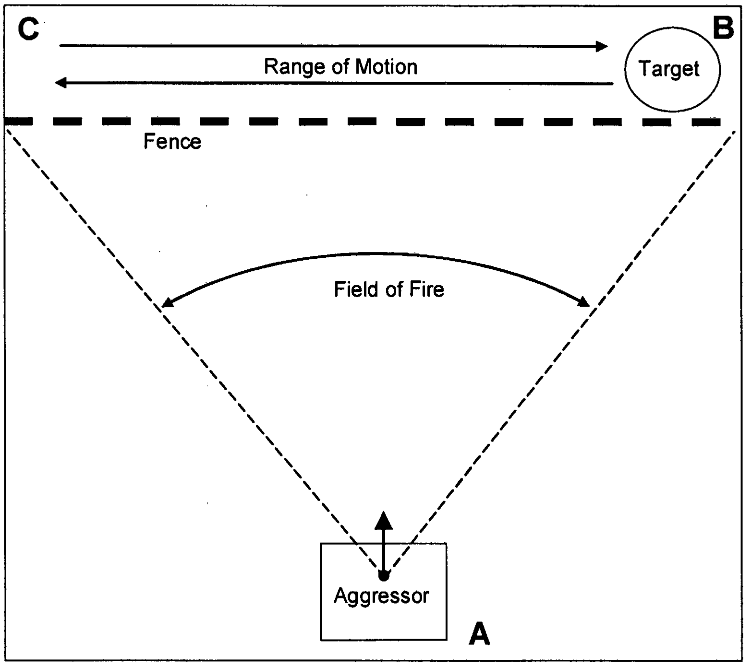


Figure 1. Controlled Virtual Interaction Arena

In all trials the Attacker was allowed to kill the Prey regardless of accuracy and time taken to complete the task in order to control for reward or punishment effects. Once the Prey was killed a message was displayed stating “Good Job, rest while game resets.” The Participant was then made to wait for one minute to allow HR and SC to return to baseline. After the rest period, Trial 2 was initiated in the same manner as above.

Condition B: Defender. Participants received a typed message on the computer screen stating "Stay alive as long as possible avoiding the Attacker's shots." The Participant was able to move side to side only, keeping the character at the same distance throughout the trails. During the first 10 to 15 seconds, the Participant moved from side to side and was told the Attacker was tracking the character with the cross-hair. Upon release, the Attacker began firing to attack the Participant. The Participant evaded the Attacker for as long as possible. At the termination of the character, the trial stopped and a message appeared on the screen stating, "Good Job, rest while the game resets." The same procedure was then repeated for a total of six trials.

Testing Section Two involved the presentation of separate measurement periods as displayed in Table 2. The elements of presentation used in Testing Phase one were presented alone and the Participant was allowed to recover from each trial before moving on to the next trial. This consisted of track-recover, shoot-recover followed by five trials of kill-recover using the active baselines in Phase one for comparison. This phase was conceived as a mixed-subjects design.

Table 2. Comparison of Phase one and Phase two

Condition	Phase of Measure				
Aggressor (Phase 1)	Baseline	Track	Shoot	Kill	Recover
Phase 2	Baseline	Track	Shoot Alone	Kill Alone	Recover

In this final "kill-recover" phase of measure the interaction room was prepared similarly except there was a central pedestal with a button on it. The participant was first briefed on the task using a script as before, but was instructed to simply press the button to eliminate the opponent. When the participant's character entered the area the character was on the dais as before and the opponent materialized approximately five seconds later behind the barrier as before. The participant was instructed to press the button as soon as the opponent materializes which instantly vaporized the opponent in the most violent manner utilizing the maximum level of blood and gore allowed in the game. After five more seconds the trial ended and the participant was instructed to rest and await the next trial. Upon completion, the Participant was debriefed (see appendix A) and any further questions were answered.

Data Scoring and Analysis

The Baseline measure was established by averaging the last minute of the initial rest period. The Active Baseline measure was calculated by averaging the last 10 seconds of the rest period for each task measurement. Critical points of measure were standard among the two conditions in phase one (see Table 1). These phases of measure are the critical points in behavior change in the tasks. These "phases" were: active baseline, track, shoot, and kill. As the behavior and task changes in video game presentation have not heretofore been measured, there is no standard to follow. Since the interaction in a real-time video game is fluid with only momentary pauses while files load, was necessary to first divide the game into attack (Attacker) versus Defend to represent a stressful situation. Next, the task was sub-divided into discrete measurement periods which corresponded to similar behavior under each task. For example, during the track phase, the Attacker tracks the Opponent, whereas the Opponent is being tracked. This yields comparable tasks from both points of reference for measurement and comparison.

All measures were taken at a rate of 100 samples per second and averaged each second for five seconds following stimulus onset. Aggregate physiological measures were averaged by trial for comparison and the five trials of "kill-recover" was analyzed by using a multivariate analysis to detect any learning or habituation effects.

Hypotheses

Primary hypothesis testing for Section One was completed by conducting a series of two complete within design ANOVAs, for the HR and SC measures separately.

1. ANOVA: 2x2x3x4 (Level of Gore x Condition x Audio x Sampling phase) Dv = HR
2. ANOVA: 2x2x3x4 (Level of Gore x Condition x Audio x Sampling phase) Dv = SCL

Tukey's HSD tests will be used to evaluate any other significant effects found.

Hypothesis testing for Section Two employed two mixed design 2x4 ANOVAs comparing the aggressor measurements in Phase One to the independent measurements of Phase two. The between subjects factor was Sequencing with two levels: Sequential and Independent. The within-subjects factor is phase of measure with the same four levels used throughout the study. HR and SCL was analyzed separately. Lastly the five trials of "kill" phase only, were compared to detect any sensitization or desensitization effects from the same repeated scenario.

Results

Demographic Analysis

A series of frequency distributions were calculated to determine the general demographic characteristics of the sample. The total sample of generally healthy college students was 38 participants:; 22 female and 16 male. Their ages ranged from 18 to 46 years with an average age of 23.2 (SD=11.91) years old. The ethnic diversity of the sample was largely representative of a Southern California population. Latin participants comprised the largest demographic group followed by Caucasian, Asian, African American and all others respectively (see Figure 2).

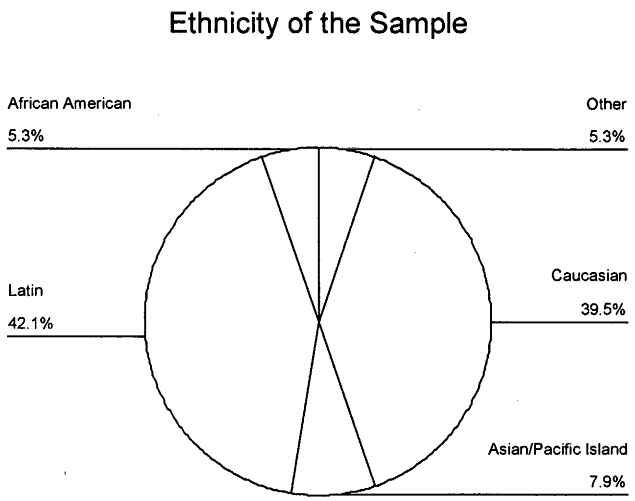


Figure 2: Demographic Composition of the Sample

Video Game Exposure Analysis

It was speculated that the very nature of the study might be more likely to attract those participants who are more familiar with video games and technology in general. Approximately one-third, or 31.6% of participants reported that they played video games. This subsample of participants was asked what types of video games they played and the frequency with which they played them. Games were classified generally into three categories; violent action, sports games, and non-violent games. Interestingly, 50% of these participants (or 15.5% of the entire sample) reported that they exclusively played non-violent video games. Approximately 8% of respondents reported playing sports games. Lastly, 7.25% of participants reported playing violent action type games (see Figure 3).

A Chi-Square analysis comparing differences in game preference by sex was performed. There was no statistically significant difference between males and females regarding the reported game type preference (Chi Square= .686, df=2, p=.710).

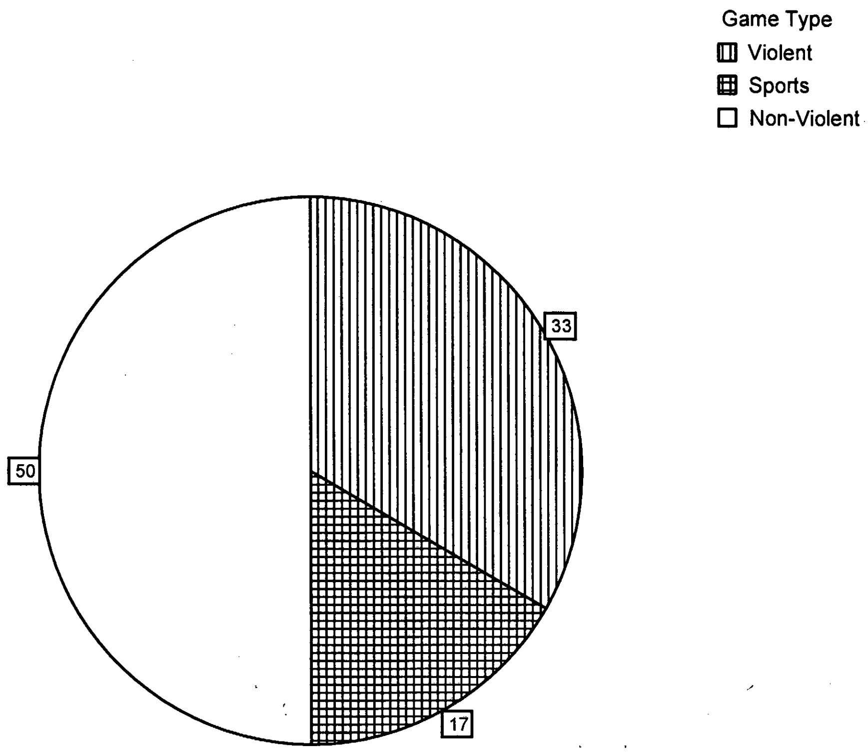


Figure 3. Game Preference of Participants Who Regularly Play

Those participants who reported playing video games were also asked to estimate the number of hours they played those games on a weekly basis. Their responses ranged from 14 hours per week to one hour per week with an average of 6.7 (SD=5.9) hours per week.

A One-Way ANOVA was performed comparing weekly gaming hours by gender (see Table 3). Although males reported a higher number of average hours spent gaming each week, there was no statistically significant difference between males (M=3.09,

$\underline{SD}$=5.03) and females ($\underline{M}$=1.41, $\underline{SD}$=4.1) when comparing weekly hours spent playing games, $\underline{F}$ (1, 36)=1.29, $\underline{p}$=.263).

Subjective Impressions of the Experience

Participants were asked to rate their subjective experiences in four dimensions; level of control, pleasantness, arousal, and realism. One-way ANOVAs were conducted to evaluate any differences between males and females regarding their subjective perceptions of the laboratory conditions (see Table 3). The mean ratings grouped by gender are displayed in Figure 4.

Ratings of perceived control were collected to examine the perception of mastery or competency during the trials. The ratings ranged from being "In Control" to "Lacking Control". Males ($\underline{M}$=5.38, $\underline{SD}$=1.63) and females ($\underline{M}$=5.45, $\underline{SD}$=1.36) reported very similar levels of perceived control during the testing sessions resulting in a small, non-significant difference between the genders, $\underline{F}$ (1,36)=.030, $\underline{p}$=.862.

Pleasantness referred to the level of happiness or recreational quality of the experience. Responses ranged from Pleasant to Unpleasant. Again, the ratings of males ($\underline{M}$=4.75, $\underline{SD}$=2.05) and females ($\underline{M}$=4.82, $\underline{SD}$=1.5) were not statistically different, $\underline{F}$ (1,36)=.041, $\underline{p}$=.906.

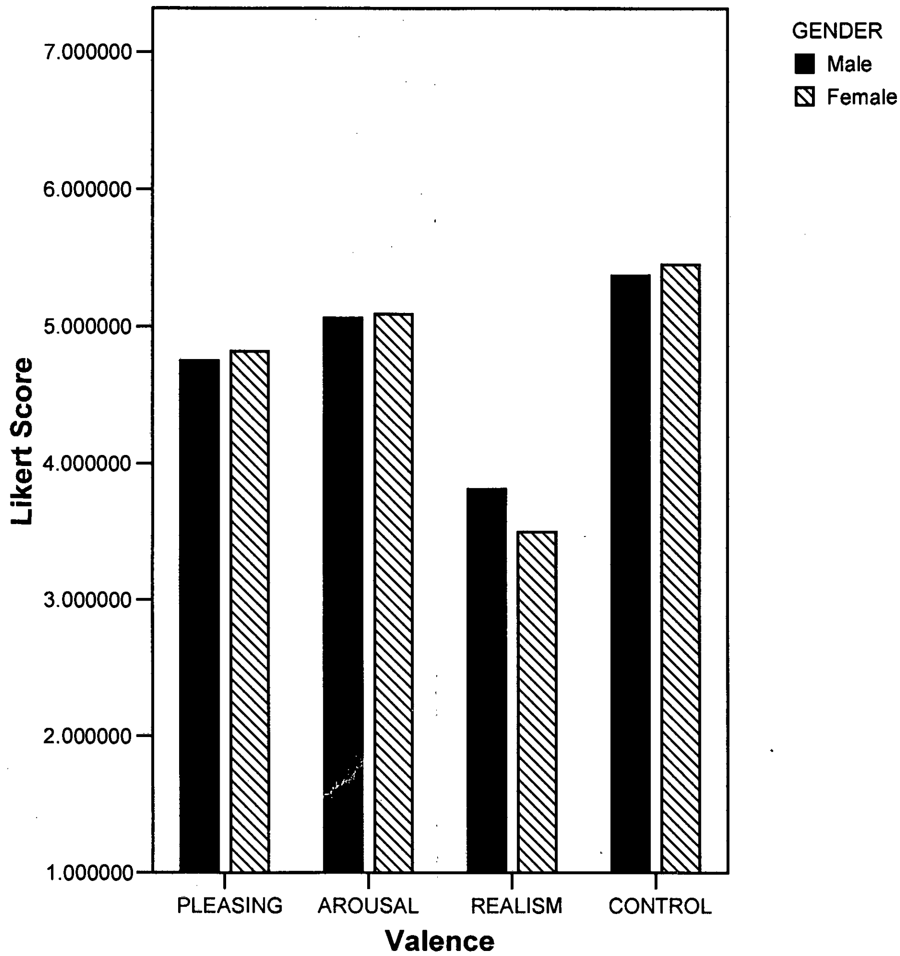


Figure 4: Subjective Impressions of Experience

Arousal was described as the participant's level of alertness and excitability. Responses ranged from Excited to Calm. Males (M=5.06, SD=1.24) and females (M=5.09, SD=.921) did not significantly differ in this dimension either. $F(1,36)=.007$, $p=.936$.

Realism referred to the salience or presence of the experimental trials and how believable of an experience the individual participant perceived. The scale ranged from Realistic to Unrealistic on a six point Likert scale with limit anchors (see Appendix B).

Again, the scores among men (M=3.81, SD=1.97) and women (M=3.5, SD=2.13) were statistically similar, $F(1,36)=2.12$, $p=.648$, a non-significant result.

Across the domains of perception, relevant to the present investigation, there were no significant differences between males and females.

Table 3: One-Way ANOVA of Self-report and Self-assessment Measures

		Sum of Squares	Df	Mean Square	F	Sig.
Hours played	Between Groups	26.290	1	26.290	1.294	.263
	Within Groups	731.428	36	20.317		
	Total	757.717	37			
Level of Control	Between Groups	.059	1	.059	.030	.862
	Within Groups	69.205	36	1.922		
	Total	69.263	37			
Pleasantness	Between Groups	.043	1	.043	.014	.906
	Within Groups	110.273	36	3.063		
	Total	110.316	37			
Arousal	Between Groups	.007	1	.007	.007	.936
	Within Groups	40.756	36	1.132		
	Total	40.763	37			
Realism	Between Groups	.905	1	.905	.212	.648
	Within Groups	153.938	36	4.276		
	Total	154.842	37			

Primary Hypothesis Testing

Data were reduced by examining the data for outliers and removing those instances where the physiological data reflected aberrant measures due to unknown factors. After examination of the raw data, any score which was more than three standard deviations from the group mean in that particular condition were excluded. All physiological data presented are displayed as the difference from the baseline measure in that particular measurement phase unless otherwise stated.

Hypothesis 1A: Heart Rate Analysis

When examining the differences between the Aggress vs. Defend conditions while collapsing both the Gore Level and Audio Complexity, the patterns of response across phases of measure were remarkably similar (See Figure 5). A complete within design ANOVA (2x2x3x4) was conducted to evaluate the effects of Condition, Gore Level and Audio Complexity by Phase of Measure (see Tables 4 and 5). The Main effect of Condition by Gore by Audio by Phase proved to be non-significant ($F(6,168)=1.20$, $p=.315$, CF=.585). The tests of phase by the other factors were analyzed using the ANOVA test as well. All conditions yielded non-significant results with the exception of the comparison of Phase of Measure by Gore. Upon further examination, a significant linear trend was observed between Phase of Measure and the two levels of Gore ($F(1,28)=6.65$, $p=.015$). During the active baseline phase of measure (Phase 1), the maximal level of gore condition (M= -.985 SD=1.52) was significantly lower than the Minimal level of Gore condition (M= 2.63, SD=.986). Additionally, during the Kill Phase of measure (Phase 4), the maximal level of Gore (M=2.63, SD=.986) was significantly higher than the minimal level or Gore (M=.917, SD=1.04) measure of heart rate.

The within subjects ANOVA comparison of the main effect for the Aggress/Defend condition was also evaluated (see Figure 5). Although the baseline measures appeared to differ somewhat between the conditions, as the phases of stimuli presentation progressed, the magnitude of response increased linearly with no appreciable difference between the conditions. $F(3,168)=2.204$, $p = .135$.

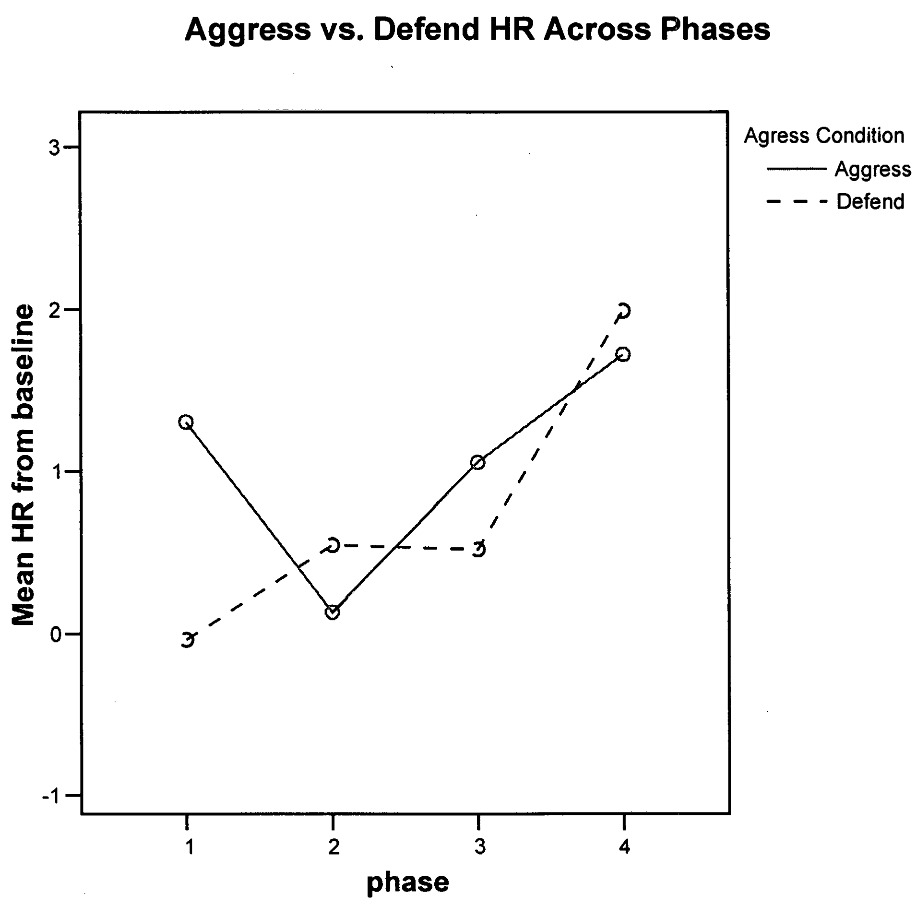


Figure 5: Aggress vs. Defend for HR Across Measurement Phase

The within design ANOVA also yielded results for the main effect of Level of Gore while collapsing Audio level and Aggress/Defend conditions. The resulting pattern of response exhibited in Figure 6, possibly indicated that as the active baseline measure was being recorded, participants varied somewhat in their expectations of the simulated environment. However, as the sequence progressed, we observe that the responses across conditions were extremely stable and followed a pattern of gradual increase with the maximal level of gore across all sound conditions registering slightly higher than the lower level of gore across active measurement phases. Upon further examination, a significant linear trend was observed between Phase of Measure and the two levels of Gore ($F(1,28)=6.65$, $p=.015$). During the active baseline phase of measure (Phase 1), the maximal level of gore condition (M= -.985 SD=1.52) was significantly lower than the Minimal level of Gore condition (M= 2.63, SD=.986). Additionally, during the Kill Phase of measure (Phase 4), the maximal level of Gore (M=2.63, SD=.986) was significantly higher than the minimal level or Gore (M=.917, SD=1.04) measure of heart rate.

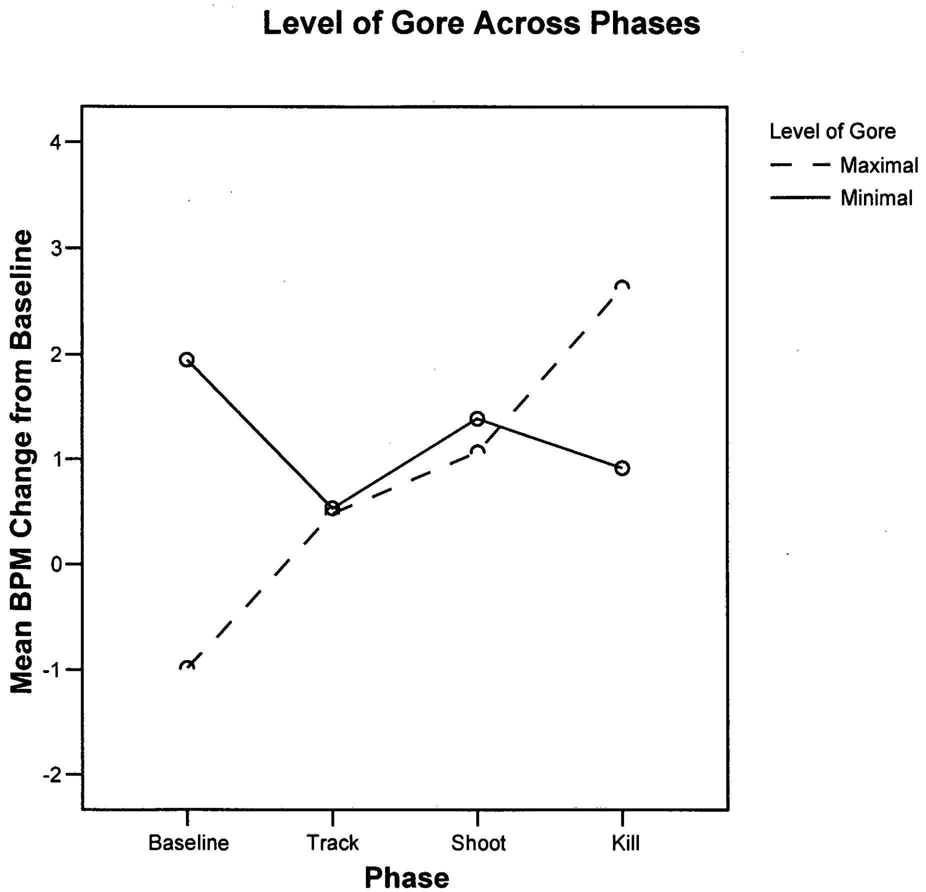
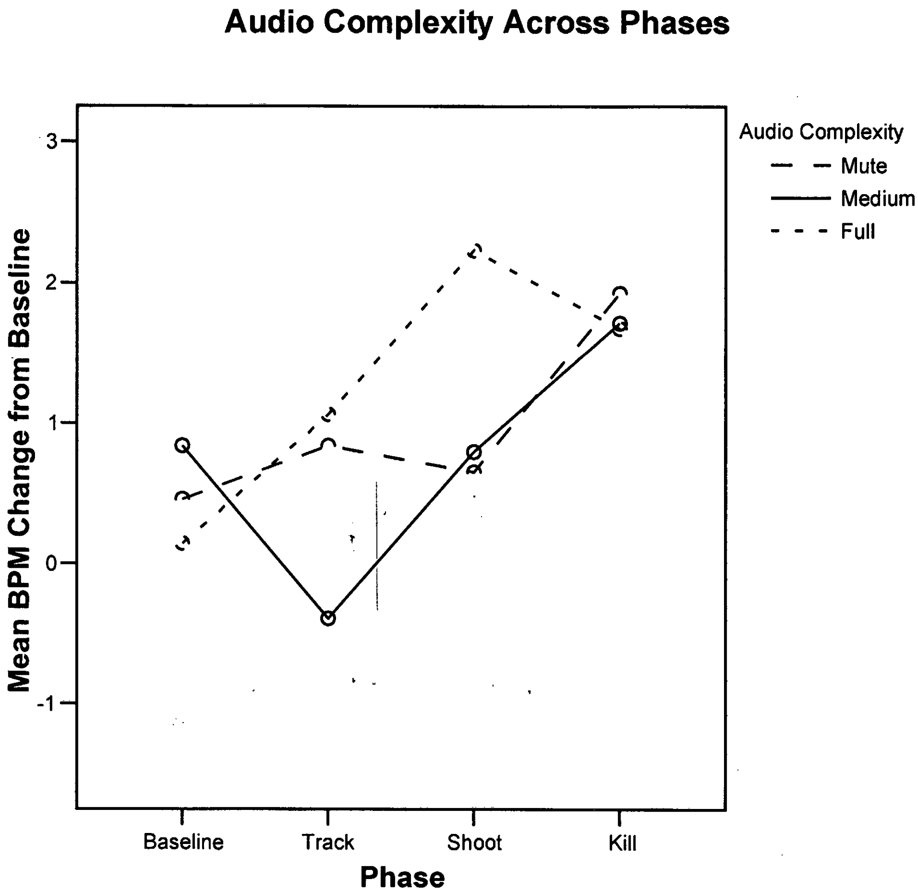


Figure 6. Maximal vs. Minimal Level of Gore for HR Across Phases of Measure

The independent results for the Audio complexity by phase of measure are displayed in Figure 7. Although the three levels of audio stimuli appeared to be similar during the active baseline condition (phase 1), during the tracking condition the response to the medium complexity appeared to differ slightly, albeit non-significantly (F(6,168)=.733, p=.563, CF=.626). Across the active measurement phases the Participant's HR elevated as the trials progressed in a linear fashion with the highest measurements for all conditions during the termination of the character, similarly to the Gore condition.

During the tracking Phase, the Medium audio complexity measured observably lower than the other measures. Hypothetically this could indicate some internal inspection of the audio stimuli when other than normal (i.e. either missing completely or fully present).

During the shooting phase of measure, the Full Audio measures elicited the highest change from baseline. Possibly the difference observed in the use of Full Audio was an artifact of the content complexity of the stimulus (i.e. machinegun firing).



Phase

Figure7. Audio Complexity for HR Across Measurement

Hypothesis 1B: SCL Analysis

Analyses of the primary hypotheses using SCL as the dependent measure were conducted similarly to the HR analyses.

A complete within design ANOVA (2x2x3x4) was conducted to evaluate the effects of Condition, Gore Level and Audio Complexity by Phase of Measure (see Table 6). The Main effect of Condition by Gore by Audio by Phase proved to be non-significant ($F(6,162)=.907$, $\underline{p}=.369$, CF=.205).

When examining the differences between the Aggress vs. Defend conditions while collapsing both the Gore Level and Audio Complexity, the patterns of response across phases of measure appeared to be discrete and followed a similar pattern of arousal with no significant changes from baseline (see Figure 8).

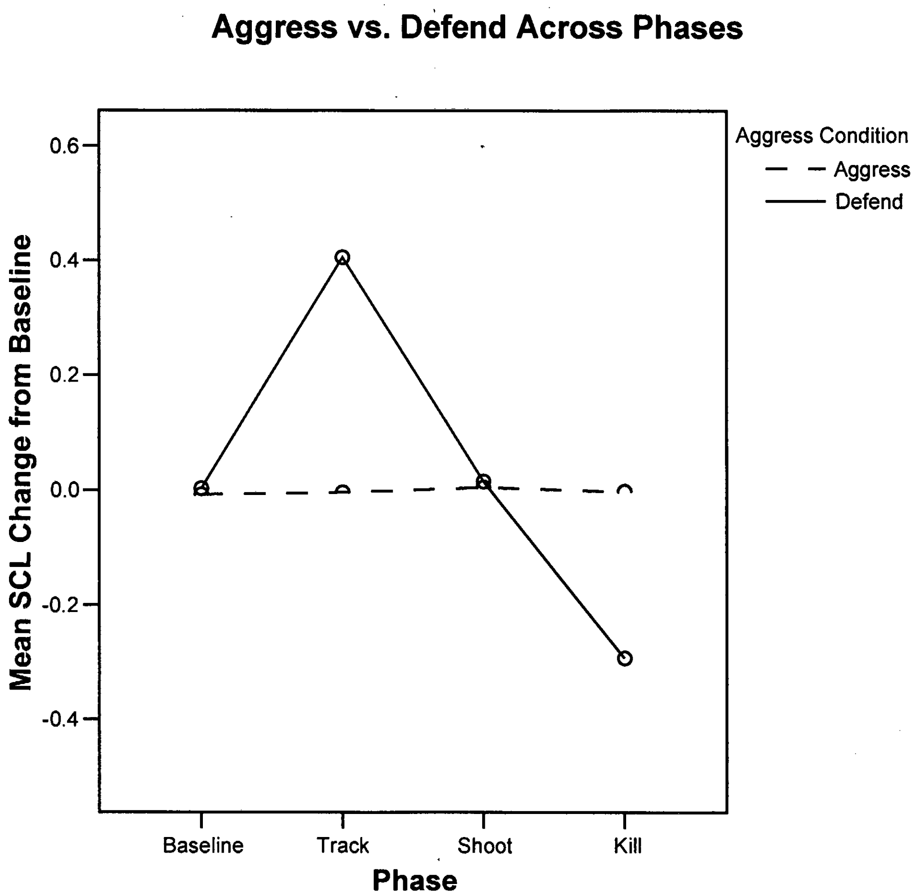


Figure 8. Comparison of Aggress vs. Defend by SCL Across Measurement Phase

The mixed design ANOVA comparison of the main effect for the Aggress/Defend condition was also evaluated. Although the different SCL measures appeared to follow the same pattern of response across conditions, the difference between the conditions at those intervals were not significant ($F(1,27) = .059$, $\underline{p} = ..809$). The participants' level of arousal as measured by SCL appeared to peak during the shooting phase and then begin a return to baseline thereafter.

The general activation of Participants when exposed to varying levels of gore was also examined. The mixed design ANOVA for SCL additionally yielded results for the main effect of Level of Gore, collapsing both of the Aggress and Audio conditions. The resulting pattern of SCL response exhibited in Figure 9 was a similar arousal pattern as the other measures. Again, an arousal pattern which peaks during the "Shoot" phase of measure is observed, followed by a return to a lower arousal state during the "Kill" phase. The levels of Gore as measured by SCL were almost identical and resulted in a non-significant difference between conditions across the phases of measure ($F(3,81)=.901$, $p=.445$).

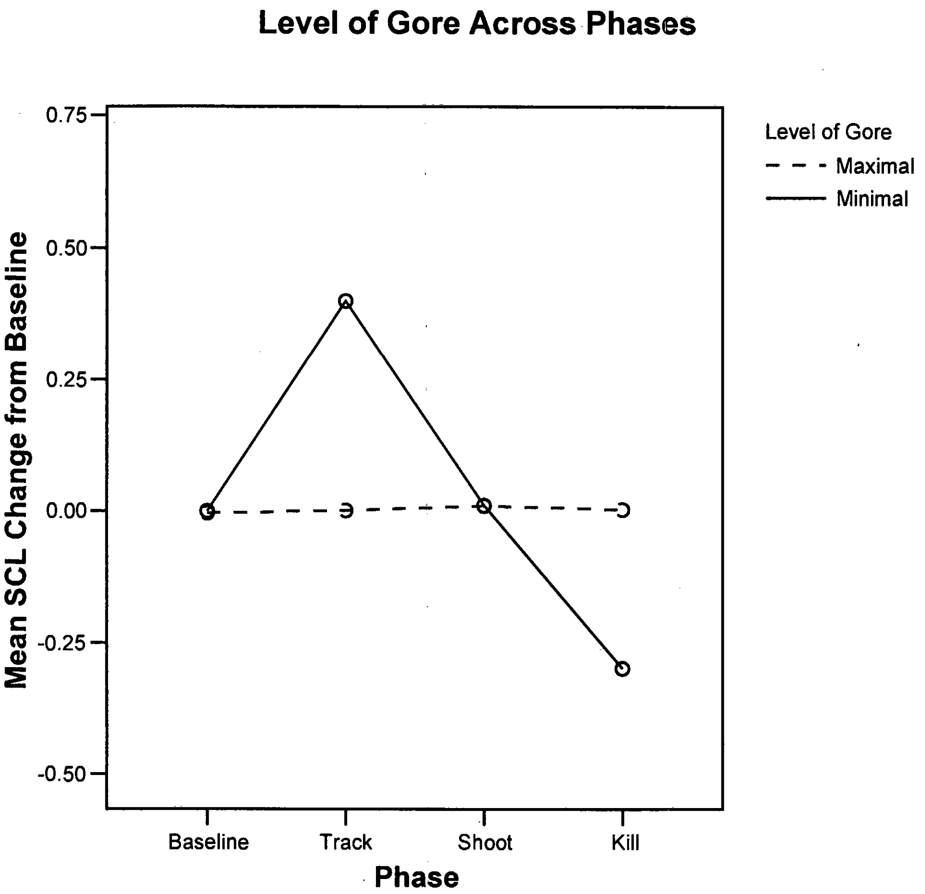


Figure 9. Comparison of Gore Levels by SCL Across Measurement Phase

The independent results for the Audio complexity by phase of measure are displayed in Figure 10.

Across the active measurement phases the Audio Complexity appears to have systematically changed the reactivity of response according to the various phases of measure. In concordance with the other main conditions for SCL presented above, the Participants' reactivity under the Full Audio conditions appears to peak during the "Shoot" phase of measure (3) and then excitation stops and begins to return to baseline. However the differences were again non-significant ($F(6,162)=.902$, $p=.495$).

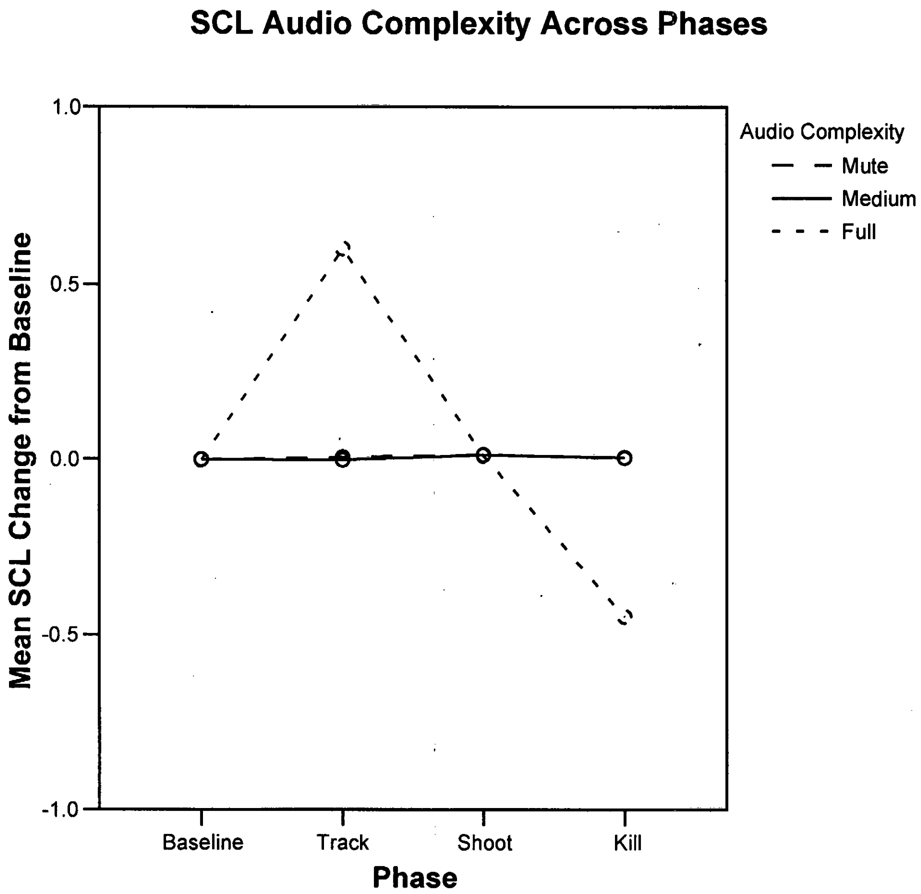


Figure 10. Comparison of Audio Complexity by SCL Across Phases

Main Effects for SCL across conditions were minimal. Although the difference in phase of measure appears to be a patterned response, the magnitude of physiological response was non-significant (see Table 7).

Hypothesis 2: Comparison of discrete versus independent measurements across phases

The second section of the project was created to measure any systematic presentation effects by comparing independent or discrete measurements (i.e. track-recover, shoot-recover, etc.) to the sequential Aggressor condition measurements in a between groups' test.

Discrete presentation of conditions versus "rolling" or sequential presentation of stimuli by measurement phase were also analyzed. Using SCL and HR as the dependent variables, the four phases of measure were compared when administered discretely and when presented as part of the entire experimental sequence.

Two Mixed Design ANOVA's were conducted with a modified data set where the Aggressor's experimental sequence phases were compared to the discrete phases of measure (see Tables 8 and 9).

Table 8. Within Subjects Effects for Independent vs. Sequential Measures for Heart Rate

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Obs Power
Sequence	Sphericity Assumed	286.369	1	286.369	2.617	.115	.073	2.617	.349
	Greenhouse-Geisser	286.369	1.00	286.369	2.617	.115	.073	2.617	.349
Phase	Sphericity Assumed	426.940	3	142.313	2.357	.076	.067	7.071	.576
	Greenhouse-Geisser	426.940	1.45	292.789	2.357	.120	.067	3.437	.388
sequence * phase	Sphericity Assumed	529.943	3	176.648	2.789	.045	.078	8.366	.657
	Greenhouse-Geisser	529.943	1.51	348.952	2.789	.085	.078	4.235	.458
Error(sequence*phase)	Sphericity Assumed	6271.437	99	63.348					
	Greenhouse-Geisser	6271.437	50.1	125.138					

a Computed using alpha = .05

The pattern of response to the measures of HR by Condition is exhibited in Figure 11. Across measurement phases, the independent measures were more variable that the sequential counterparts. In the Independent measure the Kill Phase measure was slightly lower than the independent active baseline measure. The Sequential measures demonstrated a slight downward trend.

A mixed design ANOVA was conducted examining both the interaction of phase by independent measure and the individual phases. The results indicated that there was an overall linear trend across phases but there was no significant interaction between phase and type of measure ($F(1,33)=.010$, $p=.921$).

Table 9. Within-Subjects Contrasts of Independent vs. Sequential Measures for Heart Rate

Source	sequence	phase	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Obs Power
Sequence	Linear		286.369	1	286.369	2.617	.115	.073	2.617	.349
Error(sequence)	Linear		3611.721	33	109.446					
Phase		Linear	145.187	1	145.187	1.367	.251	.040	1.367	.206
		Quadratic	253.570	1	253.570	5.401	.026	.141	5.401	.616
		Cubic	28.183	1	28.183	1.007	.323	.030	1.007	.164
Error(phase)		Linear	3504.868	33	106.208					
		Quadratic	1549.204	33	46.946					
		Cubic	923.695	33	27.991					
sequence * phase	Linear	Linear	.942	1	.942	.010	.921	.000	.010	.051
		Quadratic	459.087	1	459.087	6.497	.016	.164	6.497	.696
		Cubic	69.913	1	69.913	2.716	.109	.076	2.716	.360
Error(sequence*phase)	Linear	Linear	3090.310	33	93.646					
		Quadratic	2331.747	33	70.659					
		Cubic	849.379	33	25.739					

a Computed using alpha = .05

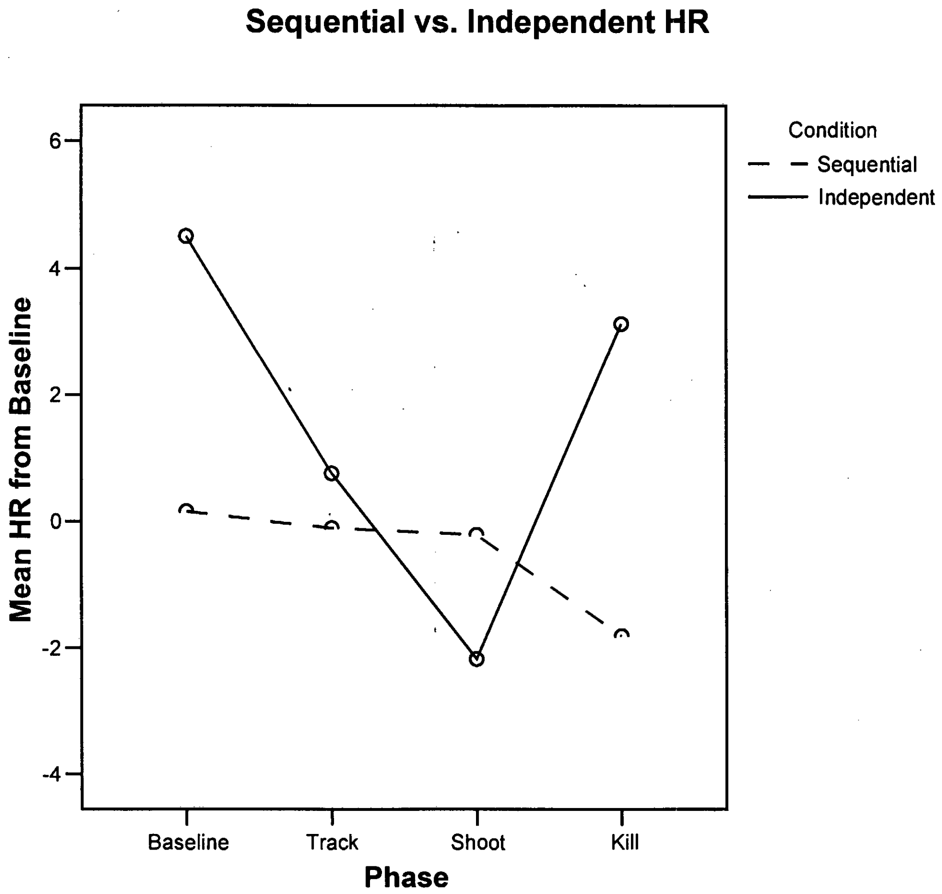


Figure 11. Comparison of Sequential vs. Independent Measures Across Phases (HR)

The pattern of SCL responses among the conditions is displayed in Figure 12. In both the Baseline Phase of measure and the Kill Phase of measure, the sequential condition appeared to elicit a higher magnitude change than the independent measures. During the Track and Shoot Phases there appeared to be a systemic, downward trend for both conditions.

A comparison of the sequential versus the independent measures of SCL across measurement phases was examined using a mixed design ANOVA (see Table 10&11).

Table 10. Within Subjects Effects for Independent Measures vs. Sequential Measures for SCL

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power(a)
Sequence	Sphericity Assumed	.000	1	.000	.035	.852	.001	.035	.054
	Greenhouse-Geisser	.000	1.000	.000	.035	.852	.001	.035	.054
Phase	Sphericity Assumed	.002	3	.001	.580	.629	.018	1.741	.166
	Greenhouse-Geisser	.002	1.269	.002	.580	.490	.018	.736	.123
sequence * phase	Sphericity Assumed	.005	3	.002	1.356	.261	.042	4.068	.350
	Greenhouse-Geisser	.005	1.175	.004	1.356	.258	.042	1.593	.218
Error(sequence*phase)	Sphericity Assumed	.120	93	.001					
	Greenhouse-Geisser	.120	36.410	.003					

a Computed using alpha = .05

The results indicated that the interaction between independently measured phases and method of measure yielded a non-significant difference The main effect for phase resulted in a significant difference ($F(1,31)=7.63$, $p=.010$). However, when the violation of sphericity was accounted for, the result was unreliable.

Table 11. Within Subjects Contrasts of Independent Measures vs. Sequential Measures for SCL

Source	sequence	phase	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power(a)
Sequence	Linear		.000	1	.000	.035	.852	.001	.035	.054
Error(sequence)	Linear		.109	31	.004					
Phase		Linear	.001	1	.001	7.627	.010	.197	7.627	.763
		Quadratic	.000	1	.000	.011	.917	.000	.011	.051
		Cubic	.001	1	.001	2.931	.097	.086	2.931	.382
Error(phase)		Linear	.006	31	.000					
		Quadratic	.110	31	.004					
		Cubic	.009	31	.000					
sequence * phase	Linear	Linear	.000	1	.000	.001	.973	.000	.001	.050
		Quadratic	.005	1	.005	1.382	.249	.043	1.382	.207
		Cubic	.000	1	.000	1.532	.225	.047	1.532	.224
Error(sequence*phase)	Linear	Linear	.003	31	.000					
		Quadratic	.111	31	.004					
		Cubic	.007	31	.000					

a Computed using alpha = .05

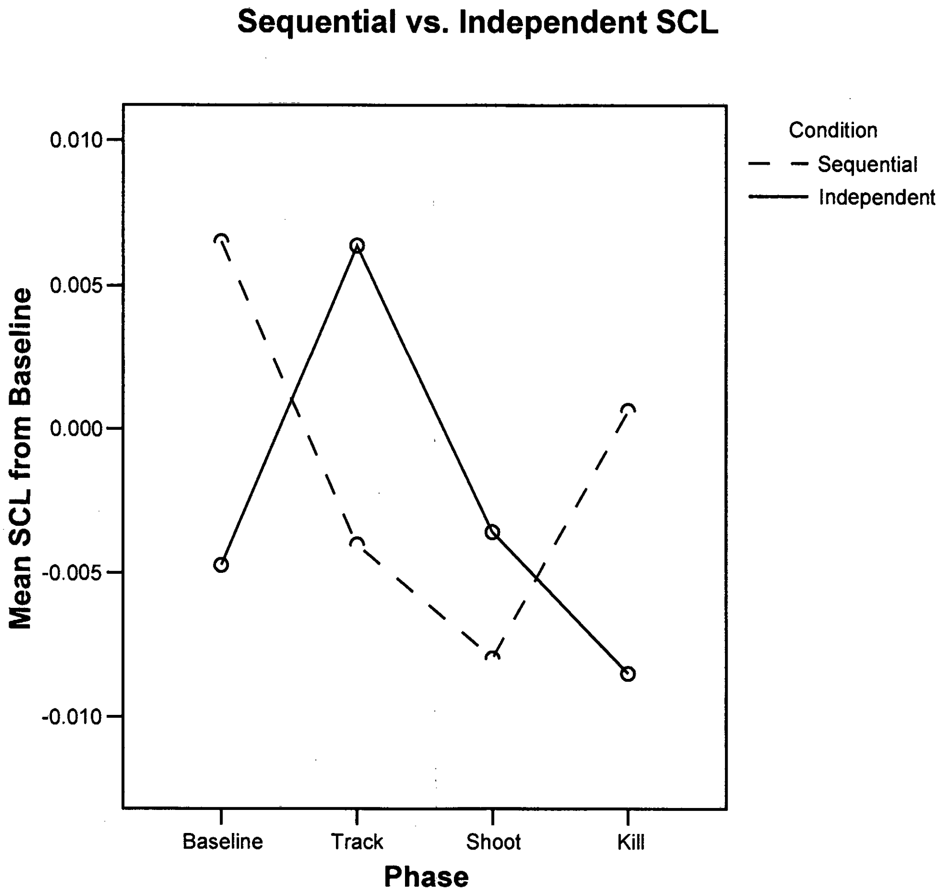


Figure 12. Comparison of Sequential vs. Independent Measures Across Phases (SCL)

Hypothesis 3: Repeated Kills and Learning Effects

Two Oneway ANOVA's were conducted to evaluate the effects of repeated exposures to the "kill-recover" phase of measure (see Table 12). A baseline measure was followed by 5 trials of simply destroying the Participants' opponent.

The results for HR across the repeated "kill" trials are displayed in Figure 13. Interestingly the Participants' HR increases dramatically from baseline to the third trial. Thereafter the response rate appears to begin a downward trend towards baseline again.

Although the pattern of response appeared to be meaningful, the Oneway ANOVA conducted for HR across the repeated trials resulted in no significant differences among the trials (F(5,214)=.32, p=.90).

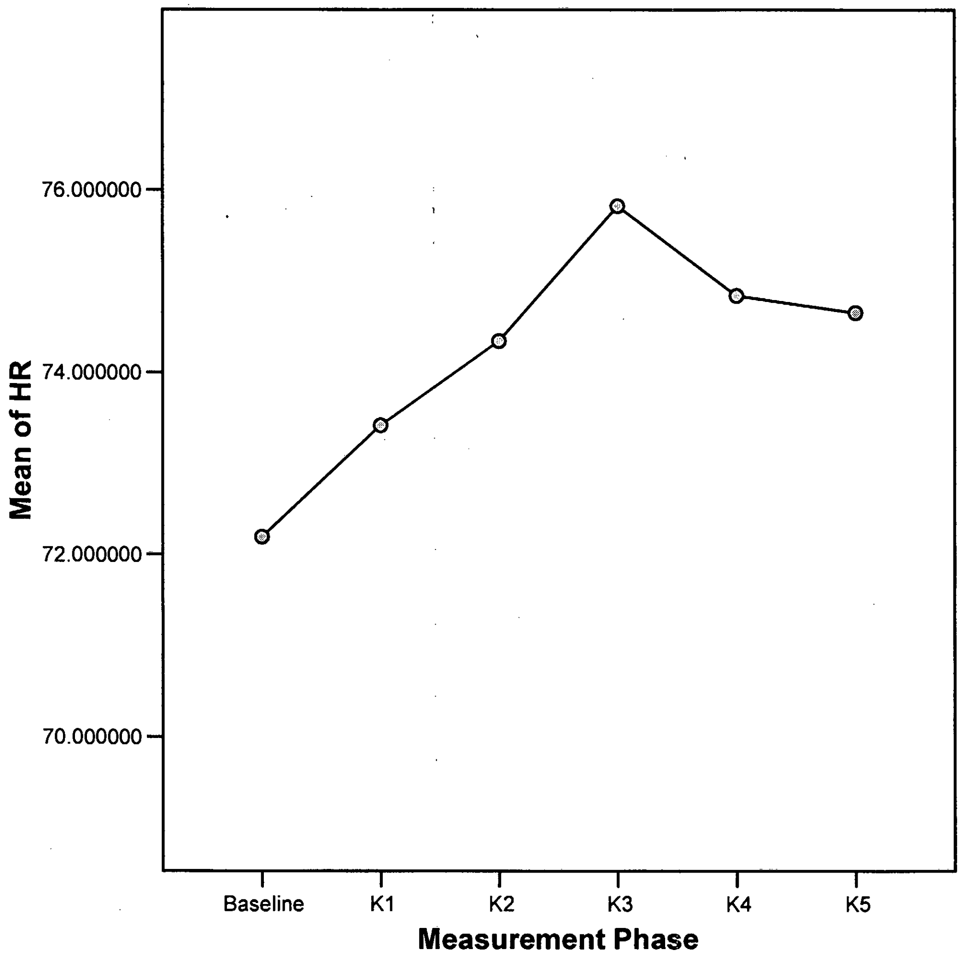


Figure 13. HR of Repeated Kills Over Five Trials

The measure of SCL for the same task of repeated kills is exhibited in Figure 14. The pattern of reactivity appeared to vary from trial to trial with little distinguishable trend.

The Oneway ANOVA for SCL also resulted in no significant differences among the repeated trials ($F(5,203)=.487$, $p=786$).

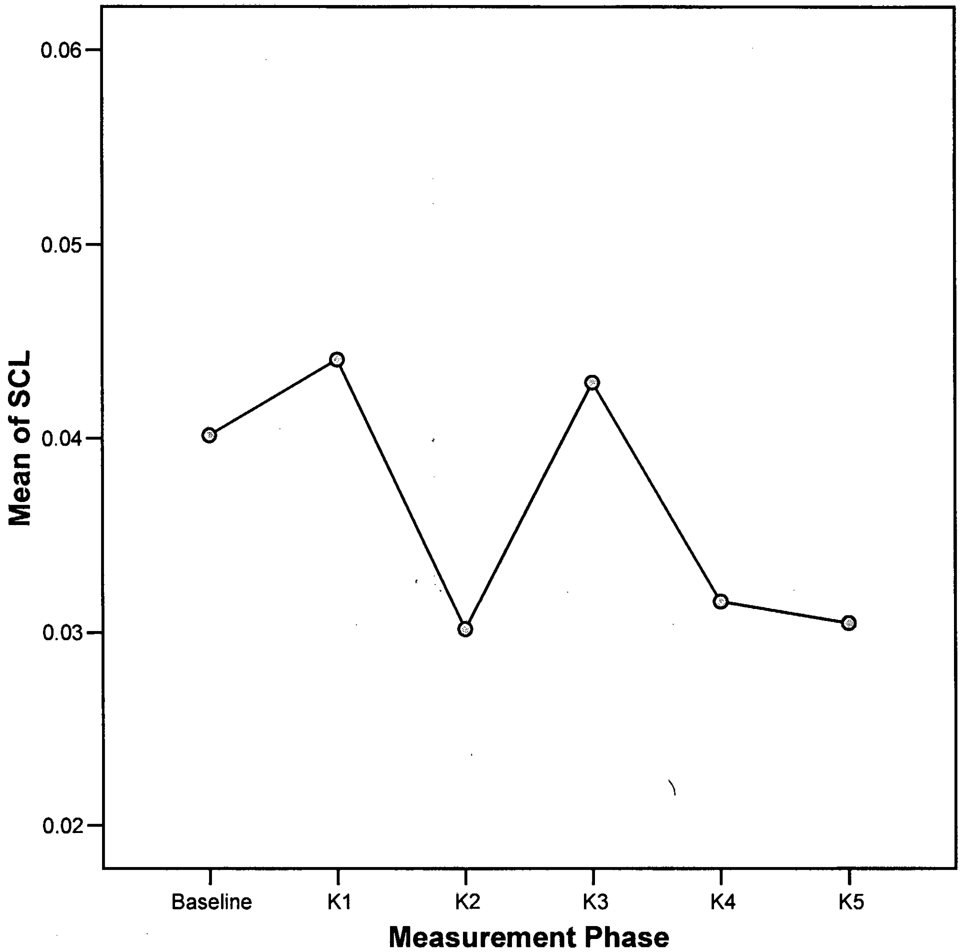


Figure 14. SCL of Repeated Kills Over Repeated Trials

Table 12. Hypothesis Testing for Repeated Kills with Intertrial Recovery

				Sum of Squares	df	Mean Square	F	Sig.
SCL	Between Groups	(Combined)		.007	5	.001	.487	.786
		Linear Term	Unweighted	.000	1	.000	.150	.699
			Weighted	.000	1	.000	.140	.709
			Deviation	.007	4	.002	.574	.682
	Within Groups			.583	198	.003		
	Total			.590	203			
HR	Between Groups	(Combined)		282.163	5	56.433	.320	.900
		Linear Term	Unweighted	19.659	1	19.659	.112	.739
			Weighted	19.390	1	19.390	.110	.740
			Deviation	262.773	4	65.693	.373	.828
	Within Groups			36831.228	209	176.226		
	Total			37113.390	214			

Discussion

After a pilot study was conducted for the purpose of fulfilling a formal thesis requirement at this University (Brannon, 2003), several recommendations for enhancing the study and perhaps being able to examine the effects of virtual interaction "in extremis" were proposed. The present study was designed to examine the physiological differences between a human aggressor and human defender as vicariously enacted through a two-dimensional computer simulation. Using a timed presentation method, the Participant's heart rate and skin conductance responses in the moment were continuously measured as they encountered challenge situations with varying levels of audio complexity, sequences of events, repetitive events and different levels of virtual violence.

The sample of participants appeared to be an ethnically diverse college sample, representative of a large West Coast metropolis. The varying elements of the participant characteristics yielded interesting comparisons to be made among those participants who did and did not regularly play video games. It was speculated at the inception of the project that people who played video games regularly and particularly, people who played violent video games, would be overrepresented in the sample. As can be observed in Figure 3, of those participants who played video games, only about 1/3 of them played violent video games. Approximately 1/5 of this sub-sample reported playing sports games, which are at times violent however, scoring points and not violence per se are the goals of those types of games. The comparisons between the genders proved to be non-significant when comparing types of games that males and females play. Although it is widely known in the entertainment community that a majority of the players of violent video games are male and perhaps only 10% are female, this particular sample was fairly equal (This can be estimated by the number of registered game owners logged in to various gaming web sites, etc). This was most likely due to selection characteristics of a college population.

Of those participants who reported playing video games, it was interesting to note that the average number of hours spent playing video games was 6.7 hours per week. This represents a significant amount of time spent participating in games for recreational activities. Again, we observe no statistically significant difference between the genders on this topic.

The Participants were asked to rate their subjective experience following the task in four dimensions. It was postulated that perhaps taking a pre and post measure of valence would be useful in providing testing information as to the participants' change in attitude over the course of the trials. This was attempted for a brief period at the beginning of the project. This practice however, was discontinued because the Participants who had not previously played video games complained that they had no experience for comparison and thus when taking a pretrial measure, they could not answer the questions and became frustrated. After completion of the trials, Participants were asked to evaluate their experience in four dimensions; level of control, pleasantness, arousal, and realism.

In examining the ratings of perceived control, the Likert scale ratings ranged from being "in control" to "lacking control". The average rating was just over five which corresponded to a rating of "mostly in control". There was no significant difference between the genders.

Pleasantness referred to the recreational quality of the experience. Responses ranged from "pleasant" to "unpleasant". Surprisingly, the average score was approximately 4.7 with four being a "neutral" rating. Thus the Participants rated the experience as "somewhat pleasant". Given that most of the participants had not played violent video games before, this was interesting since a minor-"disgust reaction" was expected from many Participants. Again there was no significant difference between the genders.

The rating of arousal measured the level of excitability and responses ranged from "excited" to "calm". The average score was a five which equated to the rating of "somewhat excited". Again we observe no significant gender difference among the ratings. Realism referred to the salience or presence quality of experimental trials. The scale ranged from "realistic" to "unrealistic". Here the average score was 3.5 indicating a rating of "slightly unrealistic" experience. This may have adversely affected the experimental trials particularly with the skin conductance response.

Hypothesis 1

In part one of this project, the differences between the aggressor and defender were measured employing the manipulations of audio complexity and level of gore to observe changes in response magnitude. Since the measures of heart rate and skin conductance level are part of two separate autonomic systems they were evaluated separately. Each section of the discussion will be divided into two parts; one addressing the effects of heart rate and the second will concern the effects of skin conductance level in light of the experimental conditions.

It was predicted that during a simulation where the participant acted as an aggressor, deceleration of HR and a general decrease in SCL would be observed similar to recent studies which found that exposure to images of butchery (Hare, Wood, Britain & Shadman, 1971, Hare 1972, and Klorman, et.al., 1975), intense concentration (Lacey, 1959, 1967) and instrumental aggression resulted in a deceleration of ANS functions. Although the hint of a pressor effect may have been present as observed in figure 5 under the aggressor condition in the tracking phase we observe a slight decrease in heart rate which jibes with Perry, et.al.'s (1997) results showing a general decrease in heart rate activity when discussing predatory behavior in boys. However this is only speculative.

The results demonstrate that when taking into consideration the Audio Complexity, Level of Gore and Condition there were only non-significant differences among the measures. When we collapse Audio Complexity and Level of Gore, to examine the Aggressor versus Defender conditions we observe a general positive increase in response magnitude for heart rate across the measurement phases. Although non-significant, the heart rate measure initially decreased from baseline to the tracking condition, indicative of a momentary pressor effect. Heart rate first climbs and then falls back to the baseline rate over subsequent trials. Also in the Defend condition we observe a steady upward, linear trend from baseline as predicted. Although non- significant, these results are consistent with the original hypotheses. Hare and associates (1970, 1971) found differential reactions to Gore (or images of butchery) depending on whether a person perceives such images with "morbid" fascination or excitement. This might explain the differential findings in HR magnitude under the Aggressor condition.

It was also hypothesized that when acting in the role of Defender, a Participant's HR would increase as a physiological manifestation of the flight response. In the present study this was not the case as we observe a general upward trend for both conditions across trials regardless of perception of role during the interaction.

The main effects for Level of Gore were also examined. The pattern in Figure 6 possibly indicated that Participants exhibited variances in their expectations of the conditions. However, it was observed that with a maximal level of gore is a steady upward trend from baseline to kill condition. Among the heart rate conditions this was the only significant linear trend which was observed. The interaction of phase of measure by Gore resulted in observable differences in both the baseline and the kill condition with a general upward trend for both conditions. It was predicted in the original hypotheses that the maximal level of gore would result in higher magnitude of response does appear to be true for the kill condition only. Thus these results provide only moderate support for the hypothesis that a higher level of gore would result in higher response magnitude.

Next the audio complexity was analyzed. It was hypothesized that a higher level of audio complexity would equate to a greater magnitude of response. Although the results were non-significant, there was an interesting positive linear trend in the full audio complexity condition across phases. The magnitude of response from baseline peaked during the shoot condition then began a return under the kill condition. Both the medium and meet conditions were less distinct. The medium audio complexity condition appeared to elicit a pressor response under the tracking phase where the others did not.

Regardless of condition measurements during the baseline and the kill phase of measure were indistinguishable. These results were inconsistent with Hendrix and Barfield's (1996) study which found that audio levels enhanced the perception of presence. Murray, Arnold and Thornton (2000) used ear plugs to simulate hearing loss and participants reported a feeling of detachment (implying that sound was crucial to the realism of the experience). It may be the case that the varying audio complexity negatively affected the reported valence of the experimental conditions but did not adversely influence the physiological responses during the trials as expected.

Turning our attention to the skin conductance measurements during the same conditions, the results for the four-way interaction among the conditions was unfortunately non-significant. It was predicted that a general decrease in skin conductance level would be observed in the Aggressor condition as compared to the Defend condition. It was also hypothesized that when acting in the role of Defender, a Participant's SCL would increase as a physiological manifestation of the flight response. These patterns were not observed and in fact, the Defend condition appeared to elicit a phasic response which peaked during the Track condition and then decreased until termination of the trials in the Kill condition. Although it was believed that the present conditions brought a more activating conceptualization of competition among the participants, the results were nevertheless consistent with the study by Lanzetta and Englis (1989). These experimenters examined SCL in relation to cooperation and competition expectancies. Similar to the present study, no significant differences were found between those who expected cooperation versus those who expected competition.

It was also predicted that a maximal level of gore would result in a greater magnitude of SCL response, this was also a non-significant result. As observed in Figure 9, the minimal level of presentation may have resulted in a phasic variation of response however, this pattern was unreliable and contrary to the predicted response.

It was initially predicted that a greater audio complexity would result in a greater magnitude of response. Again, although the results were non-significant, the full audio complexity condition resulted in a response which is consistent with the predicted hypotheses in the heart rate data were the tracking phase perhaps alerted the participant and then we observe a steady decline in magnitude until the kill phase. Both the mute and medium audio conditions resulted in unobservable differences among those responses. Considering these results, it may be more likely that the perception of "relative" differences in audio complexity make a difference in a person's response physiology.

After repeated trials of the same audio complexity are experienced by a Participant, a stimulus ceases to be novel and is not attended with the same scrutiny. Thus in the present study, the relative qualities of the audio complexity levels may have only been perceived when there was a significant relative difference in complexity as compared to a graduated measure of complexity.

Hypothesis 2

The second section of the project was developed to measure any systematic presentation effects by comparing independent measurements to the previous aggressor condition measurements in a simple between groups' test. It was predicted that independent measures would not significantly differ from measures during the aggressor condition.

This test was designed to compare independent measures of the stimulus sequence in an isolated fashion for comparison to the Aggressor condition which was measured in a "rolling" or sequential presentation without interstimulus pauses. Ideally, systematic differences between sequentially presented stimuli and independently presented material should me minimal and non-significant. This would suggest that the reactivity of a Participant in any given trial is due to the presenting experimental stimuli and not simply a systematic pattern of arousal bound to any behavioral sequence.

An examination of the patterns of response when charted together reveals an interesting pattern. Figures 10 and 11 display the results for both GSR and HR respectively.

In Figure 11 the SCL patterns are somewhat different during the active baseline and termination phases of measure. It would appear from the two measures that during the first and last phases of measure there was some minimal variability likely due to first orienting to the condition and secondly the termination of the target. It could be the case that with slightly different conditions we are observing the effects of different instructions and possibly, the anticipation of the next set of instructions since the Participant was unsure of which condition was to follow (the sequences were counterbalanced in presentation).

Also in this second section, the sequential aggressor conditions were compared to each phase of measure independently presented with inter-trial recovery periods. In this fashion each phase of measure could be compared to its independent counterpart.

Although there was a different response trend for the sequential trials versus the independent trials, there was no statistically significant difference between the conditions of measure for each phase. As observed in Figure 11, the sequential versus the independent measures for heart rate exhibited slightly different patterns of response. The sequential presentation of stimuli resulted in a smoother downward trend as compared to the independent measures which appeared to follow a downward trend into the shoot phase in a partial recovery to baseline in the kill phase. Although the null hypothesis cannot be proved, it was proposed that there would be no statistically significant difference between the two types of measure.

These results suggested that regardless of the sequence of the measurements the phenomenon observed were not simply artifacts of the presentation order (i.e. baseline, track, shoot, and kill). But more likely, these responses are part of a specific response pattern which can be exhibited with certain stimuli sets. In the case of skin to conductance level, as observed in Figure 12, again there were no significant differences in the conditions. Although the baseline and kill phases of measure appeared to systematically vary, there was no statistically significant difference. There was a significant difference for the interaction for phase. However, when violations of sphericity were considered this result was deemed unreliable. Regardless, this would imply that there was a tangible difference between the relative activation qualities of the tasks.

Hypothesis 3

The final portion of the experiment was created to evaluate any desensitization or habituation affects after repeated trials of the most extreme stimulus offered in the project. An active baseline measure was followed by five trials of destroying the target. Interestingly, although the trials were extremely gory with blood and chunks of gore exploding, and the Participants responded verbally with disgust, no participant refused to continue with the trials or questioned the validity of the experiment. Although the pattern of response was interesting, there was no statistically significant difference between the trials according to heart rate. The trend exhibited in Figure 13, demonstrates a positive linear trend peaking in the third trial (K3), and was followed by what appeared to be a gradual decline or perhaps habituation. Because of time constraints the project protocol was limited to five trials. Thus it was not possible to observe the number of trials to baseline. Future studies may consider using as many as 20 trials to more thoroughly evaluate this phenomenon.

Conclusions

The purpose of the present study was several-fold. Albert Einstein once said, "A question cannot be evaluated at the same level of complexity with which it was created." One of the main driving purposes of the present study was to build upon the interesting but marginally clear results of the pilot study (Brannon, 2003). That study conducted for a thesis requirement, revealed very interesting trends and possibilities which would later be worked into the present study.

In an attempt to clarify the meaning of the results, the controls in the present study were carefully crafted to answer some of the questions remaining after the completion of that pilot study. Namely, questions remained as to the systemic effects of the presentation order and how this might affect a gradual increase or decrease in heart rate or skin conductance level across the phases or trials. It was questioned whether the order of presentation made a difference in the magnitude of response or whether the independent measures alone were eliciting the quality of response.

Another question which arose was what extraneous factors might be contributing to the magnitude of response or detracting from it. It was hypothesized in the present study that control of audio levels or audio complexity could be a contributing factor to response magnitude. It was also hypothesized that the level of gore vis a vis the magnitude of disgust response which creates a pressor affect, might also enhance or detract from the magnitude of response depending on the condition.

The present results indicate that although there may be phasic responses which correlate well with psychophysiological studies or reactivity and attentional processes, the manipulations employed in this project were largely indistinguishable from each other. There were many reasons why these data did not produce the clarity sought by redefining these experimental conditions.

Creating a Microsoft Access file programmed to deliver the information necessary to obtain informed consent as well as record the participants' responses to medical, psychiatric and general participation requirements was especially beneficial. The data file created after each session could be electronically archived to another location and later during the data reduction stage of the project, the files could be converted into spreadsheets to ease the data analysis instead of requiring the information to be re-entered by hand.

Some of the statements for the informed consent were worded in reverse; meaning that if the participant simply responded all "Yes" or all "No" the program would not allow the person to proceed. Executing Informed consent procedures in this way ensured that each person took the time to read each of the responses required for participation and added an extra later of safety and ethical security to inform and ensure that they had read and evaluated the statements. Most researchers of psychology have encountered the student who desperately wants extra credit for a course and who will participate in almost any experiment out of desperation without careful consideration of the consequences of exposure to material. Whether this is a characterological trait of impulsiveness or a carefully evaluated trust of the institution at which they are studying is of debate. However, several students who elected to participate in this study did not carefully read the informed consent and were required by the program to go back and read the sections they had "skimmed" and had answered inappropriately. One female student, responded negatively to the depictions of gore requiring the project to be halted and to be re-evaluated by the committee members. Even during the experimental trials while the student was experiencing this abreaction, she verbally expressed the desire to continue with the study.

After investigation it was discovered that the student had ignored multiple warnings about the content of the study even though it was actually read, she did not believe that the material would be realistic. Upon re-evaluation five days later, the participant was stable with no reported ill effects, however the study protocols were re-evaluated by the committee members and the Institutional Review Board Chair for approval to continue with the study (which was approved with no changes to the safety protocol).

Although this process was coupled with multiple warnings regarding the possible negative effects of viewing these stimuli, on both the recruitment posters which had bold red lettering and the same warning on the initial description of the informed consent document, some students failed to respond appropriately and were required to go back and read the documents before participating.

One confound in the present study which was extremely difficult to control was the timing of events. Although in most psychophysiological studies the computers are linked so that the presentation and physiological measurement instruments are timed to exactly coincide, in the present study using this particular videogame proved most difficult to accomplish. Because of the nature of the videogame and the programming language used, it was impossible to link the videogame to the psychophysiological detection equipment. Although timing events were created to obtain the best possible measure, there was perhaps and one half second variance in the timing of events to the physiological record. This created obvious difficulties both in the administration of the experimental trials and also when determining the correct measurement periods following stimulus onset.

Controlling for the audio complexity proved to be difficult as well. Although the laboratory was well insulated in the subject wore headphones during the tasks to control for the noise of the computers and experimenters in the next chamber, there was occasional noise which may have confounded the record such as slamming doors in the hallway and the climate control system which could not be manipulated.

On the one hand it was believed that creating precision measurement phases would ease the analysis of data as well as create discrete data points from which the timing of events could be better analyzed. On the other hand this created a virtual interaction that was so controlled both visually and auditorily that the realism of the stimuli was likely affected. Although this was true, this type of measurement required that the elements of the interaction be artificially controlled as well as the usual progression of stimulus events in the simulation. This most likely negatively impacted the overall presence which was felt in the simulation and was reflected in the relatively median valence scores (average of 3.5 for males and 3.8 for females on a 7 point Likert scale). Participants had many different reactions to the stimuli upon initial presentation. Although some participants had observed similar games or stimuli, others appear to be surprised, laughed openly, or responded with verbal comments although no one else was in the room. With the exception of one participant which exhibited an abreaction, most participants commented that it was an entertaining study it was interesting.

Participants rated the realism of the project generally a slightly unrealistic. It may be the case that although participants were able to cognitively suspend their disbelief during the course of the trials, the underlying physiological mechanisms were not activated in such a way that meaningful results can be inferred from the study.

These results were interesting however, future studies with FMRI and other technologically advanced measurement devices will surely be necessary to adequately determine the multitude of psychophysiological changes which occur in virtual simulations of human interaction. Examining functional imaging in real time appears to be the next step in examining the moment to moment changes which occur during this type of interaction.

Finally, this study measured arousal and reactivity to visual and auditory stimuli. Although many interesting patterns of response were elicited using this system of stimuli presentation, it appears that in order to more fully evaluate the effects of moment to moment changes of perceived environmental stimuli, we must use equally complex systems in order to measure these complex changes in the nervous system.

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Appendix A

Informed Consent

APPROVED by the CSUSB Psychology Institutional Review Board: Approved 4/23/04
IRB#H02W-03 John Clapper, Chair

Physiological Measurement of Instrumental Aggression

Purpose

You are being invited to participate in this study to further our knowledge of human behavior. This study is being conducted by Sean Brannon, M.S. of Loma Linda University's Department of Psychology. The faculty supervisor of this study is Dr. Paul Haerich, LLU and it is conducted within the laboratory of Dr. Michael Lewin, CSUSB.

Although there is much controversy surrounding the viewing of violent visual media, there is little controlled research which actually determines whether visual computer representations can alter a person's physiology in any meaningful way. The purpose of this study is to examine the effect (if any) certain video presentations can have on a person's physiology.

Participation in this study involves answering personal questions about your health status, personality and experiences playing video games. You will then be fitted with surface electrodes to measure various physiological rhythms (such as heart rate and breathing rate). These measures are obtained using non-invasive methods, using surface contacts taped to the skin and pressure bands. While these measures are recorded you will be asked to play a modified video game. This particular game called Quake 3® portrays realistic simulations of violence resulting in the characters being killed along with blood and gore. This game is rated "Mature", one of the highest industry ratings for video game violence and gore. It may include graphic depictions of intense, realistic violence, strong language and sexually mature themes.

You will be aware of all conditions and measures being sampled at all times. There are no hidden cameras, etc in this laboratory. This study should take approximately 1 and ½ hours to complete.

Benefits and Risks

As with many studies which examine basic properties of physiology and behavior, this study holds no personal benefits for you directly. We hope that the results from this study will help advance our understanding of interactive computer simulations and our bodily reaction to viewing them. Although there are no direct benefits, you may receive extra credit units for your courses depending upon your instructor. You will receive these units even if you decide to discontinue your participation before the end of the session.

This study will expose you to minimal risk of psychological discomfort. No greater risk is involved than normal exposure in the typical American lifestyle that may include viewing television, movies and other potentially violent media.

Confidentiality

If you choose to participate in this study, your responses in all respects will be kept anonymous. The results of this study will only be reported in group form. Before data collection, your responses will be assigned a case number and you will not be identified in any way.

Participant's Rights & Third Party Contacts

If you feel you may have an undesirable reaction to the depictions of violence, blood or gore, please do not participate in this experiment. We want to ensure that your participation is voluntary and that you may stop the experiment at any time without penalty or negative consequences. After the experiment is completed you will be debriefed and any questions you have will be answered.

Please check the space below to indicate that you have read this consent and you agree to participate. If you decide not to participate, just return this form to the experimenter and you can leave without having to explain. If you decide to stop during the experiment, tell the experimenter your decision and you may leave. Any questions you may have at a later date can be directed to Sean Brannon, M.S. at 909-880-7336 or Paul Haerich, Ph.D., Department of Psychology at Loma Linda University 909-558-8577. On campus you may call Michael Lewin, Ph.D. at 880-7303

If you wish to contact an impartial third party not associated with this study regarding any complaint or questions about the study, you may contact the CSUSB Institutional Review Board (an ethics oversight committee) at 880-5027.

Consent Statement

I have read this consent document and have been given the opportunity to ask questions concerning my participation in this study and I have been offered a copy of this form. I certify that I am at least 18 years old and that I am aware that this study may contain presentations of simulated violence and gore. Placing my mark on this consent does not waive my rights nor does it release the investigators (and institutions) from their responsibilities. I may contact the investigators at any time if I have any additional questions or concerns.

Participants Mark ______

Experimenter's Signature ____________________ Date ____________

Debriefing Statement
Physiological Measurement of Instrumental Aggression

As was discussed in the Informed Consent document you reviewed and signed, there is much controversy surrounding interaction with computer simulations and there is little controlled research which actually determines whether a computer representation is altering a person's physiology in any meaningful way. The purpose of this study is to examine the effect (if any) these computer presentations can have on a person's physiology.

The goal of this study is to examine whether the video game is eliciting meaningful and reliable (although) temporary changes in physiology. This study also examines which factors of the video game elicit greater or lesser (temporary) changes in physiology: Sound, level of gore, identity of opponent or a combination of each?
Your participation is now complete. In order to collect the best data possible, we ask that you not explain the study in detail to anyone who might wish to participate. This ensures that participants entering the study do not have any preconceptions regarding our hypotheses that might influence their responses in any way. Please feel free to discuss whether you found the experience interesting or not, and please direct the person to our lab if you think they may wish to participate in the study.

If you would like to know the results of this study when it is complete, you may contact Sean Brannon at 909-880-7336 for more information. It is estimated that the study will be complete in the Fall of this year. You may obtain a copy of the grouped results by calling the number above. Be assured that your responses will be only reported in group form and you will remain anonymous at all times.
If you have any further questions regarding your involvement in this study, please ask the experimenter now. If you feel that you should see a therapist because of any unexpected issues raised by your participation please call The Community Counseling Center on campus at 880-5569. Also please notify us at 880-7336 or Dr. Lewin at 880-7303 as to the specific problem so we may stop the experiment and review our procedures. Again, we wish absolutely no harm to come to any research participants as a result of this study (hence our elaborate informed consent procedure).

If you have questions at a later date or would like information about possibly volunteering for other experiments in our lab, please feel free to contact us at 909-880-7336.

Thank you

Appendix B

Lab Protocol and Script

Key: EX: denotes Experimenter Verbalizations
Brackets [] indicate actions

1. Informed consent/ questionnaire.
2. MILLON administration
3. Measures
   A. Prep:
      1)Attach electrodes
      2) Headphones
      3) Mouse / keyboard use
      4) Confirmation

   B. Stimulus Set A Presentation
   C. Change Stimulus tasks
   D. Stimulus Set B Presentation
4. Debriefing
5. Data backup

3A. Preparation

EX: I'll now be reading from a script so that all participants receive the exact same instructions. However, feel free to ask questions to eliminate any confusion.

1)Attach electrodes

EX: Please make yourself comfortable. First I'll need to gently clean your skin with an alcohol pad in three places, your left and right forearms and the top of your left foot where it joins your leg. Do you have any questions before we begin?
[Performed]

2) Headphones
EX: I'm now going to hand you a pair of headphones which must stay on your head for the rest of the study to isolate stray sounds from the building, etc. I'll be talking to you through a microphone.
[Performed ensuring that the left earpiece is over left ear]

[Experimenter puts on microphone]

EX: I will now test the equipment and obtain an initial record of your vitals. Please make yourself comfortable and look only at the computer monitor.

[Screen shows pastoral scene and only white noise is put through headphones for three minutes]

3) Response apparatus

EX: Before you are a keyboard and mouse; during some tasks we will use the mouse and in others we will use the keyboard. Both will never be used together.

[Opens empty virtual arena with target at opposite end of area.]

EX: Move the mouse around and you will see the crosshair move around also. When you press the mouse button, the weapon will fire and hit the area where the cross hair is. Shoot the target now. [done] Very Good.
[If participant does not hit the target, EX: places the crosshair on the target for the participant and says, now try.]

[Ex switches input to blank screen and resets game so that participant is now on the other side of the arena. Switches monitor back.]

EX: You'll now notice that your character is at the other end of the same arena. This time however we can only use the left and right arrow keys on your keyboard. By using them, your character will be able to sidestep right and left to avoid your opponnent. Try to move all the way to the left and right, now.
[done] Very good.

[If Participant fails to move the character, the Experimenter demonstrates and then observes appropriate response]

4) Confirmation
EX: This concludes the familiarization with the computer controls. These are the only controls you must learn for the tasks. Do you have any questions? If not, then let's begin.

[EX changes monitor input to neutral screen]

1.1 Task One: part A . Aggressor

EX : In this task you will be able to use the mouse to move the crosshair and fire the weapon at your opponent with the left mouse button.

EX: When the trial begins you will see your opponent on the far side of the arena behind a chain-link fence. Do not fire at him at first. You cannot hurt him while the chainlink fence is up. Track your opponent with your crosshair for as long as the fence stays up. After a short time of tracking, you will hear a beep followed by the fence dropping down into the floor. At this time, you are to shoot and kill your opponent as quickly as possible.

When you kill your opponent, the trial will end and the game will be reset. While the computer is reset, you will have a short break of about 2 minutes in between the trials. I'll ask you to watch the screen during that time as well. Please keep your movements to a minimum as you can pull off the electrodes very easily. Do you have any questions? Ok please rest and watch the target while I reset the equipment.

1.2 Task One part B. Target

EX (Task 1 Victim): In this task you will be able to use the left and right arrow keys to move left and right only.

Try to avoid the Aggressor as long as possible. Do you have any questions? Ok please rest and watch the target while I reset the equipment.

2.1 Testing Phase II

EX: In this next section you will be in the role of aggressor again. However you will only be asked to perform one task such as tracking or killing the Target and then given a small rest period in between. Do you have any questions? Ok please rest and watch the target while I reset the equipment.

When all eight trials are over,

EX: Do NOT attempt to get up or remove the electrodes. The tape we use is surgical tape and not like that used in band-aids. Many people have attempted to quickly "rip" the tape off at the end of a session. It will grip your skin and may injure you. Please wait and I will remove it for you.

End of Script

Appendix C: ANOVA Tables

Table 4. Tests of Within-Subjects Effects for HR Across Phases

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power(a)
Conditn	Sphericity Assumed	92.850	1	92.850	.548	.465	.019	.548	.110
	Greenhouse-Geisser	92.850	1.000	92.850	.548	.465	.019	.548	.110
Gore	Sphericity Assumed	55.069	1	55.069	.304	.586	.011	.304	.083
	Greenhouse-Geisser	55.069	1.000	55.069	.304	.586	.011	.304	.083
Audio	Sphericity Assumed	67.592	2	33.796	.307	.737	.011	.614	.096
	Greenhouse-Geisser	67.592	1.749	38.653	.307	.708	.011	.537	.094
Phase	Sphericity Assumed	404.976	3	134.992	.807	.494	.028	2.420	.217
	Greenhouse-Geisser	404.976	1.604	252.492	.807	.428	.028	1.294	.166
conditn * gore	Sphericity Assumed	107.237	1	107.237	1.101	.303	.038	1.101	.173
	Greenhouse-Geisser	107.237	1.000	107.237	1.101	.303	.038	1.101	.173
conditn * audio	Sphericity Assumed	83.032	2	41.516	.433	.651	.015	.866	.117
	Greenhouse-Geisser	83.032	1.777	46.736	.433	.627	.015	.770	.113
gore * audio	Sphericity Assumed	144.407	2	72.203	.597	.554	.021	1.194	.145
	Greenhouse-Geisser	144.407	1.784	80.930	.597	.536	.021	1.066	.139
conditn * gore * audio	Sphericity Assumed	30.073	2	15.037	.220	.803	.008	.440	.083
	Greenhouse-Geisser	30.073	1.810	16.614	.220	.782	.008	.398	.081
conditn * phase	Sphericity Assumed	474.929	3	158.310	2.204	.094	.073	6.612	.541
	Greenhouse-Geisser	474.929	1.487	319.435	2.204	.135	.073	3.277	.367

gore * phase	Sphericity Assumed	959.069	3	319.690	4.483	.006	.138	13.450	.866
	Greenhouse-Geisser	959.069	1.951	491.670	4.483	.016	.138	8.745	.737
conditn * gore * phase	Sphericity Assumed	138.636	3	46.212	.553	.647	.019	1.659	.159
	Greenhouse-Geisser	138.636	1.990	69.673	.553	.577	.019	1.101	.137
audio * phase	Sphericity Assumed	283.697	6	47.283	.733	.624	.026	4.399	.286
	Greenhouse-Geisser	283.697	3.755	75.550	.733	.563	.026	2.753	.223
conditn * audio * phase	Sphericity Assumed	305.448	6	50.908	.658	.684	.023	3.948	.257
	Greenhouse-Geisser	305.448	3.026	100.941	.658	.581	.023	1.991	.184
gore * audio * phase	Sphericity Assumed	183.331	6	30.555	.393	.883	.014	2.360	.162
	Greenhouse-Geisser	183.331	2.904	63.126	.393	.752	.014	1.142	.124
conditn * gore * audio * phase	Sphericity Assumed	411.187	6	68.531	1.20	.308	.041	7.203	.464
	Greenhouse-Geisser	411.187	3.513	117.057	1.20	.315	.041	4.217	.340
Error(conditn*gore*audio*phase)	Sphericity Assumed	9590.663	168	57.087					
	Greenhouse-Geisser	9590.663	98.35	97.510					

a Computed using alpha = .05

Table 5. Within Subjects Contrasts for HR Across Conditions

Source	condn	gore	Audio	phase	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Sqd	Obs Power
Conditn	Linear				92.850	1	92.850	.548	.465	.019	.110
Error(conditn)	Linear				4746.655	28	169.523				
Gore		Linear			55.069	1	55.069	.304	.586	.011	.083
Error(gore)		Linear			5078.158	28	181.363				
Audio			Linear		22.064	1	22.064	.152	.700	.005	.066
			Quadratic		45.527	1	45.527	.610	.441	.021	.117
Error(audio)			Linear		4071.768	28	145.420				
			Quadratic		2090.651	28	74.666				
Phase				Linear	367.821	1	367.821	1.282	.267	.044	.194
				Quadratic	23.798	1	23.798	.151	.701	.005	.066
				Cubic	13.357	1	13.357	.233	.633	.008	.075
Error(phase)				Linear	8035.595	28	286.986				
				Quadratic	4419.244	28	157.830				
				Cubic	1604.870	28	57.317				
Conditn * gore	Linear	Linear			107.237	1	107.237	1.101	.303	.038	.173
Error(conditn *gore)	Linear	Linear			2726.246	28	97.366				
conditn * audio	Linear		Linear		82.290	1	82.290	.643	.429	.022	.121
			Quadratic		.742	1	.742	.012	.915	.000	.051
Error(conditn *audio)	Linear		Linear		3584.680	28	128.024				
			Quadratic		1782.687	28	63.667				
gore * audio		Linear	Linear		61.029	1	61.029	.397	.534	.014	.093
			Quadratic		83.378	1	83.378	.945	.339	.033	.155
Error(gore*a		Linear	Linear		4300.121	28	153.576				

udio)			Quadratic		2470.976	28	88.249				
conditn * gore * audio	Linear	Linear	Linear		2.337	1	2.337	.026	.873	.001	.053
			Quadratic		27.736	1	27.736	.583	.452	.020	.114
Error(conditn *gore*audio)	Linear	Linear	Linear		2496.033	28	89.144				
			Quadratic		1332.964	28	47.606				
conditn * phase	Linear			Linear	201.493	1	201.493	1.624	.213	.055	.234
				Quadratic	197.732	1	197.732	3.140	.087	.101	.402
				Cubic	75.705	1	75.705	2.663	.114	.087	.351
Error(conditn *phase)	Linear			Linear	3473.715	28	124.061				
				Quadratic	1763.447	28	62.980				
				Cubic	796.001	28	28.429				
gore * phase		Linear		Linear	813.818	1	813.818	6.655	.015	.192	.702
				Quadratic	15.709	1	15.709	.261	.613	.009	.078
				Cubic	129.543	1	129.543	4.108	.052	.128	.499
Error(gore*phase)		Linear		Linear	3423.817	28	122.279				
				Quadratic	1682.948	28	60.105				
				Cubic	882.878	28	31.531				
conditn * gore * phase	Linear	Linear		Linear	99.834	1	99.834	.745	.395	.026	.133
				Quadratic	.759	1	.759	.012	.912	.000	.051
				Cubic	38.043	1	38.043	.692	.412	.024	.127
Error(conditn *gore*phase)	Linear	Linear		Linear	3751.529	28	133.983				
				Quadratic	1727.851	28	61.709				
				Cubic	1538.613	28	54.950				
audio * phase			Linear	Linear	7.000	1	7.000	.061	.806	.002	.057

				Quadratic	81.203	1	81.203	1.467	.236	.050	.216
				Cubic	46.445	1	46.445	1.163	.290	.040	.181
			Quadratic	Linear	5.338	1	5.338	.070	.793	.003	.058
				Quadratic	115.131	1	115.131	1.368	.252	.047	.204
				Cubic	28.580	1	28.580	1.606	.216	.054	.232
Error(audio* phase)			Linear	Linear	3187.645	28	113.844				
				Quadratic	1550.042	28	55.359				
				Cubic	1118.360	28	39.941				
			Quadratic	Linear	2125.231	28	75.901				
				Quadratic	2355.696	28	84.132				
				Cubic	498.432	28	17.801				
conditn * audio * phase	Linear		Linear	Linear	70.495	1	70.495	.524	.475	.018	.108
				Quadratic	70.374	1	70.374	.782	.384	.027	.137
				Cubic	5.473	1	5.473	.158	.694	.006	.067
			Quadratic	Linear	150.040	1	150.040	1.163	.290	.040	.181
				Quadratic	.644	1	.644	.012	.914	.000	.051
				Cubic	8.422	1	8.422	.386	.540	.014	.092
Error(conditn *audio*phase)	Linear		Linear	Linear	3766.115	28	134.504				
				Quadratic	2518.676	28	89.953				
				Cubic	967.116	28	34.540				
			Quadratic	Linear	3613.485	28	129.053				
				Quadratic	1522.807	28	54.386				
				Cubic	611.192	28	21.828				
gore * audio * phase		Linear	Linear	Linear	47.085	1	47.085	.348	.560	.012	.088
				Quadratic	11.066	1	11.066	.177	.678	.006	.069
				Cubic	.806	1	.806	.022	.884	.001	.052

			Quadratic	Linear	113.402	1	113.402	.725	.402	.025	.130
				Quadratic	.745	1	.745	.015	.903	.001	.052
				Cubic	10.228	1	10.228	.399	.533	.014	.094
Error(gore*audio*phase)		Linear	Linear	Linear	3790.106	28	135.361				
				Quadratic	1755.212	28	62.686				
				Cubic	1035.815	28	36.993				
			Quadratic	Linear	4380.866	28	156.460				
				Quadratic	1370.420	28	48.944				
				Cubic	718.078	28	25.646				
conditn * gore * audio * phase	Linear	Linear	Linear	Linear	271.273	1	271.273	2.359	.136	.078	.317
				Quadratic	1.757	1	1.757	.025	.876	.001	.053
				Cubic	4.521	1	4.521	.146	.705	.005	.066
			Quadratic	Linear	26.439	1	26.439	.470	.499	.017	.102
				Quadratic	1.810	1	1.810	.040	.844	.001	.054
				Cubic	105.388	1	105.388	4.524	.042	.139	.537
Error(conditn*gore*audio*phase)	Linear	Linear	Linear	Linear	3219.432	28	114.980				
				Quadratic	1996.774	28	71.313				
				Cubic	865.329	28	30.905				
			Quadratic	Linear	1575.045	28	56.252				
				Quadratic	1281.869	28	45.781				
				Cubic	652.215	28	23.293				

a Computed using alpha = .05

Table 6. Tests of Within-Subjects Effects for SCL by Phase of Measure

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent .Parameter	Observed Power(a)
Conditn	Sphericity Assumed	.405	1	.405	.059	.809	.002	.059	.056
	Greenhouse-Geisser	.405	1.000	.405	.059	.809	.002	.059	.056
	Lower-bound	184.374	27.000	6.829					
Gore	Sphericity Assumed	.224	1	.224	.033	.858	.001	.033	.054
	Greenhouse-Geisser	.224	1.000	.224	.033	.858	.001	.033	.054
Audio	Sphericity Assumed	.388	2	.194	.028	.972	.001	.057	.054
	Greenhouse-Geisser	.388	1.000	.388	.028	.868	.001	.028	.053
Phase	Sphericity Assumed	20.612	3	6.871	.890	.450	.032	2.671	.237
	Greenhouse-Geisser	20.612	1.233	16.718	.890	.374	.032	1.098	.161
conditn * gore	Sphericity Assumed	.240	1	.240	.035	.852	.001	.035	.054
	Greenhouse-Geisser	.240	1.000	.240	.035	.852	.001	.035	.054
conditn * audio	Sphericity Assumed	.358	2	.179	.026	.974	.001	.052	.054
	Greenhouse-Geisser	.358	1.000	.357	.026	.873	.001	.026	.053
gore * audio	Sphericity Assumed	.564	2	.282	.041	.959	.002	.083	.056
	Greenhouse-Geisser	.564	1.002	.563	.041	.841	.002	.042	.054
conditn * gore * audio	Sphericity Assumed	.601	2	.300	.044	.957	.002	.088	.056
	Greenhouse-Geisser	.601	1.002	.599	.044	.836	.002	.044	.055
conditn * phase	Sphericity Assumed	20.800	3	6.933	.899	.445	.032	2.697	.239
	Greenhouse-Geisser	20.800	1.232	16.884	.899	.371	.032	1.108	.162
gore * phase	Sphericity Assumed	20.788	3	6.929	.901	.445	.032	2.702	.239

	Greenhouse-Geisser	20.788	1.232	16.867	.901	.370	.032	1.110	.162
conditn * gore * phase	Sphericity Assumed	20.657	3	6.886	.894	.448	.032	2.682	.238
	Greenhouse-Geisser	20.657	1.233	16.759	.894	.372	.032	1.102	.161
audio * phase	Sphericity Assumed	41.717	6	6.953	.902	.495	.032	5.415	.350
	Greenhouse-Geisser	41.717	1.232	33.850	.902	.370	.032	1.112	.162
conditn * audio * phase	Sphericity Assumed	41.383	6	6.897	.895	.500	.032	5.368	.347
	Greenhouse-Geisser	41.383	1.232	33.600	.895	.372	.032	1.102	.161
gore * audio * phase	Sphericity Assumed	41.539	6	6.923	.897	.499	.032	5.381	.348
	Greenhouse-Geisser	41.539	1.232	33.715	.897	.371	.032	1.105	.162
conditn * gore * audio * phase	Sphericity Assumed	41.917	6	6.986	.907	.492	.032	5.440	.352
	Greenhouse-Geisser	41.917	1.233	34.009	.907	.369	.032	1.118	.163
Error(conditn*gore*audio*phase)	Sphericity Assumed	1248.222	162	7.705					
	Greenhouse-Geisser	1248.222	33.278	37.509					

a Computed using alpha = .05

Table 7. Within Subjects Contrasts for SCL Across Conditions

Source	condn	gore	audio	phase	Type III Sum of Squares	df	Mean Squar	F	Sig.	Partl Eta	Obs Power
Conditn	Linear				.405	1	.405	.059	.809	.002	.056
Error(conditn)	Linear				184.374	27	6.829				
Gore		Linear			.224	1	.224	.033	.858	.001	.054
Error(gore)		Linear			184.532	27	6.835				
Audio			Linear		.278	1	.278	.027	.870	.001	.053
			Quadratic		.110	1	.110	.032	.859	.001	.053
Error(audio)			Linear		276.812	27	10.252				
			Quadratic		92.249	27	3.417				
Phase				Linear	6.617	1	6.617	.536	.471	.019	.109
				Quadratic	10.948	1	10.948	1.346	.256	.047	.201
				Cubic	3.048	1	3.048	1.141	.295	.041	.178
Error(phase)				Linear	333.445	27	12.350				
				Quadratic	219.559	27	8.132				
				Cubic	72.142	27	2.672				
conditn * gore	Linear	Linear			.240	1	.240	.035	.852	.001	.054
Error(conditn *gore)	Linear	Linear			183.682	27	6.803				
conditn * audio	Linear		Linear		.240	1	.240	.023	.880	.001	.052

			Quadratic		.118	1	.118	.035	.854	.001	.054
Error(conditn *audio)	Linear		Linear		276.575	27	10.244				
			Quadratic		91.647	27	3.394				
gore * audio		Linear	Linear		.334	1	.334	.033	.858	.001	.054
			Quadratic		.230	1	.230	.067	.797	.002	.057
Error(gore*a udio)		Linear	Linear		275.507	27	10.204				
			Quadratic		92.010	27	3.408				
conditn * gore * audio	Linear	Linear	Linear		.368	1	.368	.036	.851	.001	.054
			Quadratic		.233	1	.233	.068	.797	.003	.057
Error(conditn *gore*audio)	Linear	Linear	Linear		276.464	27	10.239				
			Quadratic		92.801	27	3.437				
conditn * phase	Linear			Linear	7.143	1	7.143	.582	.452	.021	.114
				Quadratic	10.295	1	10.295	1.256	.272	.044	.191
				Cubic	3.363	1	3.363	1.259	.272	.045	.191
Error(conditn *phase)	Linear			Linear	331.170	27	12.266				
				Quadratic	221.317	27	8.197				
				Cubic	72.122	27	2.671				
gore * phase		Linear		Linear	7.236	1	7.236	.590	.449	.021	.115
				Quadratic	10.219	1	10.219	1.256	.272	.044	.191
				Cubic	3.333	1	3.333	1.248	.274	.044	.190
Error(gore*p		Linear		Linear	331.254	27	12.26				

hase)							9				
				Quadratic	219.684	27	8.136				
				Cubic	72.131	27	2.672				
conditn * gore * phase	Linear	Linear		Linear	7.175	1	7.175	.583	.452	.021	.114
				Quadratic	10.132	1	10.132	1.249	.274	.044	.190
				Cubic	3.350	1	3.350	1.249	.274	.044	.190
Error(conditn *gore*phase)	Linear	Linear		Linear	332.405	27	12.311				
				Quadratic	218.944	27	8.109				
				Cubic	72.427	27	2.682				
audio * phase			Linear	Linear	10.619	1	10.619	.575	.455	.021	.113
				Quadratic	15.288	1	15.288	1.253	.273	.044	.191
				Cubic	5.082	1	5.082	1.269	.270	.045	.192
			Quadratic	Linear	3.628	1	3.628	.592	.448	.021	.115
				Quadratic	5.308	1	5.308	1.295	.265	.046	.195
				Cubic	1.791	1	1.791	1.337	.258	.047	.200
Error(audio* phase)			Linear	Linear	498.221	27	18.453				
				Quadratic	329.383	27	12.199				
				Cubic	108.177	27	4.007				
			Quadratic	Linear	165.481	27	6.129				
				Quadratic	110.686	27	4.099				
				Cubic	36.169	27	1.340				
conditn * audio * phase	Linear		Linear	Linear	10.664	1	10.664	.578	.454	.021	.114
				Quadratic	15.205	1	15.20	1.247	.27	.044	.190

							5		4		
				Cubic	5.026	1	5.026	1.255	.272	.044	.191
			Quadratic	Linear	3.595	1	3.595	.581	.452	.021	.114
				Quadratic	5.210	1	5.210	1.276	.269	.045	.193
				Cubic	1.684	1	1.684	1.262	.271	.045	.192
Error(conditn *audio*phase)	Linear		Linear	Linear	498.287	27	18.455				
				Quadratic	329.324	27	12.197				
				Cubic	108.146	27	4.005				
			Quadratic	Linear	166.977	27	6.184				
				Quadratic	110.253	27	4.083				
				Cubic	36.018	27	1.334				
gore * audio * phase		Linear	Linear	Linear	10.726	1	10.726	.581	.452	.021	.114
				Quadratic	15.719	1	15.719	1.280	.268	.045	.194
				Cubic	5.031	1	5.031	1.255	.272	.044	.191
			Quadratic	Linear	3.458	1	3.458	.560	.461	.020	.111
				Quadratic	4.913	1	4.913	1.210	.281	.043	.186
				Cubic	1.693	1	1.693	1.262	.271	.045	.192
Error(gore*audio*phase)		Linear	Linear	Linear	498.229	27	18.453				
				Quadratic	331.453	27	12.276				
				Cubic	108.223	27	4.008				
			Quadratic	Linear	166.811	27	6.178				

				Quadratic	109.604	27	4.059				
				Cubic	36.219	27	1.341				
conditn * gore * audio * phase	Linear	Linear	Linear	Linear	10.809	1	10.809	.586	.451	.021	.114
				Quadratic	15.922	1	15.922	1.299	.264	.046	.196
				Cubic	4.965	1	4.965	1.239	.276	.044	.189
			Quadratic	Linear	3.488	1	3.488	.569	.457	.021	.113
				Quadratic	5.106	1	5.106	1.256	.272	.044	.191
				Cubic	1.627	1	1.627	1.221	.279	.043	.187
Error(conditn *gore*audio* phase)	Linear	Linear	Linear	Linear	497.822	27	18.438				
				Quadratic	330.855	27	12.254				
				Cubic	108.250	27	4.009				
			Quadratic	Linear	165.553	27	6.132				
				Quadratic	109.747	27	4.065				
				Cubic	35.994	27	1.333				

a Computed using alpha = .05

Appendix D

Electronic Screening Questionnaire

MATURE

M

CONTENT RATED BY ESRB

Psychophysiology Laboratory CSUSB

Loma Linda University

CALIFORNIA STATE UNIVERSITY
SAN BERNARDINO

- Informed Consent and Demographics Procedure
- Presence Report 1
- Presence Report 2
- Presence Report 3
- Debriefing Procedure

- Experimenter Utilities

Physiological Measurement of Instrumental Aggression

Investigator: Sean Brannon, M.S.

Faculty:
Paul Haerich, Ph.D.
Hector Betancourt, Ph.D.
Michael Lewin, Ph.D.
Frederick Newton, Ph.D.
Matthew Riggs, Ph.D.

Yes I understand that my consent DOES NOT waive any of my rights, nor does it release these institutions and investigators from their ethical and legal responsibilities

If you consent to participate, please place an X in this space --> x

Part I. Survey Questions

Please answer the following questions by selecting the arrow-tab to the left of each question and clicking on your selection.

No In the past three days have you taken any prescription medications, over the counter medications or recreational drugs (such as alcohol) which could influence your mental or physical responsiveness?

If Yes, please list name and when it was last take

No Have you ever had any surgeries involving your upper extremities, face, head, neck, cardiovascular or respiratory systems?

If Yes, Please list area and type of surger

No Have you recently been under the care of a physician for any medical problems involving your upper extremities, face, head, neck, cardiovascular or respiratory systems?

If Yes, please briefly explain.

No Do you have any disabilities such as impaired hearing, vision, etc...?

If Yes, please explain.

No Have you recently been under the care of a psychiatrist, psychologist or other mental health professional for any psychological problems?

If Yes, please explain

No Do you play any video games (including Playstation, Nintendo, etc)?

If Yes, please indicate the game(s) and amount of experience	**Game 1:**		**Time**		**Per**	
	Game 2:		**Time**		**Per**	
	Game 3:		**Time**		**Per**	

No **Do you smoke cigarettes, cigars or chew tobacco?**

Click Here When Finished

ABSTRACT OF THE DISSERTATION

Physiological Responding in a Two-Dimensional Social Interaction Simulation

by

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Doctor of Philosophy, Graduate Program in Psychology
Loma Linda University, June 2007
Dr. Paul Haerich, Chairperson

Although there were no observed effects, several suggestions were made to inform researchers in designing a study of fluid interaction. With the increasing usage of computers in the conduct of research, there is ample evidence to suggest that some emotional or physiological responses may be reliably measured using two-dimensional computer simulations.

It was predicted in accordance with the previous aggression literature that when the participant was in the role of aggressor that autonomic nervous system (ANS) responses would decrease as a function of concentration or cognitive load. It was also predicted that when the participant was in the role of virtual victim, a significant increase in ANS function would be observed as a manifestation of the so termed "flight" response were recruited. A two-dimensional virtual challenge arena was programmed using a video game interface. Fourty-two college students with no prior history of pathology alternatively attacked and defended against an attacker during which, SCL and HR were measured.

General recreational data and computer usage as well as valence information was also collected. Results showed that the interaction was rated as "somewhat pleasant" regardless of which role the participant played. They also rated the conflict as "somewhat

excited" and felt "mostly in control" of the interaction. Overall the interaction was rated as being, "slightly unrealistic".

Physiological measurements were made during five discrete phases. Although statistically significant differences were observed between the measurement phases verifying that the phases are likely to be meaningful, there were no reliably significant differences between the different conflict conditions in measuring heart rate and skin conductance.

It was proposed that several possibilities, including too complex a measurement design, non-discrete measurement phases and individual variances in acclimation and perceived novelty of the task may have resulted in the failure to find meaningful group differences among conditions.